Extraction of bioactive compounds from vine pruning residues by using ohmic heating and conventional heating techniques

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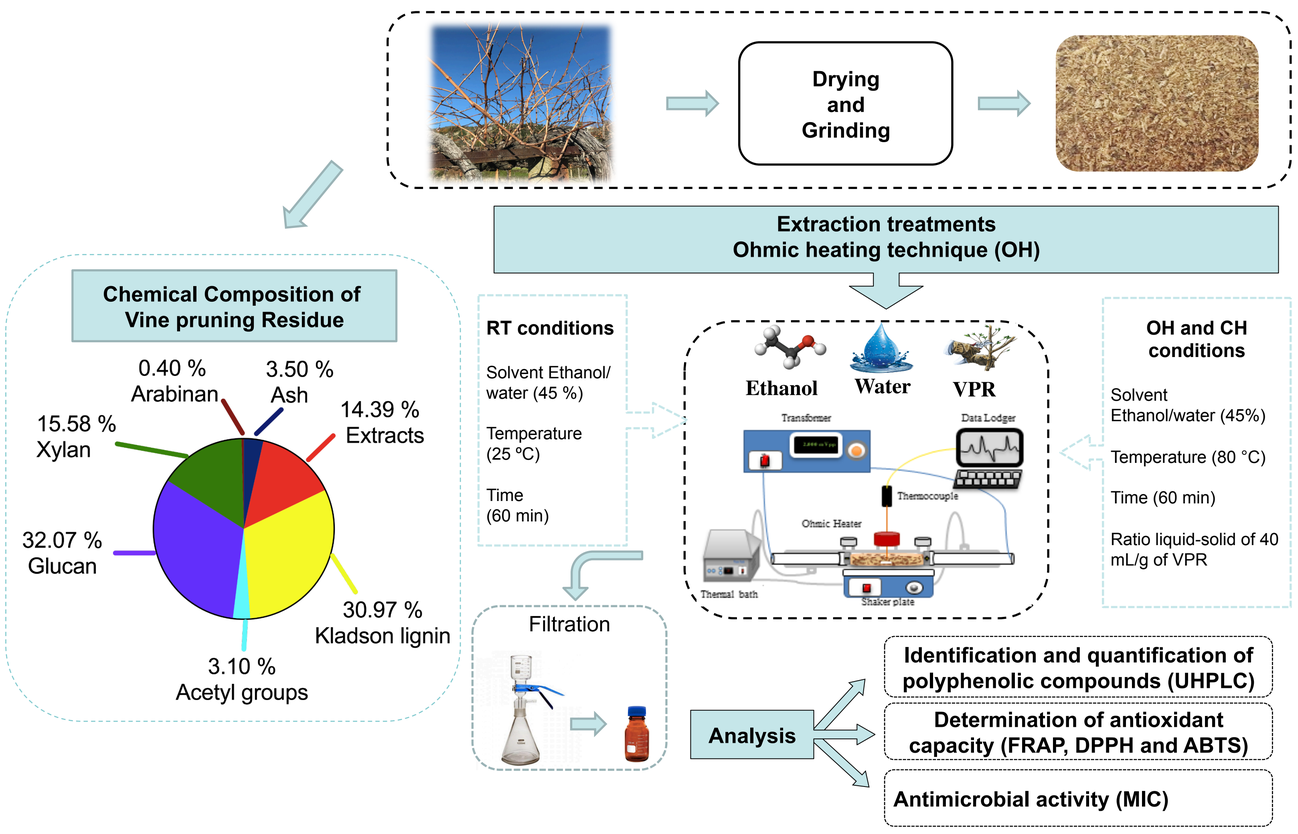
GENERAL CONTEXT

Vine pruning residue (VPR), a waste obtained from wine production, has attracted the interest of chemical and food industries thanks to its great potential as a raw material to obtain bioactive compounds [1-2]. Due to the high market price of these compounds, different technologies have been studied to improve the economic profitability of their extraction process [3-4].

OBJECTIVE

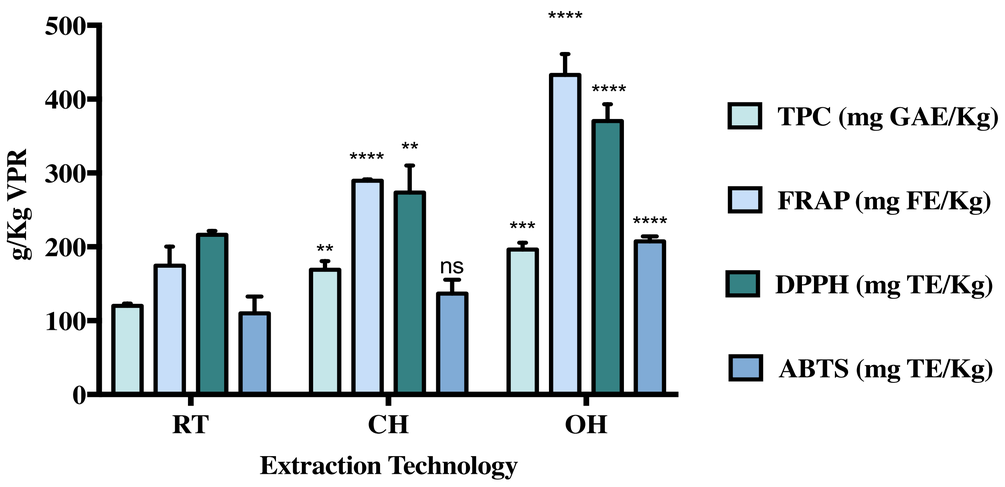
The aim of the present study was to evaluate an emerging technology - ohmic heating (OH) against conventional heating process (CH) and room temperature (RT) as a control, to extract bioactive compounds from VPR with significant antioxidant and antimicrobial activities.

MATERIALS AND METHODS



RESULTS

Total phenolic content and antioxidant activity of VPR extracts obtained by using different methods of heating: RT, CH and OH



*GAE: gallic acid equivalents; Fe (II) ferrous equivalents; TE: trolox equivalents. Values are expressed as mean ± SD of at least 3 replicates. ns $p > 0.05$, * $p \leq 0.05$, ** $p \leq 0.01$, ***$p \leq 0.001$, **** $p \leq 0.0001$ when compared with respective phase control (RT) by two-way ANOVA.

The extract obtained by the OH technique showed the highest TPC concentration (196.2 mg GAE/kg) and also, the best antioxidant activity when evaluated by different methods (432.7 mg FE/kg, 370.2 and 207.4 mg TE/kg for FRAP, DPPH and ABTS, respectively). The OH treatment raises the TPC and the antioxidant activity in the VPR extracts, probably due to the microscopic damages induced by shock waves of pressure that lead to the deterioration of the structural components of the residue, facilitating the rupture of the tissues by cavitation bubbles [5].

Phenolic compounds identified in the VPR extracts obtained through different heating techniques: RT, CH and OH

Extraction technique	RT	CH	OH
Polyphenols (mg/kg VPR)			
Gallic acid	ND	ND	34.7^{a}
o-Cumaric acid	66.5^{a}	142.5^{b}	264.6^{c}
Ferulic acid	ND	ND	460.8^{a}
Ellagic acid	ND	ND	777.3^{a}
Vanillic acid	311.8^{a}	671.6^{b}	702.9^{c}
Hesperidin	ND	ND	1490.0^{a}
Apigenin	ND	ND	1574.9^{a}
Quercetin	1327.8^{a}	2816.1^{b}	2867.8^{b}
Taxifolin	ND	197.8^{a}	217.9^{b}
HidroxiTyrosol	ND	1495.9^{a}	1516.1^{b}
Tyrosol	642.4^{a}	1371.3^{b}	1398.4^{b}
trans-resveratrol	ND	ND	1373.2^{a}

*Where The averages followed by the same letters within a file do not differ by the Tukey test ($p < 0.05$). ND: not detected.

Analysis by HPLC allowed the identification of 12 polyphenolic compounds in the OH treatment, twice the number of compounds found in the other treatments. The OH extract revealed that quercetin and apigenin (2867.8 and 1574.9 mg/Kg VPR, respectively) were the main antioxidant compounds.

Growth inhibition percentage of the VPR extracts at 1000 µg/mL against different fungi strains

Extraction technique	RT	CH	OH
Fungus strains	Inibition % 96h (1000 µg/mL)		
P. italicum	64.3 ± 2.9^{a}	67.8 ± 4.5^{a}	66.5 ± 1.4^{a}
P. expansum	25.01 ± 8.3^{c}	34.7 ± 3.4^{b}	53.3 ± 10.3^{a}
Alternaria sp.	35.1 ± 1.2^{b}	32.1 ± 1.6^{a}	40 ± 5.2^{d}
Phoma violacea	28.5 ± 5.8^{b}	31.6 ± 2.1^{a}	41 ± 5.9^{c}
C. cladosporioides	18.1 ± 9.2^{c}	43.8 ± 5.4^{b}	62.4 ± 7.9^{a}

The averages followed by the same letters within a line do not differ by the Tukey test ($p < 0.05$).

RT, CH and OH extracts exhibited antifungal activity against the studied fungi, showing greater activity after 96 h of exposure when the concentration of 1000 µg/mL was tested.

The OH extract was more active at 1000 µg/mL, showing higher inhibitory effects against *P. Expansum, Alternaria sp., Phoma Violacea, C. Cladosporioides* (inhibition of 54.5, 45.4, 33.9, 59.9%, respectively).

On the other hand, antifungal activity against the different strains varied according to the concentrations and extracts used, although none of the concentrations used presented 100% inhibition.

CONCLUSIONS

These findings demonstrated the potential of VPR extracts as a source of bioactive compounds with relevant functional characteristics, as well as the efficiency of OH in the extraction of polyphenolic compounds from VPR, that led to a reduction in energy consumption and made the process more environmentally friendly. Therefore, the potential of VPR extracts as a probable source of bioactive constituents with high antioxidant and antimicrobial activities, suggests the development of future works to evaluate the application of these extracts in different industrial sectors.

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Acknowledgements

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