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Sustainable and Valuable Antioxidant Recovery from Winery Food Waste

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Abstract

Agro-food industries are highly water demanding and generate vast amounts of organic waste resulting in a relevant environmental problem. Winery byproducts are rich in polyphenols, natural bioactive compounds with high added-value due to their antioxidant, antimicrobial and anti-inflammatory properties that lead to high market demand. Nevertheless, commercially available polyphenols come from edible sources while they are discarded with food wastes. In the circular bio-economy frame, an innovative and integral solution is proposed to extract and recover polyphenols from winery byproducts while processing wastewater is recovered as high-quality water that might be reused. Hence, a new value-added business market and model is proposed for the primary sector. Polyphenols were effectively extracted by mechanically mixing the waste and a solvent (hydroalcoholic mixtures) for 20 min at 30 °C. The ethanol percentage increase in the solvent favoured the polyphenols extraction from 165 to 461 mg GAE (Galic acid equivalent)/$kg_{bagasse}$ when the solvent was changed from water to water/ethanol (50:50, v:v). Moreover, the effect of milling over the extraction capacity from solid wastes (scrape and bagasse) was also revealed as a key factor to maximize the bioactive compound recovery. Polyphenol recovery from milled bagasse rose up 1.9 g GAE/$kg_{bagasse}$ using water as solvent and it was further promoted to 6 g GAE/$kg_{bagasse}$ using 50 % ethanol solvent. Milled scrape has higher specific polyphenol content with 6.2 g GAE/kg_{scrape} and it increased 46 % (up to 9 g GAE/kg_{scrape}) using water/ethanol (50:50, v:v) solvent. Wine lees are a more liquid byproduct generated during wine fermentation. Their lower polyphenol content, 1.2 g GAE/L_{lees}, is compensated by their more stable production throughout the year, making them attractive for polyphenol recovery. Moreover, the distribution of the major polyphenol families obtained from each waste were different. Hydroxybenzoic acids were the most abundant for all studied wastes, while flavonoids were only present in the bagasse and scrape, 25 % and 45 % of total polyphenols, respectively. Wine lees

contained hydroxycinnamic acids (up to 12 % of total polyphenols), which were almost negligible in the rest of the byproducts. Thus, a versatile biorefinery platform might be developed to convert various agro-food wastes (solid and liquid) into different polyphenol-rich products with diverse potential applications and market demands depending on their composition. These products might be used within the food sector as antioxidants and functionalized food and drinks or in other sectors like cosmetic.

Keywords: circular bioeconomy; life cycle extension; polyphenols; valorization

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