UNIVERSITY OF LIFE SCIENCES "KING MIHAI I" FROM TIMISOARA

"YOUNG PEOPLE AND MULTIDISCIPLINARY RESEARCH IN APPLIED LIFE SCIENCES"

05-06 November 2026



OPTIMIZATION OF ULTRASOUND-ASSISTED EXTRACTION OF PHENOLIC COMPOUNDS FROM GRAPE POMACE: A SUSTAINABLE APPROACH

Sara Maia, Thiago F. Soares, Juliana A. Barreto Peixoto*, M. Beatriz P. P. Oliveira, Rita C. Alves

LAQV-REQUIMTE, Faculty of Pharmacy, University of Porto, Porto, Portugal

**jpeixoto@ff.up.pt*

• Introduction [1,2]

Wine production: One of the most relevant agro-industrial activities worldwide

Grape pomace



A major by-product of winemaking, still poorly exploited

Phenolic compounds (5–10%)

- Phenolic acids, flavonols, flavan-3-ols, anthocyanins, stilbenes

Biological activities

- Antioxidant, anti-inflammatory, antimicrobial, cardioprotective

Grape pomace valorization within circular economy models through the recovery of their bioactive compounds

Requires efficient and sustainable extraction methods

Ultrasound-assisted extraction (UAE): Acoustic cavitation disrupts plant cell walls

- Higher extraction efficiency
- Shorter extraction time
- Lower solvent use
- Less thermal degradation

• Material and method

UAE optimization by Response Surface Methodology combined with Central Composite Design

Independent variables

- **Ethanol concentration** 20–80% (v/v)
- **Solid-to-liquid ratio** 400–1200 mg/100 mL
- **Extraction time** 5–15 min

→ **UAE of homogenized grape pomace**



→ **Spectrophotometric analyses**

- **Total contents in bioactive compounds**: TPC, TFC, TAC
- **Antioxidant activity**: DPPH•, FRAP

→ RSM modelling → Optimal conditions → Experimental validation

• Results and discussions

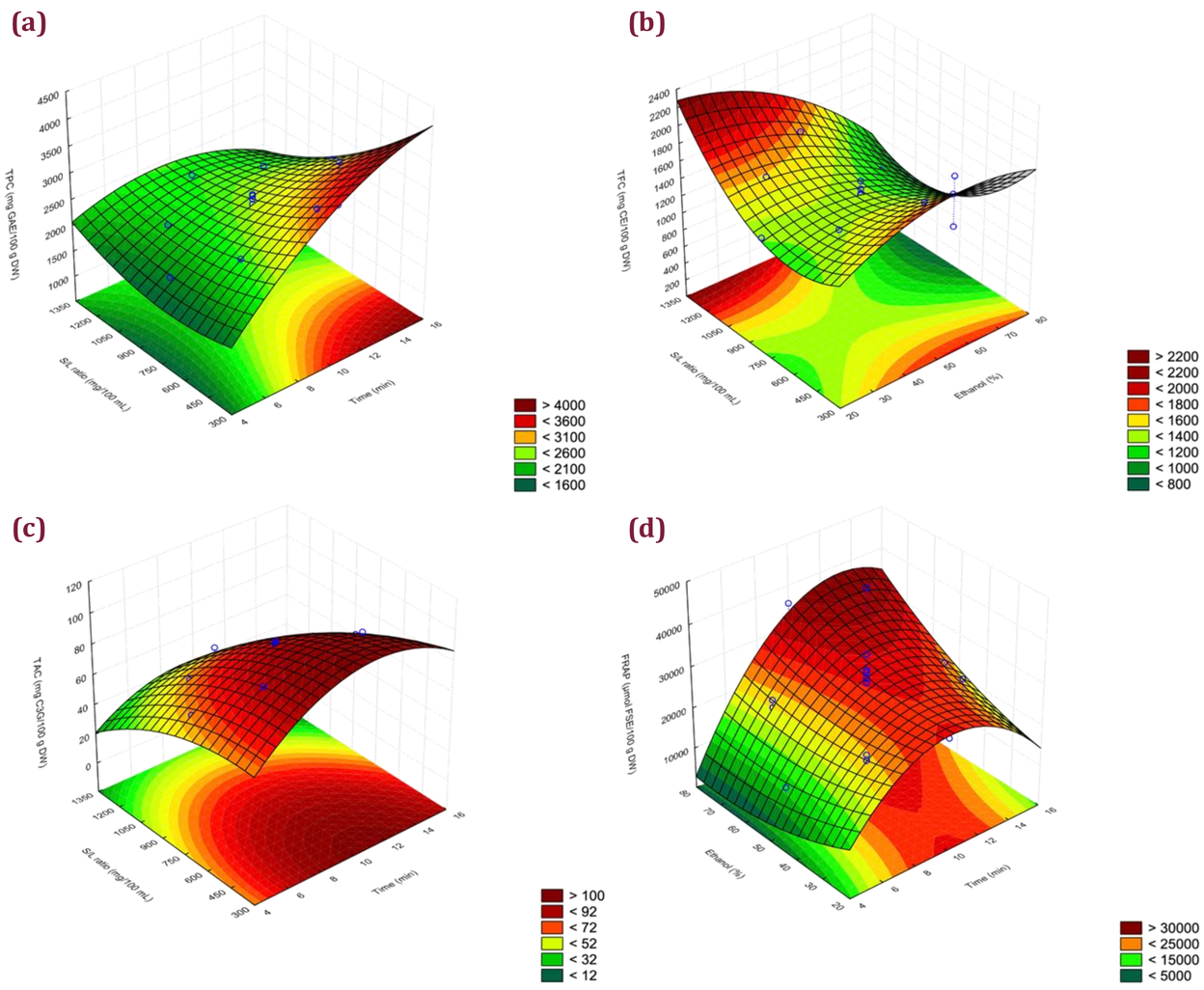


Fig. 1. Response surfaces of (a) TPC and (c) TAC as a function of S/L ratio and extraction time, (b) TFC as a function of S/L ratio and ethanol concentration, and (d) FRAP as a function of ethanol concentration and extraction time. A similar trend to (a) was observed for DPPH•.

Key findings

1. **Extraction time** and **ethanol concentration** were the most significant factors
2. **Global optimal conditions:** **58%** ethanol + **475** mg/100 mL + **13** min
3. **Experimental validation:** Good agreement between predicted and experimental values

• Conclusions

- **UAE conditions must be tailored to the grape pomace matrix** to maximize phenolic recovery;
- **Antioxidant-rich extracts** were obtained in a **short extraction time** (~13 min) using a **green hydroethanolic solvent**;
- **Grape pomace** can be turned from a winemaking residue into a **sustainable source of functional ingredients**, in line with circular economy principles.

Acknowledgements: This work received financial support from the project GrapeUP – Grape by-products high-value upcycling (COMPETE2030-FEDER-02182500). The authors acknowledge the project STrengthS4WineChaiN – Scientific and technological synergies for sustainable development of the wine chain in the North Region (Operation NORTE2030-FEDER-01786100), co-financed by the European Regional Development Fund (ERDF) through the Northern Regional Programme 2021–2027 [NORTE2030] and the PT national funds (FCT/MECI) through the project UID/50006/2025 (DOI https://doi.org/10.54499/UID/50006/2025) – Laboratório Associado para a Química Verde - Tecnologias e Processos Limpos. J.A.B.-P. is grateful to the project GrapeUP (COMPETE2030-FEDER-02182500) for her research contract. **References: [1]** R. Magalhães, M.B.P.P. Oliveira, Sustainability, 18 (2026) 5663. **[2]** J.A.B. Peixoto, N. Andrade, S. Machado, A.S.G. Costa, H. Puga, M.B.P.P. Oliveira, F. Martel, R.C. Alves, Foods, 11 (2022) 1671.