chemistry proceedings

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Abstract

Silver Nanoparticles Mediated by Natural Extracts Recovered from Wastes and By-Products †

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† Presented at the 17th International Symposium "Priorities of Chemistry for a Sustainable Development" PRIOCHEM, Bucharest, Romania, 27–29 October 2021.

Keywords: green synthesis; phenolic compounds; plant wastes; silver nanoparticles

Introduction: Current environmental problems demand an eco-friendlier approach to the chemical synthesis of metal nanoparticles (NPs) [1]. By using plant extracts obtained from waste materials and by-products resulting from the essential oil and textile industry, the resulting green nanoparticles represent a sustainable alternative for the classical synthetic route [2,3]. In our study, we obtained silver nanoparticles (AgNPs) by using aqueous plant extracts from *Cannabis sativa*, *Thymus vulgaris*, *Lavandula angustifolia*, and *Origanum vulgare*. The chemical composition of the extracts was determined by chromatographic and spectroscopic methods. AgNPs with less than 70 nm were obtained and characterized by UV-VIS, FT-IR spectroscopy, and SEM. The antioxidant activity (DPPH and ABTS assays) and the antibacterial properties against Gram-positive and Gram-negative bacteria of some of the samples were evaluated. **Materials and methods:** For the green NPs synthesis, the plant extracts were freshly prepared and filtered through a 0.45 mm PVDF, then 0.5 mL extract was mixed with 0.5 mL 5 mM silver nitrate solution and 0.7 mL purified water. The total reaction time was 8 min at 90 °C. **Results:** The bio-reduction of silver ions was mediated by the phenolic compounds present in the aqueous extracts. This reaction was easily observed by a visual colour change from pale gold to a reddish-brown and confirmed by UV-Vis spectral analysis, with an average particle size of 35–70 nm. Nanoparticle morphology was observed using SEM and average spherical shapes were noticed. **Conclusions:** The preparation of silver nanoparticles was successfully performed using aqueous extracts recovered from industrial wastes and by-products. Obtaining NPs through green synthesis is a fast, easy, and eco-friendly reaction that reduced Ag^+ to Ag^0 to spherical AgNPs with small average particle size.

Author Contributions: Conceptualization and study design, D.M.C.; methodology, A.C., D.R., A.I.L., C.M., D.C., L.C. and D.M.C.; validation, A.C., D.R., A.I.L., C.M., D.C., L.C. and D.M.C.; formal analysis, A.C., D.R., A.I.L., C.M., D.C., L.C. and D.M.C.; investigation, A.C., D.R., A.I.L., C.M., D.C., L.C. and D.M.C.; resources, A.C., D.R., A.I.L., C.M., D.C., L.C. and D.M.C.; data curation, D.R., D.C., L.C. and D.M.C.; writing—original draft preparation, A.C., D.R., A.I.L., C.M., D.C., L.C. and D.M.C.; writing—review and editing, D.R., D.C., L.C. and D.M.C.; visualization, A.C., D.R., A.I.L., C.M., D.C., L.C. and D.M.C.; supervision, D.R., D.C., L.C. and D.M.C.; project administration, D.M.C.; funding acquisition, C.M., L.C. and D.M.C. All authors have read and agreed to the published version of the manuscript.

Citation: Moisa, C.; Lupitu, A.I.; Csakvari, A.; Radu, D.; Chambre, D.; Copolovici, L.; Copolovici, D.M. Silver Nanoparticles Mediated by Natural Extracts Recovered from Wastes and By-Products. *Chem. Proc.* **2022**, *7*, 7. https://doi.org/10.3390/chemproc2022007007

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

Published: 28 February 2022

Funding: This research was funded by a grant of the Romanian Ministry of Education and Research, CNCS—UEFISCDI, project number PN-III-P1-1.1-PD-2019-0607, within PNCDI III.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

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

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