

SPYDE PROJECT REPORT

Development of Smart SPraYable Medical DEvices to Alleviate Skin Diseases: One idea for Multiple Purposes

WP4: Synthesis of silver biogenic nanoparticle and liposomes starting from the extracts

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Summary

This study marks the first stage of Work Package 4 (WP4) of the SPYDE project, focusing on the synthesis (T4.1) and characterization (T4.2) of biogenic silver nanoparticles using extracts derived from grape chain by-products. As part of SPYDE's mission to advance sustainable nanotechnology within a circular bioeconomy framework, we have developed a green, cost-effective method to synthesize silver (Ag) and zinc oxide (ZnO) nanoparticles using grape pomace extract (GPE), an abundant winemaking by-product rich in polyphenols, flavonoids, and antioxidants^{1,2}. These natural compounds functioned as both reducing and stabilizing agents, eliminating the need for toxic chemicals typically used in conventional nanoparticle synthesis³.

A thermal aqueous extraction was used to obtain the bioactive-rich GPE, followed by a simple one-pot synthesis. Rapid color changes - brown for AgNPs and milky white for ZnO NPs visually confirmed nanoparticle formation. These observations were validated through UV-Vis spectroscopy, revealing characteristic peaks at 400 nm (AgNPs) and 371 nm (ZnO NPs). Dynamic Light Scattering (DLS) analysis showed average particle sizes of 94 ± 7 nm (AgNPs) and 343 ± 119 nm (ZnO NPs), while zeta potential measurements of -30 mV and -16 mV, respectively, indicated good colloidal stability. X-ray diffraction (XRD) confirmed their crystalline nature, and FTIR and EDX analyses validated the presence of stabilizing functional groups and high elemental purity.

This eco-friendly synthesis route offers a promising strategy to valorize viticultural waste into high-value nanomaterials, with potential applications in antimicrobial coatings, biomedical technologies, and environmental remediation. The successful development of AgNPs fulfills Deliverable D4.1 and lays the foundation for the next phases of WP4, including the formulation of liposomes (T4.3) loaded with antioxidant and regenerative extracts. Future work will also explore the valorization of Wine Lees (WL) to extract post-biotics for skin regeneration, reinforcing SPYDE's commitment to innovation, sustainability, and circular resource use.

References

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