

GREEN APPROACH TO VALORIZATION OF TANGERINE PEEL WASTE: NADES-ASSISTED EXTRACTION AND PROCESS INTENSIFICATION FOR RECOVERY OF BIOACTIVE COMPOUNDS

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ABSTRACT

Tangerine peel is a substantial source of underutilized biomass rich in bioactive constituents, particularly phenolic compounds and flavonoids. The increasing generation of this agro-industrial waste poses environmental and management challenges, necessitating the development of sustainable and efficient valorization strategies. In this study, bioactive compounds were extracted from tangerine peel using natural deep eutectic solvents (NADES), composed of naturally derived components, as alternative extraction media. Two NADES systems (glycerol:fructose (4:1) and choline chloride:glycerol (1:2)) were applied in maceration at room temperature and at 80 °C), while aqueous extractions were conducted using ultrasound-assisted extraction (UAE) and microwave-assisted extraction (MAE) as process intensification techniques. The results indicate that both the extraction technique and the solvent significantly influence the composition and antioxidant activity of the extracts. The highest total phenolic content (TPC) was recorded in MAE (0.022 mg GAE/mg), confirming the high efficiency of microwave technology due to intensive heating and improved mass transfer. In contrast, NADES systems showed lower TPC and total flavonoid content (TFC) values, but significantly better antioxidant activity, indicating selective extraction of more potent antioxidant components. Differences between the two NADES systems, may be due to different polarity and intermolecular interactions which affect the extraction of specific phenolic compounds. Elevated temperature during maceration led to a slight increase in TPC with a variable impact on antioxidant activity, indicating a possible degradation of thermolabile components. Overall, NADES systems show a high potential for extracting more biologically active components, while MAE is superior in terms of total yield of phenolic compounds.

Keywords: agricultural waste, tangerine peel, NADES, green extraction, phenolic compounds, antioxidant activity.

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