

# Green Extraction Strategies for Sea Urchins Waste Valorization

Stefania Marzorati, Giordana Martinelli, Michela Sugni and Luisella Verotta

*Department of Environmental Science and Policy, Università degli Studi di Milano, via Celoria 2, 20133 Milano (Italy)*

## Abstract

*Paracentrotus lividus*, a species of sea urchins occurring in Mediterranean Sea and eastern Atlantic Ocean, is a highly appreciated food resource, being Italy the main consumer among European countries. 30 million individuals are annually consumed only in Sardinia (Grisolia *et al.*, 2012). Since gonads are the edible part, representing only a small fraction of the entire animal, the remaining ends up as a waste. Recently, it was successfully developed an innovative methodology to obtain high-value collagen from sea urchin by-product tissues to be used for regenerative medicine applications. However, the tissues used for collagen extraction are a small portion of sea urchin waste (less than 20%) and the remaining part, mainly the carbonate-rich test and spines, would be discarded (Ferrario *et al.*, 2020). In the present project, this “secondary waste” was first grinded to powder and employed as valuable addition to feed for animals requiring high doses of carbonates, like laying hens and sea urchins themselves. Second, and most importantly, the biologically relevant products contained in the powder have been investigated. These compounds, contained in residual cell tissues, tests and spines, are polyunsaturated fatty acids, carotenoids and a class of small polyphenols, called polyhydroxynaphthoquinones (PHNQ). PHNQ have high economic significance because of their widespread application in several cosmetics and pharmaceuticals industries and, because of their polyhydroxylated quinoid nature, PHNQ show remarkable pharmacologic effects, representing also a potential valuable addition for aforementioned regenerative medicine applications (Shikov *et al.*, 2018). In this work, green extraction strategies aimed to obtain compounds of interest from sea urchins’ waste were developed and the results were compared to conventional solvent-based extraction methods. The core strategy was supercritical CO<sub>2</sub> technique, characterized by low environmental impacts: organic solvents are avoided and CO<sub>2</sub> is used as extraction fluid, ensuring safe and selective process, with the possibility to recycle the employed CO<sub>2</sub> in industrial plants. The extraction was performed directly on the powder without any pretreatment. Fatty acids, carotenoids and PHNQ were successfully and selectively extracted depending on the physical parameters of the extraction. Overall, a selective and green extraction method was validated for the valorization of waste from sea urchins, demonstrating the feasibility of the technique targeting added-value compounds.

**Keywords:** Supercritical CO<sub>2</sub>, Green extractions, Polyhydroxynaphthoquinones, antioxidants.

### **References**

Grisolia, J.M. et al., 2012. Food Quality and Preference, 25 (1) p.46-56. doi:

10.1016/j.foodqual.2012.01.004

Ferrario, C., et al., 2020. Mar Drugs, 18 (8) p.414. doi: 10.3390/md18080414.

Shikov, A.N., et al., 2018. Phytochem. Rev., 17 p.509-534. doi: 10.1007/s11101-018-9547-3

**Acknowledgments:** The financial support of the PRIN project "BRITeS" and the CARIPLO project "CirCULAR" is gratefully acknowledged.