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| **Biogenic Synthesis of Eco-Benign Silver Nanoparticles Loaded with Isoniazid: A Novel Therapeutic Strategy for Multidrug-Resistant Tuberculosis** |
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| **Background:** Eco benign synthesis is defined as a synthesis process that utilises nontoxic and biocompatible raw materials that cause no harm to the environment. As such, it prioritises reducing the environmental impact of chemical synthesis, which is a promising strategy for developing infectious disease drugs. Tuberculosis (TB) is a major global health burden exacerbated by drug resistance and toxicity issues, especially with first-line TB drugs such as isoniazid (ISO). Metallic nanoparticles, specifically silver nanoparticles (AgNPs), have shown potential in increasing drug efficacy and reducing toxicity. Plant-mediated synthesis is an eco-benign process that avoids the use of toxic chemicals and utilises natural reducing and stabilising plant phytochemicals for AgNP synthesis. This study aimed to establish an eco-benign approach to the functionalisation of silver nanoparticles (AgNPs) with isoniazid (ISO), using Spinacia Oleracea leaf extract (SLE) as the reducing and stabilising agent and polyvinylpyrrolidone (PVP) for enhanced stabilisation. |
| **Methods:** AgNPs were synthesised using SLE, functionalised with ISO (NP+ISO), and further stabilised with PVP (NP-ISO-PVP). To achieve maximum ISO loading efficiency, two conjugation methods were explored: ISO was added either before or after PVP i.e. PVP 1 (NP + ISO + PVP) and PVP 2 (NP + PVP + ISO). PVP concentration was also varied: PVPa 0.0125 and PVPb 0.025, as PVP is known to provide stability through particle coating; however, the coating amount may affect drug loading. Synthesised AgNPs were characterised spectrophotometrically using ultraviolent-visible spectroscopy (UV-VIS), morphology, size and elemental characterisations were conducted using transmission electron microscopy (TEM), dynamic light scattering (DLS) and TEM – Energy Dispersive Xray (TEM-EDX). |
| **Results:** The results confirmed the successful synthesis of spherically monodispersed, ISO-loaded AgNPs with sizes ranging from 73 – 131nm and polydispersity values below 0.3. Notably, the PVP 1 conjugation method exhibited superior performance, facilitating optimum drug loading efficiency of ~93%. Additionally, the pivotal role of PVP in particle size reduction was also established. |
| **Conclusions:** These results validate the potential of using eco-benign synthesis to develop novel nanotherapeutics against TB. Further investigations will be conducted on the antituberculosis effects of ISO-AgNPs, which could have positive implications for the treatment of drug-resistant TB. |