

Design, Sustainable Processing and Nanoliposome Encapsulation of Red Grape Pomace Rich in Polyphenolic Compounds with Antioxidant Activity

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Streszczenie

In this study, we aimed to investigate the potential of utilizing red grape pomace as a source of polyphenolic compounds in the growing, fragmented winemaking sector in Poland. For polyphenol extraction, we compared two methods: conventional extraction using water and alcohol solutions, and the supercritical CO₂ technique with ethanol as a cosolvent. The conventional method yielded at least 30% more polyphenols compared to the advanced SC-CO₂ technique. Experimentally chosen conditions, including a solvent composition of ethanol–water (1:1; v/v) containing 3% HCl, a liquid-to-solid ratio of 25:1 mL/g, and 2 min of ultrasound pretreatment and conventional extraction at a temperature of 30 °C over 4.5 h, enabled an extraction efficiency of 101 mg of total polyphenols per 1 g of raw material used, with an antioxidant capacity equivalent to 600 μmol of Trolox. According to HPLC analyses, the main components of the investigated biomass were epicatechin, anthocyanins and p-coumaric acid. The extract was encapsulated in liposomes, revealing no negative effect on their stability or aggregation under the conditions tested (21 days). The study suggests that conventional water–ethanol extraction can be a relatively safe and effective method for managing winemaking residuals, increasing the competitiveness of small producers through the production of high-value antioxidant additives.

Słowa kluczowe

polyphenols, grape pomace, extraction, nanoliposomes, encapsulation

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