MSc thesis (Trabajo Fin de Master TFM)

Synthetic matrices with alginate-based interpenetrating polymer networks (IPNs) for 3D breast cancer models

Group leader:

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CIPITRIA LAB Bioengineering in Regeneration and Cancer

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In collaboration with:

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POLYMAT

Chemistry, Chemical Engineering, Biotechnology, Biomedical Engineering or similar

at Biogipuzkoa Health Research Institute
in collaboration with POLYMAT and UPV/EHU

Research team: We are an interdisciplinary team (https://cipitrialab.com) and seek to understand how biophysical and biochemical properties of native extracellular matrix and synthetic biomaterials guide cell response in tissue regeneration, cancer dormancy and metastasis.

Master thesis project: The cell microenvironment includes the extracellular matrix, biochemical factors and neighbor cells, and the interaction between them regulates cell function in regeneration and disease (1). Alginate is an inert biopolymer that allows functionalization and control over mechanical and biochemical properties (2, 3). We have developed alginate-based hydrogels with spatial control over adhesion patterns, mechanical and degradation properties (4, 5). This is possible by combining Diels-Alder click chemistry with UV light-mediated thiol-ene reaction.

Interpenetrating polymer networks (IPNs) are composite hydrogel systems, usually combining a polymer that allows control of biophysical properties and a second polymer that confers biofunctionality. Alginate-based hydrogels can be combined with structural proteins to form IPNs. In this project, we will combine alginate with various proteins (fibronectin, collagen or decellularized matrices) by physical or chemical crosslinking (6), with the aim of imparting enhanced biofunctionality for 3D breast cancer models.

Specific objectives of this project consist of:
- Synthesize alginate-based interpenetrating polymer networks (IPNs)
- Characterize mechanical properties (elasticity, viscoelasticity, stress relaxation), degradability, and eventually, injectability
- Validate the alginate-based IPNs for 3D breast cancer models with metastatic breast cancer cell lines, evaluating viability, tumor growth and cell-matrix interactions

Profile: You should have a background in Chemistry, Chemical Engineering, Biotechnology, Biomedical Engineering or similar. Skills in hydrogel fabrication and in vitro cell culture are of advantage but not a requirement.

References: (1) Cipitria, Salmeron-Sanchez, Advanced Healthcare Materials, 2017; (2) Lueckgen et al., Biomaterials, 2018; (3) Lueckgen et al., Biomaterials, 2019; (4) Lueckgen et al., Acta Biomaterialia, 2020; (5) Garrido et al, Biomaterials Advances 2023; (6) Trujillo et al., Polymers, 2021.

Starting date: flexible between Nov 2023 – April 2024.

Want to join? Please send your application including a motivation letter, your CV and a transcript of your university record to: amaia.cipitria@biodonostia.org. Please indicate "Master thesis - Alginate IPNs cancer models" in the subject line.