

COMPARISON OF NATURAL DEEP EUTECTIC SOLVENTS AND ORGANIC SOLVENTS FOR THE ULTRASOUND ASSISTED EXTRACTION OF ANTIOXIDANTS FROM LAVENDER DISTILLATION SOLID WASTE

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Lavender solid by-products remaining after the extraction of the essential oil is an agro-industrial waste rich in phenolic compounds that can be utilized as natural antioxidants in the food and pharmaceutical industry. In the first part of this study, the use of both conventional organic solvents and Natural Deep Eutectic Solvents (NADES) combined with ultrasound-assisted extraction was explored. Extractions were performed under optimum conditions determined for the ethanolic solvent (ethanol: water, 1:1) in a previous study, and the eutectic mixtures, tested as 80% (v/v) aqueous solutions, were lactic acid: sodium acetate, lactic acid: glucose and lactic acid: glycine: water, with corresponding molar ratios of 3:1, 5:1, and 3:1:3. Lactic acid: glycine: water exhibited the highest TPC (27.01 mg GAE/g), antiradical activity (94.69 %) and reducing power (8.73 $\mu\text{mol TPTZ/L}$). Lactic acid: sodium acetate was more efficient than the ethanolic extract (23.58 mg GAE/g and 20.38 mg/g, respectively). The TPC of the lactic acid: glycine: water extract further increased on 40% water content (33.57 mg GAE/g), while anti-solvent (water) precipitation technique resulted in 30% recovery of TPC from UA-NADES extract. The low recovery percent, shows, that the extracted bioactive compounds cannot be easily separated from the NADES in order to be further processed, which is a disadvantage commonly mentioned in literature. Thus, in the second part of the study, the effects of drying methods, i.e., freeze-drying and spray-drying along with the effects of the addition of 10 % w/v maltodextrin were investigated on the ethanolic extract. The comprehensive evaluation employing the FRAP, DPPH, and Folin-Ciocalteu methods consistently pointed to the freeze-drying method, particularly when accompanied by maltodextrin, as the optimal approach for preserving the antioxidant capacity of lavender extracts. Additionally, freeze-dried powder obtained using maltodextrin, showed the highest bulk density and the lowest moisture content and hygroscopicity. In contrast, water activity values of the spray dried powders were found to be statistically lower than their freeze dried counterparts ($p < 0.05$).

KEYWORDS: Lavender solid waste, natural deep eutectic solvents, ultrasound-assisted extraction, phenolics, encapsulation.