Research Summary Sheet

Summary of Deliverable 4.1 /1

Biotechnological and physical-chemical optimized strategies to extract and convert biomolecules from agro-wastes: Grape pomace

Context and Challenges

Grape (Vitis sp.) is the world's largest fruit crop, mostly used in winemaking, a process during which approximately 20-30% of the weight of pro-cessed grapes ends up as pomace, its primary by-product. Grape pomace is rich in phenolic compounds, in particular flavonoids, phenolic acids and stilbenes, of which many have shown to be beneficial to human health. Several studies were previously published regarding the extraction of these valuable molecules from red pomace by conventional solvent extraction, but less information is present regarding white ones.

Supercritical CO_2 as well as pressurized liquid extraction methods are green technologies that can achieve high yields of bioactive compounds from natural sources with minimum impact on the functionality of the extracts with the use of food grade and non-toxic solvents. Industrially those methods are still underused and more research is needed to show the advantages but also the optimal conditions with respect to the starting material, pre-treatment as well as the target components.

The aim of UNIBO and RISE was the recovery of bioactive molecules from red (Merlot cultivar) and white (Garganega cultivar) grape pomace, by means of different techniques, and the phytochemical characterisation of the ex-tracts.

Solvent-based extractions and enzymatic digestions (separately and in two-step sequential extraction method) were optimised at UNIBO for the two types of pomace, and the phytochemical characterisation of the extracts was assessed by both spectrophotometrical and HPLC-DAD analyses.

A two-step extraction process was compared by RISE to a single step pro-cess to obtain functional extracts. The following steps were studied: pre-treatments to obtain different drying and milling levels; use of supercritical CO_2 as a defatting step by extracting oil and lipophilic compounds with antioxidant activity; pressurized liquid extraction gives an extract rich in polyphenols. The results were

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analyzed in terms of extraction yield; total phenolic content (TPC); antioxidant activity (DPPH); phenolic profile (HPLC).

Results and Applications

Optimised solvent-based extraction with 75% (v/v) acetone was selected as the best process for the recovery of bioactive molecules from both red and white grape pomace. An initial step of enzymatic digestion (different for red or white feedstock) can be added to improve the total phenolic yield or to increase the release of specific molecules. The extracts were characterised and several potentially exploitable bioactive and added-value com-pounds were detected in complex mixtures.

For supercritical CO_2 extraction, highest yield was achieved with dried material (moisture 6.4%), extraction temperature of 80°C, pressure of 350 bar and 30g/min flow rate for 1h. Extraction yield was 12.2% and the antioxidant activity of the oil extract was 5.25±0.06 µg/mL (EC50 - efficient concentration).

For pressurized liquid extraction, comparing different pre-treatments after 30 min extraction, higher total phenolic content (TPC) and global yield were achieved for dried and defatted dried substrate extracted by 75% co-solvent (EtOH:H_2O 50%) and 25 % of CO_2 solvent with 8 g/min total flow rate under 100 bar at 80°C. Higher antioxidant activity was obtained for extracts from wet substrate with intact seeds. Global yield was 257±16.5 mg/g DW (from defatted dried), 262±4.7 mg/g DW (from dried), TPC was 52.2±1.89 mg GAE/g DW (defatted dried), 54.8 mg GAE/g DW (dried) and the antioxidant activity: EC50 12.5±0.88 µg/ml (wet with intact seeds).

Breakthroughs, benefits and added value

Comparative data between the solvent and supercritical/pressurized liquid extractions were obtained in order to evaluate the most performant process for the valorization of wine pomace. The extracted polyphenol mixture will be used as additives for polymer formulations and the solid residues obtained will be valorized as potential reinforcing agents in polymeric matrixes.

Further information on NoAW project: http://noaw2020.eu

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