

Green technologies for extraction and recovery of bioactive compounds from plant by-products processing industries: their potential application as nutraceuticals, food ingredients and antimicrobial substances

Giulia Basile – giulia.basile@unina.it

Department of Agricultural Sciences, University of Naples Federico II
Prof. Raffaele Romano – rafroman@unina.it

STATE OF ART

Nowadays, there is a need to implement strategies to transform the current linear and unsustainable agrifood chain into a circular and more efficient production and consumption system (Othman *et al.*, 2022). Food processing inevitably generates by-products and **food wastes** are rich in a lot of bioactive compounds with well-done properties (Vojvodić Cebin *et al.*, 2020). So, the growing consumer understanding of the relationship between diet and health stimulates opportunities for novel foods with health benefits. To comply with the principles of **green chemistry**, the recovery of bioactive compounds from food waste should be achieved using environmentally, friendly, sustainable and possibly low-cost methods (Panzella *et al.*, 2020). The main green techniques applied nowadays are **supercritical fluid extraction (SFE)**, **ultrasound-assisted extraction (UAE)**, **microwave assisted extraction (MAE)**, **Accelerated Solvent Extraction (ASE)** and the use of **Natural Deep Eutectic Solvents (NaDES)** (Al Khawli *et al.*, 2019; AlYammahi *et al.*, 2022; Abdelrahman *et al.*, 2023).

AIM OF THE STUDY

This PhD project will evaluate the use of different green technologies to extract bioactive compounds, low molecular weight phenolic compounds, lignin and fermentable sugar (**Figure 1**). To minimize the number of trials and optimize the extraction processes, a chemometric approach will be applied through a design of experiment (DoE) and multivariate statistical analysis. The bio-activity of extracts will be evaluated when designing new products.

Schematic representation of the experimental plan

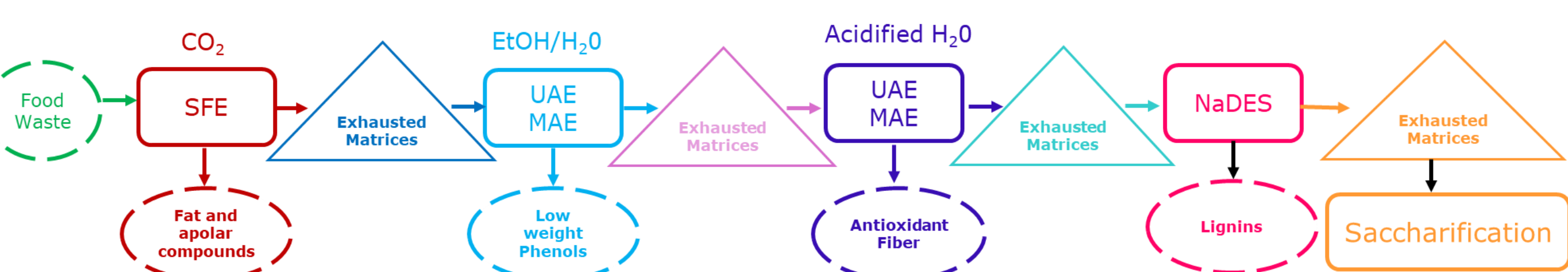
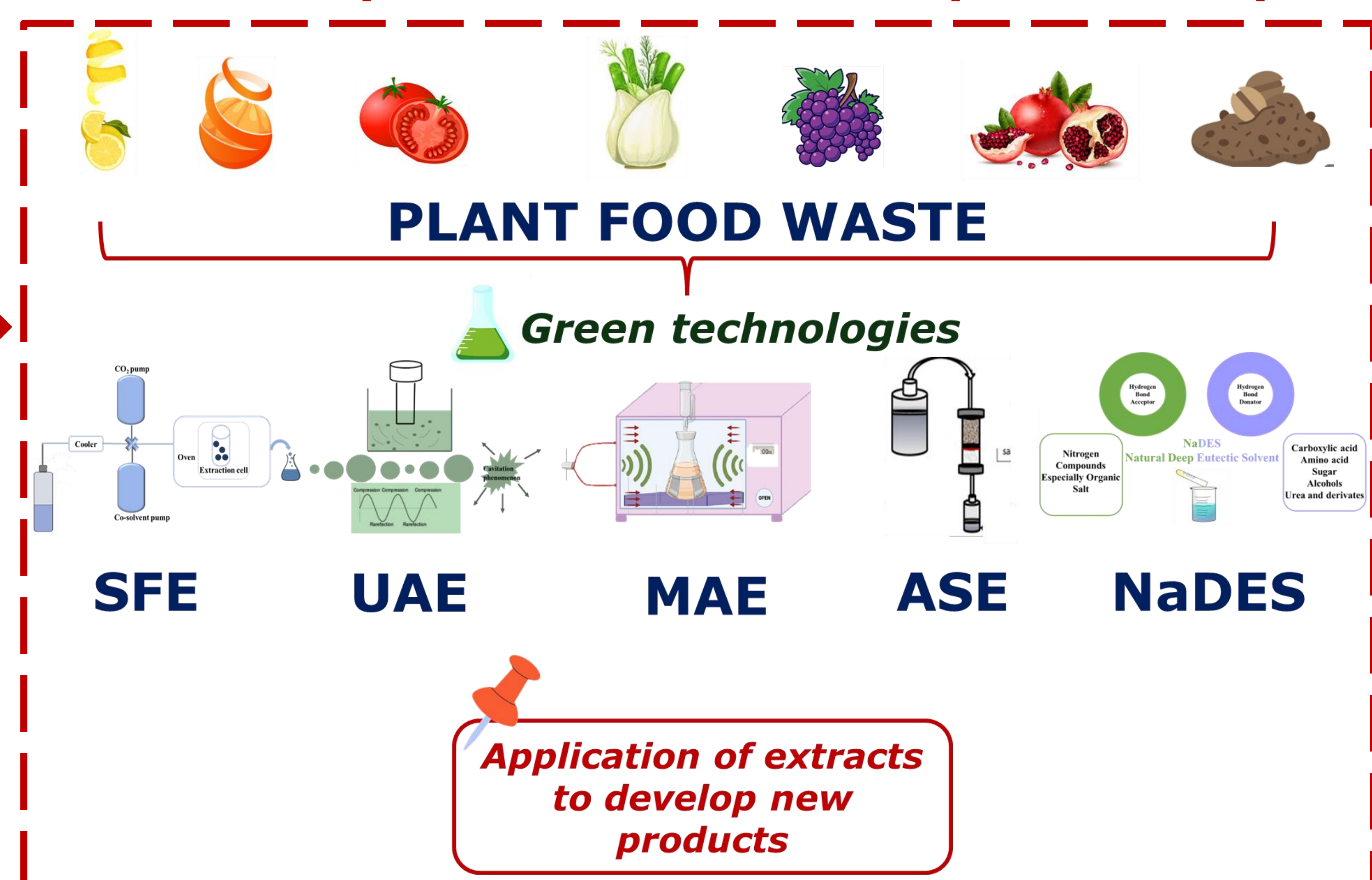


Figure 1: Multi-schematic approach combining various green technologies to recover all possible fractions from food waste.

PhD Thesis Objectives and Milestones

Months	Activity	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
A1)	Green technologies application																								
	1) Study of the composition of Food Waste																								
	2) Choice of extractions to be implemented																								
	3) Fine-tuning of cascade extraction																								
	4) Optimization of extraction parameters																								
A2)	Bio-activity of extracted fractions																								
	1) Quantification of bioactive compounds																								
	2) Bio-activity of extracts																								
A3)	Application of extract																								
	1) Development of fermented beverage																								
	2) Development of bakery products																								
	3) Development of active packaging																								
A4)	Evaluation of Novel Products																								
	1) Evaluate the beneficial properties of foods																								
	2) Evaluate the actual functionality of the packaging																								
A5)	Thesis and Paper Preparation																								

REFERENCES

- Abdelrahman Raghad, et al. Synergistic combination of natural deep eutectic solvents and green extraction techniques for the valorization of date palm leaves: Optimization of the solvent-biomass interaction. *Microchem. J.* 195 (2023): 109503.
- Al Khawli Fadila, et al. Innovative green technologies of intensification for valorization of seafood and their by-products. *Mar. Drugs* 17.12 (2019): 689.
- AlYammahi Jawaher, et al. Advances of non-conventional green technologies for phyto-saccharides extraction: current status and future perspectives. *Phytochem. Rev.* 22.4 (2023): 1067-1088.
- Othman Souha, et al. Valorization of quince peel into functional food ingredients: A path towards "zero waste" and sustainable food systems. *Heliyon* 8.10 (2022).
- Panzella Lucia, et al. Bioactive phenolic compounds from agri-food wastes: An update on green and sustainable extraction methodologies. *Front. Nutr.* 7 (2020): 60.
- Vojvodić Cebin Aleksandra, et al. Onion solid waste as a potential source of functional food ingredients. *Engineering Power: Bulletin of the Croatian Academy of Engineering* 15.3 (2020): 7-13.