Green Synthesis of Nanoparticles

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ABSTRACT

Nanoscience and nanotechnology are rapidly developing fields of the recent era in agreement with systems, devices, and structures that possess distinctive features and capabilities due to their atomic arrangement under sizes of 1–100 nm scale. A number of methods have been reported for the fabrication of nanomaterials that are both chemical and biological methods and each method has its own significance. The main focus in this research is to adapt green synthesis in order to fabricate particles in nanometer size, since biological methods are eco-friendly, clean, safe, cost-effective, uncomplicated, and yield high productivity. The plant *citrus limon*, which is used to synthesize nanoparticles, exhibits notable effects from its bioactive components, especially from active functional groups like sugars and phenols. The synthesis of copper oxide and zinc oxide from various plant extracts demonstrates the wide range of uses for green synthesis. Different spectroscopic techniques and SEM results confirmed their results.

Keywords: Citrus Limon, Copper Nanoparticle, Nanoscience, Nanotechnology, Zinc Nanoparticle.

INTRODUCTION

In modern times, life becomes easier because of advancements in nanoscience and nanotechnologies across nearly all scientific disciplines. Notably, remarkable advances in nanotechnology have been made in the field of human health. They can be utilized as fillers or coatings materials in order to provide protection against UV rays, which are imperative in making windows, lenses, and sunscreens. Furthermore, the nanoparticles of silver and copper can be incorporated in food packaging material in order to keep packaged foods fresh or in socks fabrics to reduce odor in socks. In medicinal field, the Au nanoparticles are used for drug delivery and cancer detection.

Citrus limon(L.) Burm. f. is a tree with evergreen leaf and edible yellow fruits from the family *Rutaceae*. Scurvy was customarily treated with *C. limon*fruit juice, or lemon juice. These include the treatment of irregular menstruation, high blood pressure, and the common cold. In addition, the essential oil of *C. limon* is a well-known cough treatment. The juice has long been used to treat fevers, rheumatism, sore throats, scurvy, elevated blood pressure, and chest pain.*C. limon*has a significant role in the food, fertilizer, aerosol technology and cosmetics industries (Bayda *et al*., 2020) (Abdelmoaty *et al*., 2021) (Falke *et al*., 2024) (Semsari *et al*., 2024).

OBJECTIVE

Green Synthesis Method

The aim of this research is to adapt an eco- friendly way of synthesizing nanoparticles. In this instance, the biological method is represented as a substitute to chemical and physical methods. Moreover, this method does not require expensive, harmful and toxic chemicals that left hazardous materials in the environment that ultimately incorporated with greenhouse gas emission. Green synthesis can be done in one step using plants extract and left no any hazardous material in the environment after manufacturing of nanoparticles.

METHODOLOGY

The nanoparticals were synthesized by taking 20ml extract into a beaker which was then placed on hot plate and stirred continuously while maintaining the temperature 90-100°C. Zinc nitrate was slowly added into

lemon extract. After complete addition, heat and stirred the reaction mixture for 4 hrs. The reaction was monitored by taking UV spectrum for the formation of ZnO nanoparticle that shows the absorption between 300-450nm, using double beam spectrophotometer. After completion of the process, the reaction mixture was transferred into a crucible. Afterwards, the crucible was placed on hot plate and stirred continuously until thick material formed. The crucible containing thick material was placed in a furnace for 2 hour at 400 ˚C and white powder was formed. Same method follows for synthesizing copper oxide nanoparticles.

RESULT

UV-Visible, Fourier-transform infrared spectroscopy (FTIR) and scanning electron microscope (SEM) analysis revealed successful formation of nanoparticles. Zinc oxide and copper oxide nanoparticles synthesized with plant extract showed exceptional particle sizes in nanometer-scale; especially most of them were appeared in50-100 nm diameters in their SEM results. The distinctive contributions of plant extracts to the synthesis process are highlighted by the elevated intensities of specific bands revealed by FTIR spectra.

CONCLUSION

The fabrication of nanoparticles by green synthetic method is convenient, eco-friendly and minimize the harmful effects of chemical and physical methods by preventing the use of toxic chemicals and formation of toxic/health hazardous by-products. The synthesized particle from this method were appeared in the range of 100nm sizes as shown in its SEM image. Further their formation was also affirmed by UV and FTIR techniques that shows the characterstic peaks for the ZnO and CuO nanoparticles in their respective range of wavelenghts and wavenumbers, respectively.

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