

## From Waste to Worth: Green Extraction and Circular Valorization of Artichoke By-Products for Functional Ingredients and Biopolymer Applications

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### Abstract

The growing demand for sustainable solutions in the agri-food sector urges the valorization of processing by-products. In this context, our work focuses on *Cynara scolymus* (artichoke) waste streams, aiming to transform them into high-value functional ingredients and biodegradable materials. Using ultrasound-assisted water maceration and membrane-based purification, we efficiently extract bioactive molecules such as chlorogenic acid and cynarine (up to 12% concentration), alongside dietary inulin [1,2]. The optimized process operates at pilot scale (100 kg/day), ensuring minimal environmental impact. In parallel, we developed a high-resolution mass spectrometry (HRMS) method for advanced phytochemical profiling and seasonal comparison of specialized metabolites. Residual lignocellulosic biomass is further valorized to produce polylactic acid (PLA)-based films, showcasing a fully integrated circular model [3]. These natural polymers are currently being evaluated for use in sustainable food packaging and agricultural applications. Moreover, antioxidant-rich extracts derived from artichoke by-products are incorporated into functional food prototypes, such as biscuits and pasta, and assessed for nutraceutical and cosmetic potential. This research is part of the UFRAT project (Urban Food Recovery and Transformations), carried out in collaboration with Vitrosele, a leading player in the regional artichoke industry. Our multidisciplinary strategy fosters a scalable and replicable model for local agri-food systems, contributing to waste minimization, green innovation, and market diversification. Overall, this work exemplifies how Mediterranean plant biodiversity can fuel circular economy approaches while advancing food safety and environmental sustainability.

### Keywords

Artichoke by-products, green extraction, chlorogenic acid, biodegradable films, circular economy.