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Nanoencapsulation of bioactive compounds extracted with "green" methods from plant by-products for food applications

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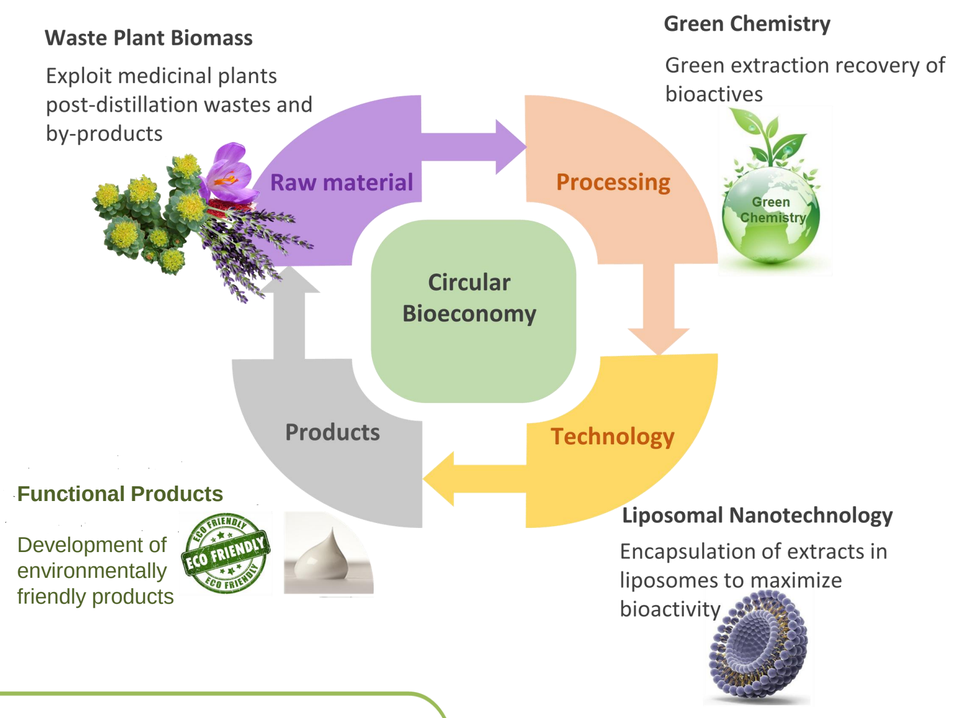
INTRODUCTION & AIM

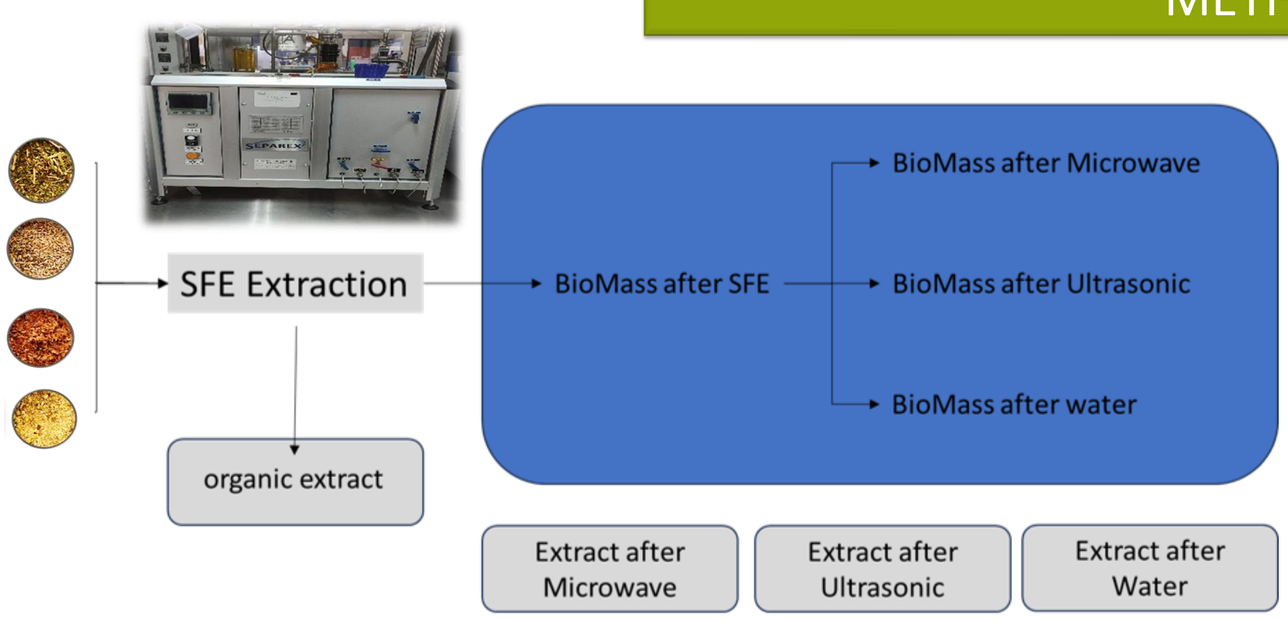
By-products generated from the distillation of medicinal aromatic plants (MAPs), in alignment with the principles of circular, sustainable, and ecological economy, can be perceived as a significant resource for various applications. The innovative approach of NanoCosmos facilitates a novel operational strategy aimed at recovering bioactive constituents from the solid by-products of MAPs that remain subsequent to the extraction of essential oils and/or post-harvesting processes. Nanotechnology will be employed to enhance the bioactivity of these compounds at minimal extract concentrations through their encapsulation. Four particular MAPs waste/by-products will be scrutinized, namely chamomile (*Matricaria chamomilla*), and lavender (*Lavandula angustifolia* vera) post distillation biomass, Saffron (*Crocus sativus*) petals, and Golden Root (*Rhodiola rosea* herba) aerial parts,. The project facilitates the exchange of knowledge on bioactive compound properties, optimization of green extraction processes of such compounds from plant by-product materials, and the creation of innovative nanoencapsulated biocomponents, by cross fertilization in the area of bioactive compounds from different plant by-product materials resulting in a more cost-effective use of skills and resources in circular bioeconomy.



The Consortium

National and Kapodistrian University of Athens · ELGO - DIMITRA Hellenic Agricultural Organization - Dimitra · UCD Dublin · Fondazione Edmund Mach · Dermopartners Skin care contract manufacturing · Dioscurides · Bionos Testing Efficacy

METHOD



Deep Eutectic solvents extraction (DES)

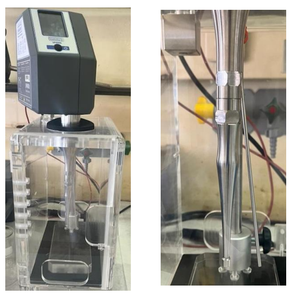
S. No.	Solvent abbreviations	Hydrogen bond donor	Hydrogen bond acceptor	Molar ratio			Temperature (°C			
1	ChCl-Gly Choline chloride with glycerol (Glycerine)	Glycerol	Choline chloride	1:1	1:2	1:3	50	60	70	80
2	ChCl-MA	Malic acid	Choline chloride	1:1	1:2	1:3	50	60	70	80
3	ChCl-LA	Lactic acid	Choline chloride	1:1	1:2	1:3	50	60	70	80
4	ChCl-Glu	Glucose	Choline chloride	1:1	1:2	1:3	50	60	70	80
5	LP-Gly	Glycerol	L-Proline	1:1	1:2	1:3	50	60	70	80
6	LP-LA	Lactic acid	L-Proline	1:1	1:2	1:3	50	60	70	80

US (bath) Assisted Extraction

- Frequency: 40 kHz
- Power: 240 W (max)
- Amplitude: 100%
- T < 30˚C

SFE Parameters

- Solvent: 90% CO_2
- Co-solvent:10% isopropanol
- Pressure: 250 bar
- Oven-Basket T: 45˚C
- Separator T: 35˚C
- solvent flow: 25 ml/min
- co-solvent flow: 3.18 ml/min



US (Probe) Parameters

- Frequency: 24kHz
- Power: 60 W (max)
- Amplitude: 70%
- T < 30˚C
- Placement of the tip: 4 cm

Chamomile SFE extract

Rhodiola rosea SFE extract

CONCLUSION

- The implementation of these methodologies utilizing various solvents is proposed.
- Suggested solvents include Ethanol/Water (50% v/v and 70% v/v).
- Subsequent to the SFE of the raw materials, it is essential to perform additional environmentally friendly extraction techniques, such as Ultrasound Probe and Microwave Extraction.

FUTURE WORK

- Metabolite profiles of the four specific plant by-products will be analysed via hyphenated techniques such as UPLC-DAD-MS/MS, GC-MS/MS and classical phytochemical approaches for the identification of the main, but also minor ingredients of the obtained fractions
- Assessment of the Total Phenolic Content (TPC) and Antioxidant Capacity of the resultant extracts.

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