

---

# THE POTENTIAL OF SEA URCHINS WASTE: ECO-FRIENDLY COLLAGEN-BASED HYDROGELS FOR TISSUE REGENERATION

Tamara Chwojnik<sup>\*†1</sup>, Margherita Roncoroni<sup>1</sup>, Michela Sugni<sup>1</sup>, Giordana Martinelli<sup>1</sup>, and Stefania Marzorati<sup>1</sup>

<sup>1</sup>Department of Environmental Science and Policy [Milano] – Italie

## Résumé

Sea urchins possess unique anatomical and physiological features, such as **Mutable Collagenous Tissues (MCTs)**, which offer eco-friendly opportunities for biomedical applications<sup>1</sup>. Up to **90% of edible sea urchins** are discarded as waste, yet their peristomal membranes remain a valuable source of **MCT-derived native collagen** for producing biomimetic materials.

In recent years, our lab has developed **collagen-based biomaterials** for tissue regeneration<sup>1,2</sup>, ranging from **collagen scaffolds (Coll)** to **composites with sea urchin-derived antioxidants (Coll-PHNQs)**. Although these materials performed well in **in vitro and in vivo models**<sup>3,4</sup>, improvements in mechanical and ultrastructural properties were needed.

Hydrogels represent a key advancement in collagen biomaterials, offering improved **mechanical strength and structural fidelity** through collagen network crosslinking<sup>5</sup>. This study aimed to develop a **collagen methacrylate (CollMA) hydrogel** using **photo-crosslinking**.

Collagen was extracted from sea urchin peristomal membranes<sup>1,2</sup>, methacrylated using **methacrylic anhydride**, and crosslinked via UV light and **Irgacure®**. The resulting hydrogels were analyzed for **ultrastructure (SEM)**, **degradation (PBS, collagenase)**, **hydration**, and **swelling**-and compared to Coll.

CollMA retained its fibrillar structure and showed **higher porosity, enhanced stability**, and a **lower enzymatic degradation rate** than Coll.

This marks the **first development of methacrylated collagen hydrogels** from sea urchins. Further studies should explore their **biocompatibility and performance** in real-world biomedical contexts.

1)Di Benedetto et al., Mar. Drugs 2014, 12, 4912-4933

2)Ferrario et al, Mar. Drugs 2020, 18, 414

---

\*Intervenant

†Auteur correspondant: tamara.chwojnik@studenti.unimi.it

- 3) Carolo et al., Mar. Drugs 2023, 21, 506
- 4) Zivelonghi et al., Front. Vet. Sci 2024, 11, 1491385
- 5) Leonard et al., Adv. Funct. Mater. 2024, 34, 2405335

**Mots-Clés:** sea urchin, collagen, collagen based biomaterials, tissue regeneration, hydrogel