Effect of hydrothermal treatment of wet olive pomace to obtain phenolic compounds with antioxidant activity

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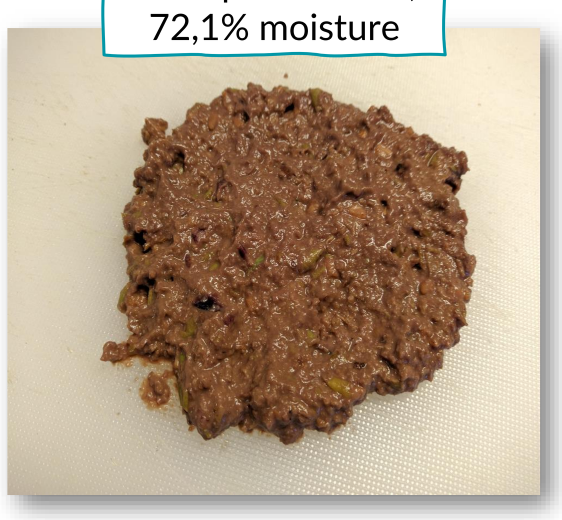
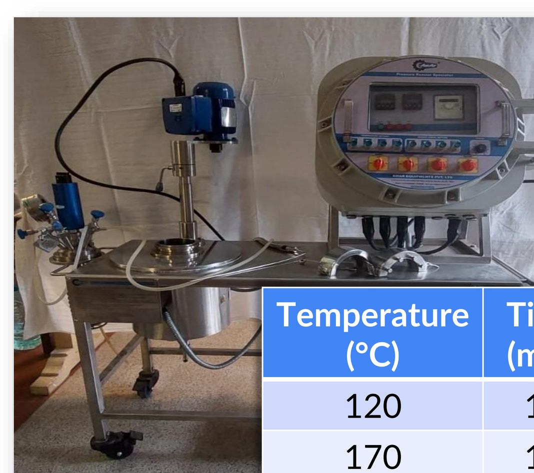
Introduction

Wet olive pomace (WOP) is the by-product from oil mills that use a two-phase extraction system to obtain extra virgin olive oil. After the extraction process, approximately 98-99% of the phenolic compounds present in the fruit remain in the WOP, so this by-product is a rich source of this type of compounds, which have strong antioxidant activity [1]. The most widely used method for separating phenolic compounds from natural products is conventional solid-liquid extraction with organic solvents. Emphasis has been put in the study of alternatives to the use of conventional organic solvents, because these solvents are known to have adverse environmental effects. The hydrothermal extraction with water as solvent is one of these alternatives. During this process, the lignin structure can be broken into smaller molecules, increasing the solubilization of phenolic compounds with antioxidant activity [2]. The aim of this work is to study different hydrothermal extraction conditions as a previous step to define the levels of three independent variables (temperature, time and liquid-solid ratio) for its use in future optimization studies in the extraction of phenolic compounds from WOP.

Methodology

WOP: 50% mixture Arbequina/Picual, 72,1% moisture

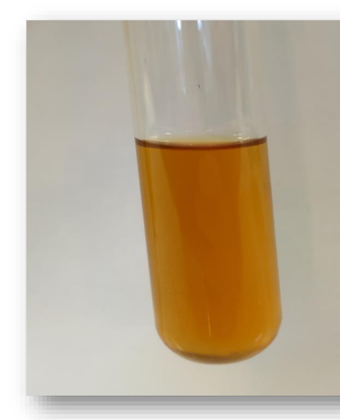




Extractions: electrically heated reactor at 230 rpm

Temperature (°C)	Time (min)	Liquid-solid ratio (mL/g WOP db)
120	15	2.6
170	15	2.6
120	90	2.6
170	90	2.6
120	15	20
170	15	20
120	90	20
170	90	20
120	30	20
170	30	20
145	40	5

Centrifugation 6000 rpm 15 min

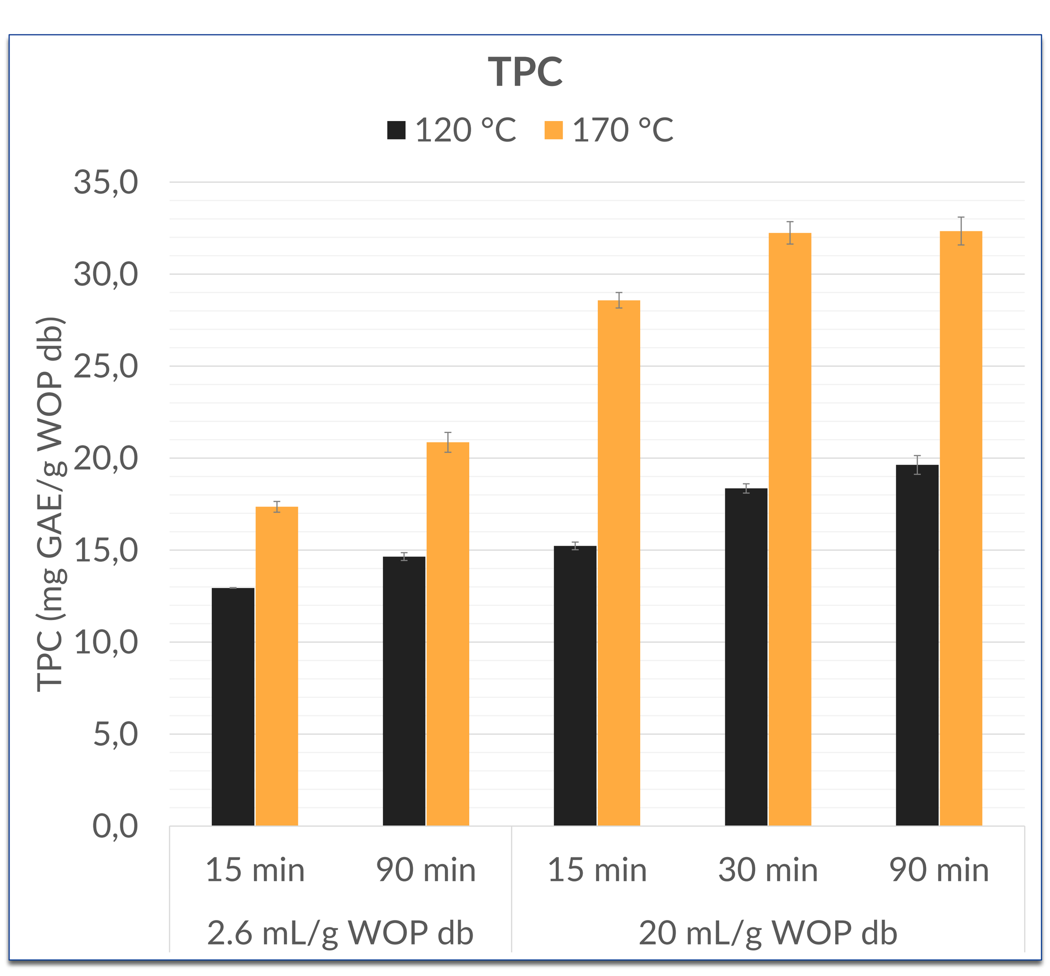


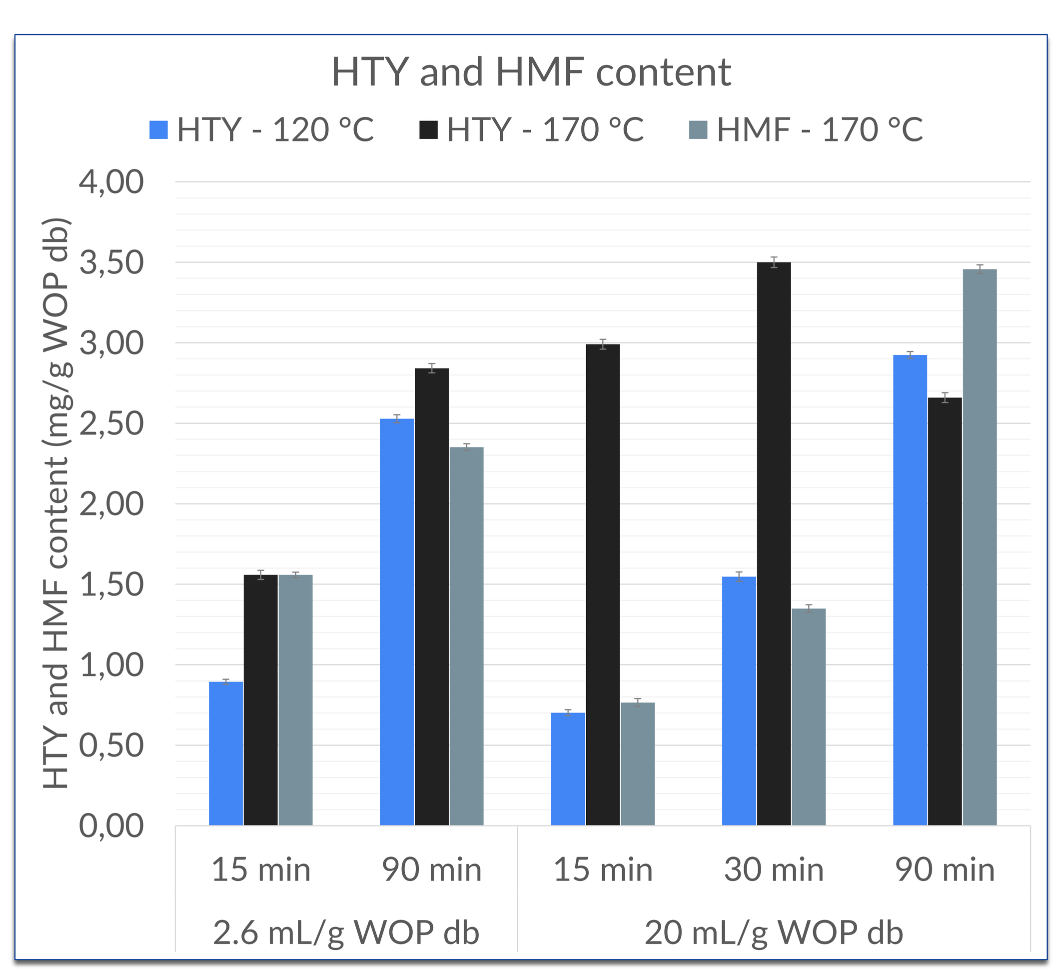
Total phenols content (TPC): Folin Ciocalteu Antioxidant activity: FRAP and DPPH

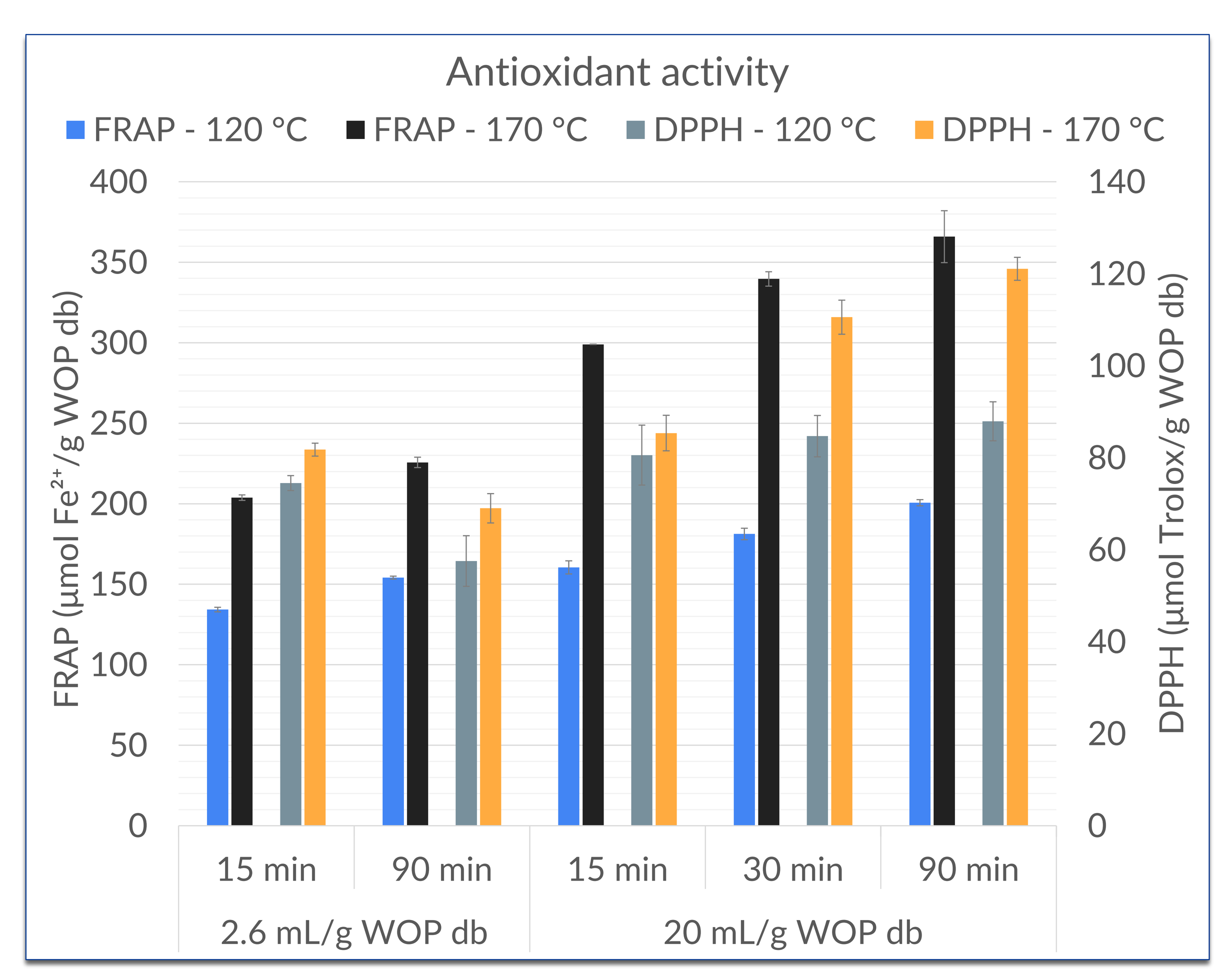
Hydroxytyrosol (HTY) and 5-hydroxymethylfurfural (HMF) content: HPLC-DAD

Results and discussion

In general, as the temperature, time and liquid-solid ratio increase, higher levels of TPC and antioxidant activity are obtained. Regarding the HTY content, in the case of extractions with a liquid-solid ratio of 2.6 mL/g WOP db, as the extraction time increases, the HTY content increases, both for 120 °C and for 170 °C. The same trend is observed for the extractions at 120 °C and a solid-liquid ratio of 20 mL/g WOP db. However, in the extractions with a solid-liquid ratio of 20 mL/g WOP db and 170 °C, a decrease in the HTY content is observed between times of 30 and 90 minutes. This may indicate a possible degradation of HTY as a consequence of more severe treatment. In the case of the HMF content, no formation of this compound was detected for extractions at low temperature (120 °C). In the case of extractions at 170 °C, there is an increase in the HMF concentration with the extraction time for the two liquid-solid ratios tested. As a degradation compound, HMF is not a desirable target to extract [3]. All extractions at 120 °C were not satisfactory due to poor solid-liquid separation, evaluated as visual turbidity in the extracts post-centrifugation, especially in the case of lower liquid-solid ratio, which corresponds to WOP without the addition of water. To evaluate if it is possible to achieve a good solid-liquid separation with the addition of a relatively low amount of water and higher temperature than 120 °C, extractions were carried out at 145 °C, liquid-solid ratio of 5 mL/g WOP db and 40 min. In this conditions, good solid-liquid separation post-centrifugation were achieved, with TPC of 18.6 ± 0.7 mg GAE/g WOP db, FRAP of 208.7 ± 1.6 µmol Fe^{2+}/g WOP db, DPPH of 83.5 ± 2.2 µmol Trolox/g WOP db, HTY and HMF content of 1.95 ± 0.05 mg/g WOP db and 0.15 ± 0.02 mg/g WOP db, respectively.







Conclusions

In conclusion, extraction conditions with temperature between 145-170 °C, time between 15-60 min and liquid-solid ratio between 5-20 mL/g WOP db will be used to study the best conditions to extract phenolic compounds from WOP applying hydrothermal extraction with the equipment presented in this work.

References

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