Ultrasound effects on SoLVE process applied to the extraction of polyphenols from olive pomace: a techno-economic study

Margherita Pettinato [a], Giulia D'Agostino [a,b], Alessandro Alberto Casazza [a,b] & Patrizia Perego [a,b]

[a] Department of Civil Chemical and Environmental Engineering, Genoa, Italy
[b] National Research Centre for Agricultural Technologies (CN AgriTech), Naples, Italy
E-mail: margherita.pettinato@unige.it

Solid-Liquid multivariable Extractor (SoLVE) **[1]** is a new technology characterized by a strong versatility and particularly suitable for the extraction of thermosensitive compounds. Indeed, molecules like polyphenols, which find valuable applications in the food and cosmetic industries, need to be carefully recovered to maintain the antioxidant effect, which makes them interesting for industry. SoLVE consists of a packed-bed system as extraction chamber, where solvent composition, pressure, temperature, and ultrasound parameters can be tuned over time for tailored solutions. In this study, the ability of SoLVE to extract polyphenols was tested using olive pomace, a byproduct of the olive oil production sector, whose market play a key role in Italy **[2].** An experimental study was undertaken to investigate how ultrasounds delivery on SoLVE extraction chamber can influence performance. Process optimization was carried out by analyzing extraction kinetics models and based on the comparison of extraction yields in terms of total polyphenols, antiradical power, and concentration of the main phenolic compounds **[3]** (3,4-dihydroxybenzoic acid, vanillic acid, and quercetin). Results showed that ultrasound application had significant impact on the process, working both on mechanical extraction and by the micro mixing of the packed-bed. Data collected from the lab-scale system was, then, used to assess the economic feasibility of the process, following the hierarchical decision approach and the economic potential evaluation proposed by Douglas **[4]**. The cost analysis was conducted at various design levels, as a function of some operating parameters, such as the liquid-solid ratio in the extractor and the scale factor. This cost estimation represented a preliminary effort, and a deeper analysis of the process is necessary to determine the optimal solution, but it provides a promising estimation of the process feasibility.

Keywords: *Ultrasound cavitation; Waste valorization; Bioactive compounds; Economic potential; Kinetic modeling; Peleg's equation.*

References

[1] Perego, P., Casazza, A.A., Pettinato, M., 2021. International Patent Application nr. WO2021090250A1.
[2] Restuccia D., Prencipe S. A., Ruggeri M., Spizzirri, U. G. DOI:10.3390/su142315674.
[3] da Silva M.F., Pettinato M., Casazza A.A., Maciel M.I.S, Perego P., 32022. DOI: 10.1016/j.cherd.2021.11.011.
[4] Douglas J. M., 1988. Conceptual design of Chemical Processes. McGraw-Hill.