Life Cycle Analysis of extraction techniques for recovery of valuable compounds from olive leaves

OIKONOMOPOULOU V. (1), PAPADAKI S. (2), PAVLOU N. (3), SOULIS . (4), TSIMOGIANNIS D. (1,4), NWACHOKOR O. (5), VYRKOU A. (5), ANGELIS-DIMAKIS A. (5), <u>KROKIDA . (1)</u>

1 School of Chemical Engineering, NATIONAL TECHNICAL UNIVERSITY OF ATHENS, Athens, Greece
2 Dignity Private Company, Athens, Greece
3 Department of Agricultural Sciences, Cyprus University of Technology, Lemesos, Cyprus
4 NFA (Natural Food Additives), Athens, Greece
5 School of Applied Sciences, University of Huddersfield, Huddersfield, United Kingdom

In the framework of circular economy, agricultural by-products are utilized for the recovery of added-value compounds. Olive leaves account for 10% of total weight of olive trees and contain significant amounts of antioxidants compounds. The extraction technique is widely applied for the recovery of these functional compounds. Under the frame of sustainability, it is important to evaluate the environmental impact of such practices.

In this study Life Cycle Analysis (LCA) methodology was applied to evaluate the environmental performance and identify the environmental problems arising from the development of final functional extracts. Various extraction processes (conventional solid-liquid extraction and ultrasound-assisted extraction) were used for the valorization of olive leaves. The examined processes were either validated in pilot scale or in lab scale and extrapolated in higher scale using customised flowsheets and commercial modelling tools. LCA was implemented using commercial LCA software tools (openLCA with ecoinvent v2.2 and Agribalyse v3.0.1 databases). An ISO-standardized methodology (ISO 14040 and ISO 14044) for the evaluation of carbon, energy and water footprints taking into account critical factors in the life cycles of products and services was followed. The most relevant environmental aspects and parameters (e.g. GHG emissions, energy consumption, water depletion), with their influencing factors, were identified and compared. The LCA led to the estimation of overall eco-efficiency of the extracts, and guided the optimization of the extraction process, with the aim to maximize its eco-efficiency, by reducing the environmental impact, arising from the applied processes and materials used.

The solvent systems used play an important role on the extraction yield and different impact categories depending on their environmental footprint. The comparative life cycle assessment showed that ultrasound-assisted extraction was more sustainable method for the recovery of natural antioxidants.