Microwave-assisted extraction: a green approach for triterpenic acids extraction

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Microwave-assisted extraction (MAE) uses microwave energy to facilitate the extraction process and offers numerous advantages over conventional extraction techniques, such as shorter extraction time, solvent and energy consumption, and higher extraction efficiency (da Rosa et al., 2019). In addition, MAE has emerged as a promising green technology for the extraction of bioactive compounds from bioresources (Usman et al., 2023). Among these compounds, triterpenic acids have revealed various pharmacological properties, including anti-inflammatory, anticancer, antioxidant, and hepatoprotective activities (Chudzik et al., 2015). These compounds are present in the olive fruit and they pass into the olive pomace during olive oil production. Recent studies also suggest that triterpenic acids are concentrated on the residual olive skin, a waste generated when olive pits are recovered from olive pomace (Romero et al., 2017). Therefore, the residual olive skin, which is generated in large quantities each year, has a great potential to extract these biocompounds that present a wide range of applications in the food, health and industrial biotechnology sectors (Thimmappa et al., 2014). The aim of this work was to recover triterpenic acids by MAE from residual olive skin and to compare its content with other by-products of the olive industry (olive pomace and exhausted olive pomace).

Response surface methodology (RSM) was applied to study three independent variables, ethanol/water concentration, extraction time and temperature using an experimental design. The chosen response variables were: energy consumption, extraction yield and concentration of maslinic and oleanolic acids. Then, an optimization of the three variables studied was carried out to minimize energy consumption and simultaneously maximize the rest of the variables. The optimal conditions predicted by the model were: ethanol absolute, 4 min and 99 ºC, which resulted in an extraction yield of total solids of around 19% (w/w) and the extraction of about 33 mg/g of triterpenic acids on a dry basis (Figure 1). The content the triterpenic acids in the residual olive skin was approximately 80% higher than those obtained from olive pomace and exhausted olive pomace using the same extraction conditions (Figure 1).

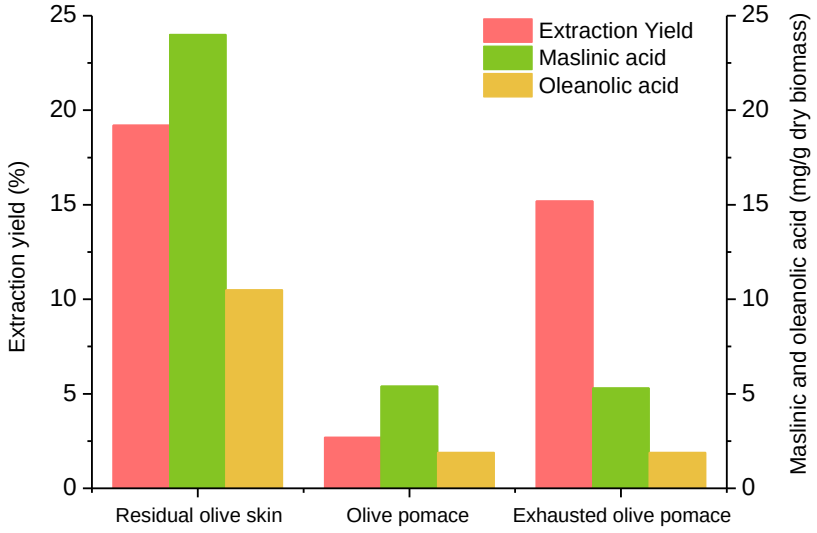

Figure 1. Extraction yield (%) and content of maslinic and oleanolic acid (mg/g dry biomass) in various olive biomasses.

In conclusion, this study demonstrates that residual olive skin is a rich source of triterpenic acids, especially, maslinic acid that can be efficiently extracted using MAE. This can be applied as a first step following a cascade biorefinery process that would contribute to the circular bioeconomy of the olive oil industry.

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