





## Abstract

# Green Approach to Synthesis of Silver and Gold Nanoparticles from Shoots and Pomace Waste Extracts <sup>†</sup>

Anda Maria Baroi <sup>1,2,\*</sup>, Daniela Ionela Toma (Sardarescu) <sup>3,4</sup>, Alexandru Vlaicu <sup>1</sup> , Cristina Emanuela Enascuta <sup>1</sup> , Toma Fistos <sup>1,3</sup>, Roxana Ioana Matei (Brazdis) <sup>1,3</sup>, Radu Claudiu Fierascu <sup>1,3</sup>  and Irina Fierascu <sup>1,2</sup> 

- <sup>1</sup> National Institute for Research & Development in Chemistry and Petrochemistry (ICECHIM), 202 Spl. Independentei, 060021 Bucharest, Romania; alexvlaicu16@yahoo.co.uk (A.V.); cristina.enascuta@gmail.com (C.E.E.); toma.fistos@icechim.ro (T.F.); roxana.brazdis@icechim.ro (R.I.M.); fierascu.radu@icechim.ro (R.C.F.); irina.fierascu@icechim.ro (I.F.)
- <sup>2</sup> Faculty of Horticulture, University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Marasti Blvd., 011464 Bucharest, Romania
- <sup>3</sup> Faculty of Chemical Engineering and Biotechnology, National University of Science and Technology Politehnica Bucharest, 1-7 Gh. Polizu Str., 011061 Bucharest, Romania; ionela.toma93@yahoo.com
- <sup>4</sup> National Research and Development Institute for Biotechnology in Horticulture, 117715 Stefanesti, Romania
- \* Correspondence: anda.baroi@icechim.ro
- <sup>†</sup> Presented at the 19th International Symposium “Priorities of Chemistry for a Sustainable Development”, Bucharest, Romania, 11–13 October 2023.

**Keywords:** grapevine waste; natural extracts; phytochemicals; green synthesis; nanostructure; characterization



**Citation:** Baroi, A.M.; Toma, D.I.; Vlaicu, A.; Enascuta, C.E.; Fistos, T.; Matei, R.I.; Fierascu, R.C.; Fierascu, I. Green Approach to Synthesis of Silver and Gold Nanoparticles from Shoots and Pomace Waste Extracts. *Proceedings* **2023**, *90*, 2. <https://doi.org/10.3390/proceedings2023090002>

Academic Editors: Mihaela Doni, Florin Oancea and Radu Claudiu Fierăscu

Published: 5 December 2023

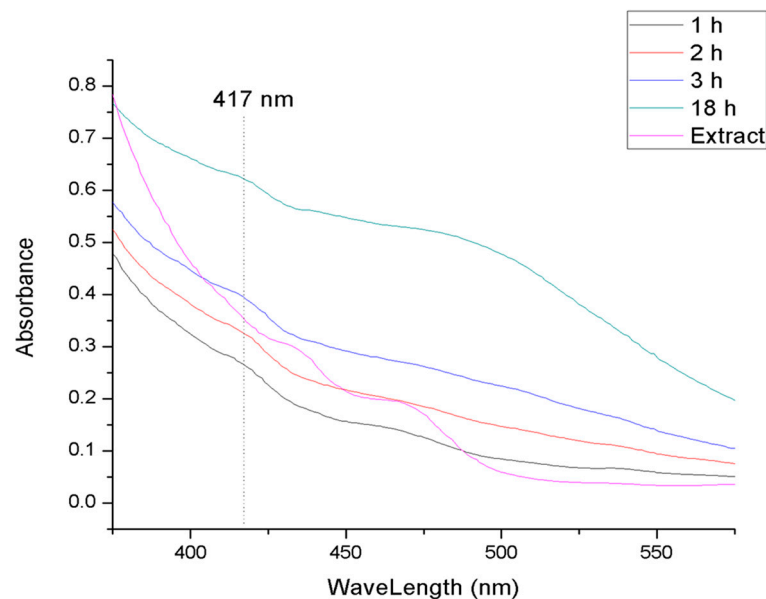


**Copyright:** © 2023 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

**Introduction:** The annual accumulation of viticultural and winery waste products has a negative impact on the environment and the economy, since their composition contains organic substances, different heavy metals, an acidic pH, and an increased salinity [1]. On the other hand, in the composition of these wastes, there are various quantities of bioactive compounds (phytochemicals) that can be exploited in different industries, such as the cosmetic, medical, or food industries. The phytochemicals present in the waste extracts that are directly involved in the phytosynthesis of metallic nanoparticles (NPs) are phenolic compounds, namely, flavonoids, terpenoids, or other biomolecules [2]. The aim of the current study is to use the rich extracts in phytoconstituents, obtained via different extraction methods (microwave, ultrasound, and temperature-assisted extractions) from vine shoots and pomace in order to phytosynthesize silver and gold nanoparticles (NPs).

**Materials and methods:** The high levels of biomolecules present in Feteasca Neagra vine shoots, and Muscat Otonel and Feteasca Neagra pomace extracts, have contributed to a reduction in metal ions leading to the formation of metallic nanomaterials. In order to determine the most efficient way of phytosynthesizing nanoparticles, different ratios between extracts and metal-containing solutions have been studied. The formation of metallic NPs has been monitored via UV–Vis spectrometry in the wavelength range of 300–700 nm (Figure 1). The properties and morphologies of the obtained nanostructures have been evaluated using analytical characterization techniques (UV–Vis spectroscopy, X-ray diffraction, X-ray fluorescence) and microscopic techniques (scanning electron microscopy).

## Results:



**Figure 1.** UV–Vis spectra of the synthesized AgNP from Feteasca neagra shoot extract.

**Conclusions:** The UV–Vis spectra of AgNP and AuNP present the characteristic absorption peaks between 417 and 420 nm for silver and between 540 and 545 for gold, respectively. The XRD and XFR spectra confirm the synthesis of AgNP and AuNP. According to scanning electron microscopy, both AgNP and AuNP present a uniform dispersion in solution.

**Author Contributions:** Conceptualization, A.M.B., I.F. and R.C.F.; methodology, A.M.B., I.F. and A.V.; formal analysis, R.C.F., C.E.E., T.F. and R.I.M.; investigation, A.M.B., D.I.T., A.V. and R.C.F.; writing—original draft preparation, A.M.B. and I.F.; writing—review and editing, A.M.B. and I.F.; supervision, I.F.; project administration, I.F. All authors have read and agreed to the published version of the manuscript.

**Funding:** The authors gratefully acknowledge the support of the Ministry of Research, Innovation and Digitization through Program 1—Development of the national research-development system, Subprogram 1.2 Institutional performance: Projects to finance excellence in RDI, Contract no. 15PFE/2021. The support provided by a grant from the Ministry of Research, Innovation and Digitization, CCCDI—UEFISCDI, project number PN-III-P2-2.1-PED-2021-0273, within PNCDI III, is also gratefully acknowledged.

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

**Informed Consent Statement:** Not applicable.

**Data Availability Statement:** The supporting data are available from the corresponding author.

**Conflicts of Interest:** The authors declare no conflict of interest.

## References

1. Ahmad, B.; Yadav, V.; Yadav, A.; Rahman, M.U.; Yuan, W.Z.; Li, Z.; Wang, X. Integrated biorefinery approach to valorize winery waste: A review from waste to energy perspectives. *Sci. Total Environ.* **2020**, *719*, 137315. [[CrossRef](#)] [[PubMed](#)]
2. Agarwal, H.; Nakara, A.; Shanmugam, V.K. Anti-inflammatory mechanism of various metal and metal oxide nanoparticles synthesized using plant extracts: A review. *Biomed. Pharmacother.* **2019**, *109*, 2561–2572. [[CrossRef](#)] [[PubMed](#)]

**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.