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Sciforum-210351: Green-Synthesized Ag, ZnO, and CuO Nanoparticles: From Formation and Characterization to Biomedical Potential

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Green synthesis of metal and metal oxide nanoparticles using plant extracts represents a sustainable and environmentally friendly approach to obtaining functional nanomaterials with potential biomedical applications. Plant extracts are complex sources of bioactive compounds that may participate in nanoparticle reduction, formation, and stabilization, while the nature of the metal and synthesis conditions significantly influence nanoparticle formation and the properties of the resulting nanosystems. **This study experimentally compares the green synthesis and physicochemical characteristics of silver (Ag), zinc oxide (ZnO), and copper oxide (CuO) nanoparticles, while their biomedical potential is discussed in the context of previously published biological studies.**

Nanoparticle formation was monitored by UV–Vis spectroscopy, while interactions between plant-derived biomolecules and the formed nanoparticles were investigated using FTIR spectroscopy. Particle morphology and size were determined by TEM analysis. Comparative evaluation revealed differences among Ag, ZnO, and CuO systems in terms of formation behavior, morphology, particle size, and stability. Silver was predominantly obtained as elemental Ag nanoparticles, whereas zinc and copper preferentially formed ZnO and CuO nanoparticles due to their greater susceptibility to oxidation.

The biomedical potential of the investigated nanosystems was comparatively discussed based on previously published studies, including available data on antitumor, antimicrobial, hemolytic, genotoxic, and antigenotoxic activities. This literature-based comparison was used to relate differences in nanoparticle composition and physicochemical characteristics to their reported biological effects. By integrating the experimental findings on green synthesis and physicochemical characterization with previously reported biological data, this comparative approach provides insight into how differences in nanoparticle composition, formation, and properties may influence their biomedical potential.



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Green-Synthesized Ag, ZnO, and CuO Nanoparticles: From Formation and Characterization to Biomedical Potential

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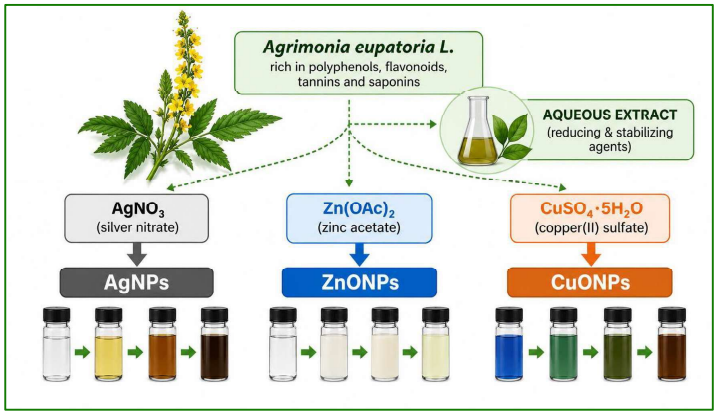
INTRODUCTION

- ✓ **Plant-mediated green synthesis** provides a sustainable approach for producing functional metal and metal oxide nanoparticles.
- ✓ Plant-derived biomolecules can contribute to nanoparticle **reduction, formation, and stabilization.**
- ✓ **Metal identity and synthesis** conditions strongly influence nanoparticle formation and physicochemical properties.
- ✓ **AIM: To experimentally compare the green synthesis and physicochemical characteristics of Ag, ZnO, and CuO nanoparticles and discuss their biomedical potential based on previously published biological studies.**

METHOD

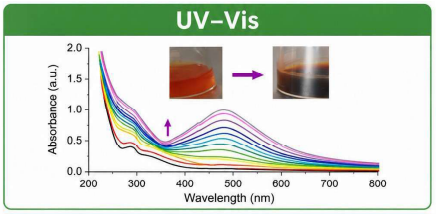
- ✓ **Green synthesis** of Ag, ZnO, and CuO nanoparticles using plant extract.
- ✓ Nanoparticle formation monitored by **UV–Vis spectroscopy.**
- ✓ Plant biomolecule–nanoparticle interactions investigated by **FTIR spectroscopy.**
- ✓ Particle morphology and size determined by **TEM analysis.**
- ✓ **Biomedical potential** comparatively evaluated based on previously published biological data.

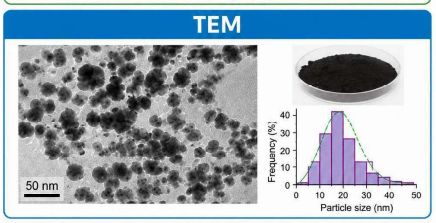
SYNTHESIS

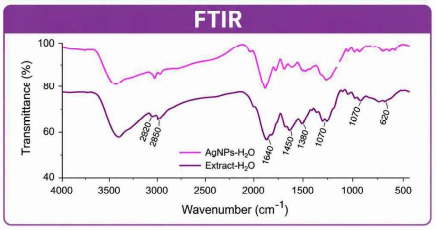


CHARACTERIZATION

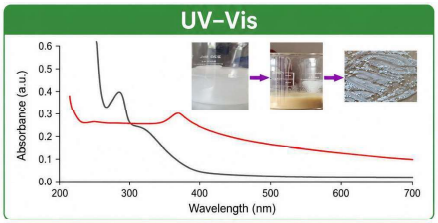
AgNPs

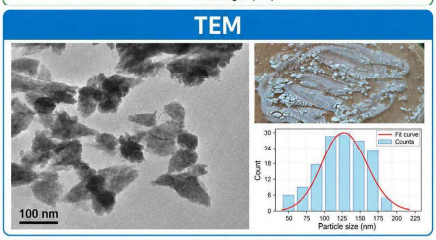


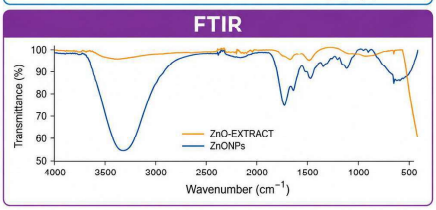




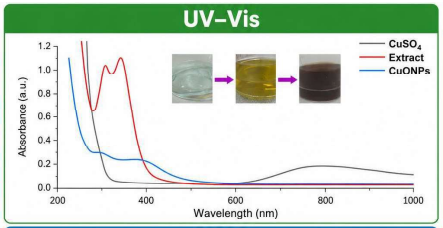
ZnONPs

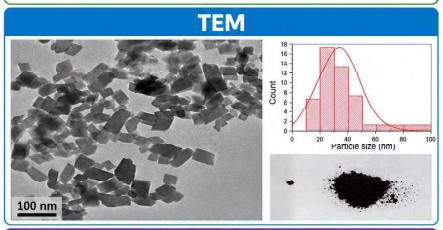


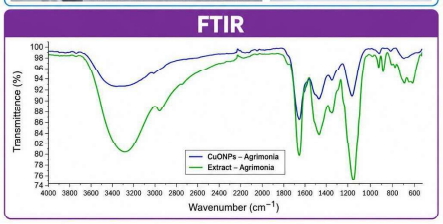




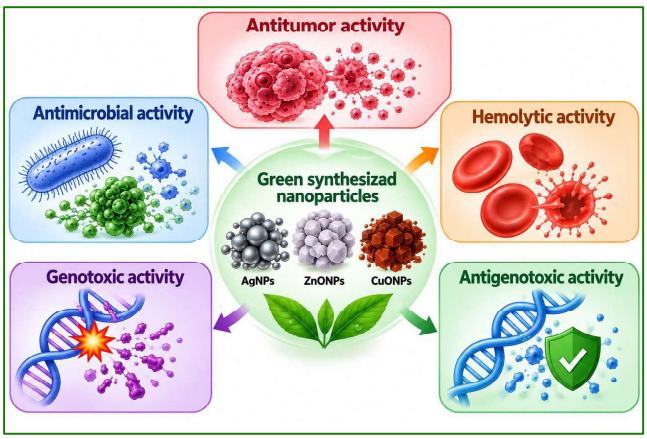
CuONPs







BIOMEDICAL POTENTIAL



CONCLUSIONS

- ✓ Ag, ZnO, and CuO nanosystems exhibited **distinct formation behavior, morphology, and particle size.**
- ✓ Ag was predominantly obtained as **elemental AgNPs**, whereas Zn and Cu preferentially formed **ZnO and CuO nanoparticles**, reflecting their greater susceptibility to oxidation.
- ✓ Published biological studies indicate **distinct antitumor, antimicrobial, hemolytic, genotoxic, and antigenotoxic profiles** among these nanosystems.
- ✓ Overall, integrating experimental physicochemical characterization with published biological evidence highlights the importance of **nanoparticle composition and properties in determining biomedical potential.**

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