



## Abstract

# Grape Seed Powders as a Source of Phenolic Compounds: UHPLC Orbitrap MS4 Characterization <sup>†</sup>

Danijel D. Milinčić <sup>1</sup>, Uroš Gašić <sup>2</sup>, Aleksandar Ž. Kostić <sup>1</sup>, Slađana P. Stanojević <sup>1</sup>, Živoslav Lj. Tešić <sup>3</sup> and Mirjana B. Pešić <sup>1,\*</sup>

<sup>1</sup> Institute of Food Technology and Biochemistry, Faculty of Agriculture, University of Belgrade, Nemanjina 6, 11080 Belgrade, Serbia; danijel.milincic@agrif.bg.ac.rs (D.D.M.); akostic@agrif.bg.ac.rs (A.Ž.K.); sladjas@agrif.bg.ac.rs (S.P.S.)

<sup>2</sup> Department of Plant Physiology, Institute for Biological Research “Siniša Stanković”, National Institute of Republic of Serbia, University of Belgrade, Bulevar Despota Stefana 142, 11060 Belgrade, Serbia; uros.gasic@ibiss.bg.ac.rs

<sup>3</sup> Faculty of Chemistry, University of Belgrade, Studentski Trg 12–16, 11000 Belgrade, Serbia; ztesic@chem.bg.ac.rs

\* Correspondence: mpesic@agrif.bg.ac.rs

<sup>†</sup> Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

**Abstract:** Grape seeds represent a rich source of phenolic compounds that exhibit various health benefits. Therefore, grape seed powders can be a potential functional ingredient in the formulation of different nutritionally valuable food products. The aim of this study was the UHPLC Orbitrap MS4 characterization of phenolic compounds and their derivatives in indigenous (Smederevka, Tamjanika, and Prokupac) and international (Italien Riesling, Muscat Hamburg, Merlot, and Cabernet Sauvignon) grape seed powders. Phenolic compounds were extracted from grape seed powders with 80% methanol containing 0.1% HCl and analyzed by UHPLC Orbitrap MS. The identification of phenolic compounds was conducted based on their monoisotopic mass, MS fragmentation (MS4, MS3, MS2), available standards and literature data. Using standards, gallic, protocatechinic, p-hydroxybenzoic, and vanillic acids were identified in the seed extracts of all analyzed grape varieties. On the other hand, gentisic acid was not detected in the seed extracts of the Smederevka and Merlot varieties. Other phenolic acids and their derivatives, such as ellagic acid (300 m/z), gallic acid hexoside (331 m/z), dihydroxybenzoic acid hexoside (315 m/z), caffeoyl tartaric acid (311 m/z), and coumaroyl tartaric acid (295 m/z), were identified in all analyzed seed extracts based on exact mass and MS2 fragmentation. Commonly present flavan-3-ols (catechin, epicatechin, and catechin gallate) and different B-type procyanidins (B-type procyanidin dimer, trimer, and gallate isomers) were also identified in all analyzed samples. To the best of our knowledge, the procyanidin profiles of the indigenous variety Tamjanika (eight compounds) were analyzed for the first time. Flavonol aglycones (taxifolin and quercetin) and glycosides (quercetin, isorhamnetin, and kaempferol glycosides) were also identified, but their presence in the seeds was selective and closely dependent on grape varieties. In sum, grape seed powders of indigenous and international varieties contain different classes of phenolic compounds, primarily flavan-3-ols, procyanidins, and phenolic acids, which increase and favor their future application in the food industry.

**Keywords:** UHPLC Orbitrap MS; seed; phenolic compounds; procyanidins; indigenous grape variety



**Citation:** Milinčić, D.D.; Gašić, U.; Kostić, A.Ž.; Stanojević, S.P.; Tešić, Ž.L.; Pešić, M.B. Grape Seed Powders as a Source of Phenolic Compounds: UHPLC Orbitrap MS4 Characterization. *Proceedings* **2023**, *91*, 376. <https://doi.org/10.3390/proceedings2023091376>

Academic Editors: Slađana Sobajic and Philip Calder

Published: 27 February 2024



**Copyright:** © 2024 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

**Author Contributions:** Conceptualization, M.B.P. and D.D.M.; methodology, M.B.P., D.D.M. and U.G.; software, D.D.M. and U.G.; validation, D.D.M. and U.G.; formal analysis, A.Ž.K. and S.P.S.; investigation, D.D.M., U.G. and M.B.P.; resources, M.B.P. and Ž.L.T.; data curation, D.D.M. and U.G.; writing—original draft preparation, D.D.M.; writing—review and editing, M.B.P.; supervision, Ž.L.T. and M.B.P.; project administration, M.B.P. and Ž.L.T.; funding acquisition, M.B.P. and Ž.L.T. All authors have read and agreed to the published version of the manuscript.

**Funding:** This work was supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, Grant No. 451-03-47/2023-01/200116 and the Science Fund of the Republic of Serbia, #GRANT No. 7744714, FUNPRO.

**Institutional Review Board Statement:** Not applicable.

**Informed Consent Statement:** Not applicable.

**Data Availability Statement:** The authors declare that the data supporting the findings of this study are available from the corresponding author upon reasonable request.

**Conflicts of Interest:** The authors declare no competing financial interest.

**Disclaimer/Publisher's Note:** The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.