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Chemical characterization and bioactive properties of different winemaking residues towards their valorization

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In the last decades, there has been an increasing concern in the search for strategies towards the valorization of agricultural residues. Annually, wine production is responsible for the generation of large quantities of phytotoxic waste, whose disposal is challenging as these residues can be hazardous to the environment when they are overused as fertilizers or simply discarded [1]. However, some of these residues can be a source of interesting compounds such as proteins, fibers, and phenolic compounds. In particular, the bioactive phenolic molecules have attracted considerable attention from the pharmaceutical, cosmetic, and food industries. Up until now, different studies have been conducted on the characterization of grape pomace and their components such as seeds, skins, and stems, particularly focusing on residues from red grape varieties [2]. However, less attention has been paid to other by-products generated during winemaking such as residues from white wine production, wine lees, and diatomaceous earth, which are used in the filtration of wine and represents approximately 250 tons/year of residues from the wine sector just in Portugal. In this context, as part of the project BacchusTech that seeks to develop a new innovative process, including the extraction, purification, and concentration of bioactive compounds present in winemaking residues, this work aimed in characterizing the pomace obtained from red and white wines production, the residues obtained after white pomace distillation, wine lees and diatomaceous earth in terms of phenolic compounds composition and extracts bioactivity. The residues were extracted using an hydroalcoholic solvent (80%, v/v), total phenolic compounds were estimated using the Folin-Ciocalteu reagent and individual phenolic compounds were identified and quantified by liquid chromatography coupled to mass spectrophotometry (HPLC-DAD-ESI-MS/MS). Additionally, the biological activity was assessed through TBARS, DPPH, and reductive power assays to determine the antioxidant activity, and the antimicrobial activity was evaluated by broth microdilution against eight bacteria and two fungi.

The non-anthocyanin and anthocyanin phenolic composition were in accordance with the previously reported by Sun et al. and He et al. [3,4], respectively, in red wines. Fifteen non-anthocyanin phenolic compounds were found, five phenolic acids (gallic acid and derivatives, *p*-hydroxybenzoic and *p*-coumaric acid), four flavan-3-ols (procyanidin dimers), two O-glycosilated flavanols (isorhamnetin and quercetin derivatives), three flavanol aglycones (quercetin, kaempherol, and myricetin), and one unknown compound. Regarding anthocyanins, five compounds were found, namely malvidin derivatives linked to acyl groups. Wine lees and white grape pomace before distillation presented the highest amounts of phenolic compounds; however, only diatomaceous earth sample reveal the presence of *O*-glycosylated flavonoids. All samples showed antibacterial and antifungal activity against most of the tested microorganisms, especially the red and white grape pomace before distillation and diatomaceous earth in the bacteriostatic activity and the wine lees in the fungistatic activity. In general, all samples showed promising antioxidant capacity, with very good results being obtained on TBARS assay, particularly for the white pomace after distillation (EC_{50} = 0.016±0.002 mg/mL), diatomaceous earth (EC_{50} = 0.063±0.001 mg/mL) and in red pomace before distillation (EC_{50} = 0.08±0.04 mg/mL).

Overall, the obtained results demonstrated that the evaluated wastes are good sources of bioactive compounds, namely anthocyanins and other phenolic compounds, that can be used as raw materials for subsequent steps of concentration, purification and/or isolation of added-value compounds.

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