

Biopolymer-based nanoparticles as platform for sustainable applications

Authors: Emilia Oleandro¹, Giovanna G. Buonocore¹, Marino Lavorgna^{1,2}, Mariamelia Stanzone^{1*}

¹Institute of Polymers, Composites and Biomaterials-CNR, P.le E.Fermi 1 – 80055 Portici (Naples), Italy

² Institute of Polymers, Composites and Biomaterials-CNR, Via Previati 1/E - 23900 Lecco, Italy

Nanomaterials are extensively studied for their potential use across various industrial sectors, owing to their unique structural and functional properties. Among these, biopolymers, such as protein-based nanoparticles, represent a promising and sustainable approach for the encapsulation and protection of active compounds, thanks to the natural abundance, biocompatibility, non-toxicity, and stability of proteins. These engineered nanocarriers are designed to obtain a tunable release only under specific conditions, enabling controlled and targeted delivery.

Various techniques are explored for the design and development of bio polymer-based nanoparticles, including antisolvent precipitation, spray drying, supercritical fluid processing, coacervation, and emulsion-based methods. Due to their versatility and functionality, the biopolymer-based nanocarriers have led to their wide application in multiple fields, such as agriculture, food/food packaging and cosmetics.

This work aims to provide a comprehensive overview of such delivery systems and their corresponding preparation techniques to outline potential applications in the agricultural field. In particular, the relationship between chemical behavior, functional properties and final fabrication methods will be highlighted and discussed, focusing on the inherent system capability of responding to specific environmental or physiological triggers to release their payload effectively and precisely.