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Chemical composition and biological activity of different residues obtained from the wine industry

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In recent years, the bioactive compounds present in agri-food sub-products have attracted increased attention due to their health benefits and advantages within a circular economy context. Annually, wine production is responsible for the production of large amounts of phytotoxic waste, which elimination is considered challenging since these residues can be hazardous to the environment when used as fertilizers or just discarded. Phenolic compounds are secondary metabolites processed by plants that have shown several health benefits, acting as antioxidants, antimicrobials, anticarcinogenic, or antidiabetics, among others. Bioactive phenolic molecules have attracted considerable attention from the pharmaceutical, cosmetic, and food industries. So far, several studies have been developed on the characterization of grape pomace and its components (seeds, skins, and stems), especially directed to the residues of red varieties.¹ However, less attention has been paid to other by-products generated during winemaking, such as waste from the production of white wine, wine lees and diatomaceous earth. The latter is used in the filtration of wine and constitutes about 250 tons/year of waste from the wine sector in Portugal alone, making it a very pertinent residue with still scarce information being found in the literature. In this context, within the framework of the BacchusTech project that seeks to develop new innovative processes, comprising the extraction, purification, and concentration of bioactive compounds present in winemaking residues, different residues including pomace, lees and diatomaceous earth were evaluated for their chemical composition and bioactivities. 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-MSn). Additionally, the biological activity was assessed through TBARS, DPPH, and reducing power assays to determine the antioxidant activity, and the antimicrobial activity was evaluated by broth microdilution against eight bacteria and two fungi.

The phenolic composition was in accordance with the previously reported in red wines.^{2,3} 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*-glycosylated flavanols (isorhamnetin and quercetin derivatives), three flavanol aglycones (quercetin, kaempferol, 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 contents 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. The best bacteriostatic activity was evidenced by the red and white grape pomace before distillation and diatomaceous earth, while the wine lees stood out for their 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 ($EC_{50} = 0.016 \pm 0.002$ mg/mL), diatomaceous earth ($EC_{50} = 0.063 \pm 0.001$ mg/mL) and red pomace before distillation ($EC_{50} = 0.08 \pm 0.04$ mg/mL).

Overall, the results obtained showed that the residues analyzed are good sources of bioactive compounds, namely anthocyanins and other phenolic compounds, which can be used as raw materials for the steps of concentration, purification and/or isolation of compounds of added value.

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