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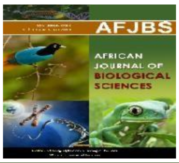

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# Magnesium oxide Nanoparticle synthesis using *Rhizophora lamarckii* plant extract and its characterization

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**ABSTRACT**

Nanoparticle production is nanotechnology's most important feature. In recent years, physical and chemical techniques to nanoparticle synthesis have shown severe flaws, necessitating the creation of an environmentally benign nanoparticle synthesis methodology. As a result, in this paper, we will detail how to synthesise magnesium oxide nanoparticles (MgONPs) from *Rhizophora lamarckii* and secondary chemicals found in the plant's leaf broth. *Rhizophora lamarckii* is being used to produce MgO nanoparticles by varying parameters such as temperature and pH. A UV-Visible spectrophotometer is used to analyse the absorbance spectra of MgONPs throughout the final synthesis process. SEM, and FTIR and XRD were employed to evaluate the biosynthesized nanoparticles. The current study, which employs a plant to produce MgONPs, is an efficient, environmentally friendly, and straightforward method that could have a significant impact on future industrial and commercial metallic nanoparticle production.

**Keywords: Nanoparticles, *Rhizophora lamarckii*, UV-Visible spectrophotometer, Biosynthesized**

## 1. INTRODUCTION

Nanotechnology is playing an increasingly important role in biology, medicine, physics, chemistry, and electronics (1). Agriculture, medicine, waste management, catalysis, pollution control, and therapeutic sectors such as antibacterial and anticancer medicines are all potential applications for nanotechnology. Nanoparticles can have many shapes, sizes, morphologies, and geometries (2). Physical and chemical approaches to nanoparticle production are damaging to both the environment and humans. The chemical synthesis of nanoparticles has a negative influence on the environment and humans since it emits poisonous hazardous compounds such as sodium borohydride and hydrazine (3). Hydrazine produces irritation in the eyes, throat, and nose. In severe situations, it can cause seizures, coma, and damage to the liver and kidneys (4). Chemical techniques such as microemulsion and evaporation/condensation are equally expensive. Physical methods, such pulse laser ablation, microwave-assisted, and pulsed/explosion wire discharge, need more energy, time, and money (5). As a result, synthesising nanoparticles using green technology appears more practical, non-toxic, cost-effective, and environmentally beneficial (6). It is a bottom-up technique in which plant extract, bacteria, or fungi are employed as raw material and redox reactions occur (7).

Medicinal plants are often used as reducing agents in green nanoparticle synthesis, and they create a wide spectrum of nanoparticles such as copper, silver, gold, zinc, and iron (8). Biologically generated metal nanoparticles have enormous possibilities as cytotoxic agents against cancer cells, antioxidant powder, antibacterial and anticoagulant agents (9). NPs, which are made from a rich pool of secondary metabolites, contain alkaloids and flavonoids. Magnesium nanoparticles offer a wide range of essential uses, particularly in the biological domain, among other metal nanoparticles (10). Magnesium oxide nanoparticles are employed in a variety of applications, including large magnetic resistant materials, sensors, catalysts, optical, electrical, gas sensors, superconductors, solar energy conversion, and the production of organic-inorganic nanostructure composites (11) (12).

The notion of synthesising MgONPs from mangrove plants originated in this setting. Mangrove plants have been used in traditional medicine to cure many ailments. This study suggests a straightforward and efficient methodology for producing MgONPs. Its leaves are useful for treating eye issues and headaches. There is insufficient qualitative and quantitative data to establish the quality and purity of leaves. In this study, magnesium oxide nanoparticles are synthesised using a leaf extract of *Rhizophora lamarckii*. UV-Vis, FTIR, SEM, and XRD techniques are used to characterise the MgONPs that have been synthesised. The plant-mediated synthesis of MgONPs, as mediated by various characterisation approaches, provides substantial insights into the many characteristics that exist today.

## MATERIALS AND METHODS

### *Collection of plant sample*

*Rhizophora lamarckii* leaves were obtained from a forest reserve near Hauz Khas, Delhi. The leaves were thoroughly cleaned with distilled water before being dried on blotting paper. Then, they were sun dried for one day to remove moisture before being pounded into fine powder with a mortar and pestle. This powder was simmered in MilliQ water for 5-10 minutes. Extract obtained after dissolution was used to synthesise MgO nanoparticles.

***Preparation of leaf extract***

Leaf extract was prepared by weighing 4g of leaf powder and adding it to a reaction beaker containing 100ml MilliQ. The solution was boiled on the heating mantle at 80 degrees for around 10 minutes. After the solution cooled to room temperature, filtration was carried out through Whatman filter paper to produce filtrate. The residue was discarded, and the finished extract was kept at 4°C.

***Synthesizing CuO Nanoparticles***

All of the chemicals were AR Grade and obtained from reliable providers. MgO nanoparticles were produced using a green technique. Filtered leaf broth was added drop by drop to a 90ml stirring solution containing 10mM magnesium nitrate until the colour changed from yellow to yellowish brown. The liquid was centrifuged at 6000 rpm for 15 minutes. Resulting mixture was left to stir for an hour. It was kept at room temperature overnight and wrapped in aluminium foil before being tested with a range of spectrophotometer techniques.

***Characterization***

All reagents were acquired from Fisher Scientific Chemicals. The unique properties of nanoparticles were investigated by recording their absorption spectra with an Eppendorf spectrometer. The FTIR spectrum was obtained using a Perkin Elmer instrument and FTIR accessories from PCI analytics, with the synthesised NPs recorded as KBr pellets in the 4000-400 $cm^{-1}$ range (13). The morphological characteristics of the resulting nanoparticles were measured with the SEM ZEISS Instrument EVO 18 Special Edition. SEM images of the synthesised nanoparticles may provide proof of newly generated MgONPs. To assess the stability of synthesised NPs, their size was measured using a Zetasizer and pH was assessed using a HACH device (14). XPERT-PRO X-Ray Diffractometer was used to analyse the results of XRD.

## 2. RESULTS AND DISCUSSION

Nanoparticles can be created utilising biological agents such as plant extracts, which offers substantial advantages over conventional approaches. It also eliminates the need to monitor cell cultures during large-scale manufacturing. (15). An aqueous leaf extract of *Rhizophora lamarckii* is the most cost-effective method for nucleating nanoparticles. In the current study, MgO NPs were combined with an extricated arrangement of *Rhizophora lamarckii* leaf extract to serve as a dissolvable rather than natural solvent. MgONPs creation can be confirmed using a variety of analytical techniques that provide precise information about nanoparticle synthesis.

***UV–Visible Analysis***

The nanoparticles were characterised using UV-Vis absorption spectroscopy on an Eppendorf Biospectrometer. Figure 1 depicts the UV-visible spectrum of MgO NPs generated by *Rhizophora lamarckii*. A significant absorption band was detected in the 290-300 nm range, indicating the existence of MgONPs. The absorption spectra alter as the extract composition increases, resulting in production of MgO nanoparticles. As a result, as the content of plant extract grows, so does the absorption spectrum, with maximum absorption occurring at approximately 300 nm. The observed spectra result from the production of MgO NPs. Even after extended storage, the absorption spectra remained consistent. The collected spectra revealed that the synthesised nanoparticles were symmetrical and spherical in shape.

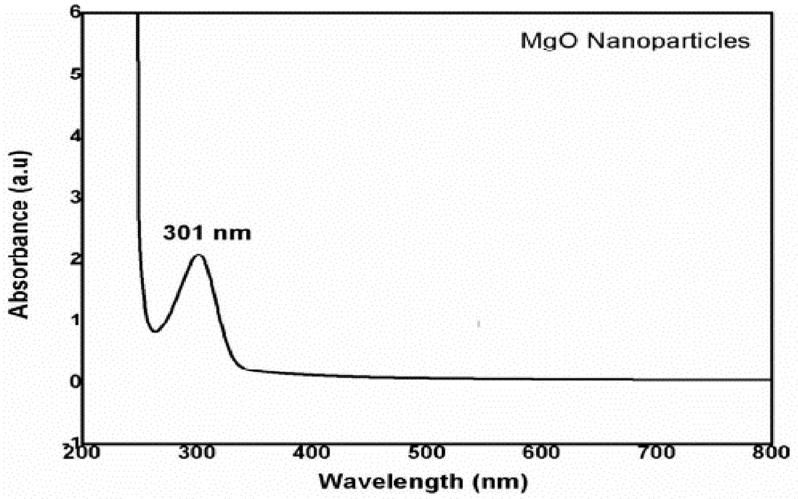


Figure 1: UV-Vis Spectra

***Photocatalytic activity***

The photocatalytic activity of synthesised MgO nanoparticles was assessed in sunlight using methylene blue dye degradation. Figure 2 displays absorption spectra at different time intervals of irradiation after MgONPs were exposed to sunlight with dye solution and monitored using UV spectra. The greatest absorption spectra in the UV-visible spectrum occur at 660nm. As depicted in the illustration, absorption spectra gradually diminish after irradiation, and the dye disappears within 240 minutes. MgO nanoparticles react with dye to produce electrons and holes, resulting in super oxide radicals. When these hydroxyl radicals reacted with electrons, they destroyed the colour molecules.

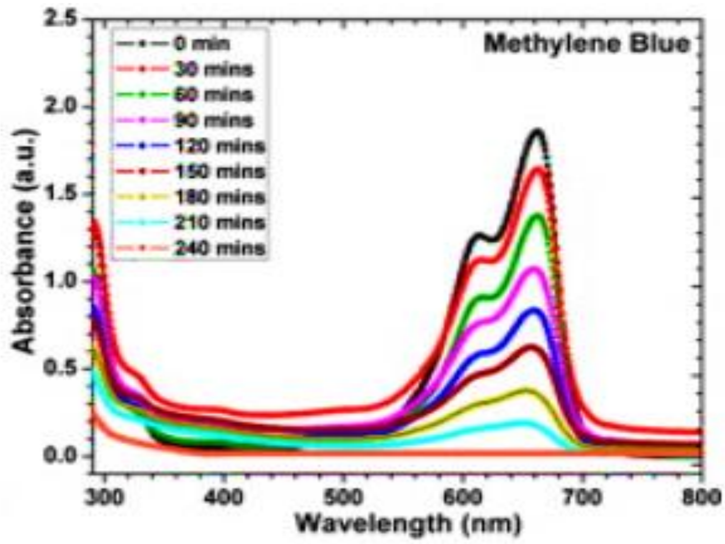


Figure 2: Photocatalytic activity of MgO NPs

***XRD Analysis***

The resultant nanoparticles were examined with an X-ray diffraction analyzer (Bruker D8, MA, USA). Prior to the XRD investigation, the materials were lyophilized by freezing them in a vial of liquid nitrogen and then subjected to a lyophilizer for 24 hours (FreeZone Freeze dryers, MO, USA) (16). X-ray diffraction could be used to study crystal structure of lyophilized molecules. Figure 3 shows the XRD patterns produced by MgONPs. The XRD analysis may reveal varied diffraction peaks at different intensities for MgO, with the highest at 200. The weak diffraction peaks appeared initially, followed by the greatest peak intensity. The results confirmed previously observed diffraction peaks for MgONPs.

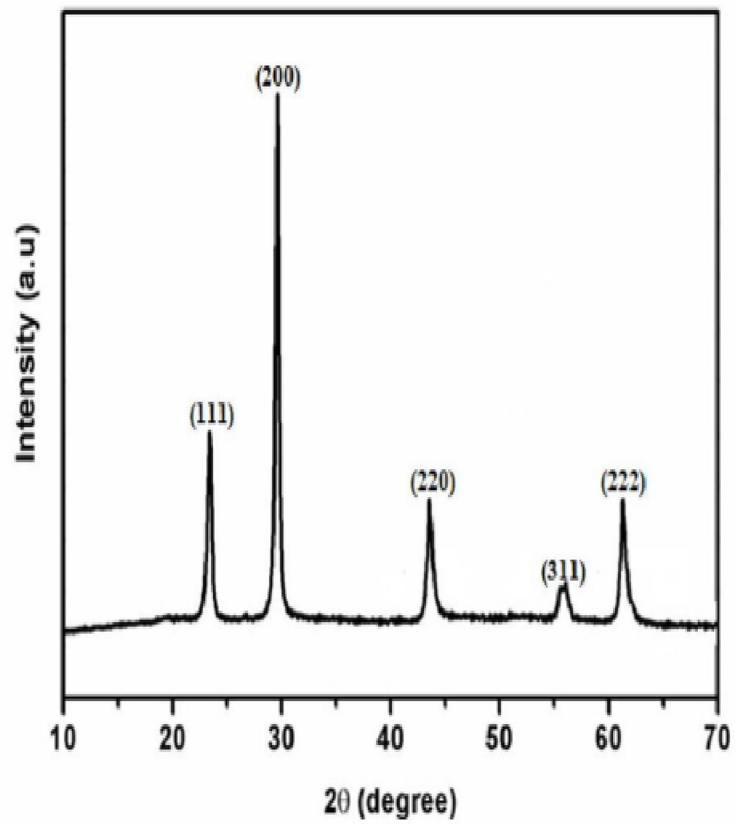


Figure 3: XRD Analysis of MgONPs

***FTIR Analysis***

FTIR was used to identify biomolecules that decrease and encapsulate MgONPs. Figure 5 shows the FTIR spectra of MgONPs isolated from *R. lamarckii* leaf extract. The spectra have bands at 3405, 2925, 1626, 1402, 1260, and 1035 $cm^{-1}$, with misplaced peaks at 3395, 2921, 1644, 1450, 1232, and 1077 $cm^{-1}$. Peaks at 3405 $cm^{-1}$ (shifted to 3395 $cm^{-1}$) and 1626 $cm^{-1}$ (shifted to 1644 $cm^{-1}$) show stretching of the N-H amine group. Stretching of the C-H alkane group is shown by absorption maxima shifting from 2925 $cm^{-1}$ to 2921 $cm^{-1}$ and 1402 $cm^{-1}$ to 1450 $cm^{-1}$. The amine and alkane functional groups of *R. lamarckii* are most likely involved in reducing and capping newly synthesised MgONPs.

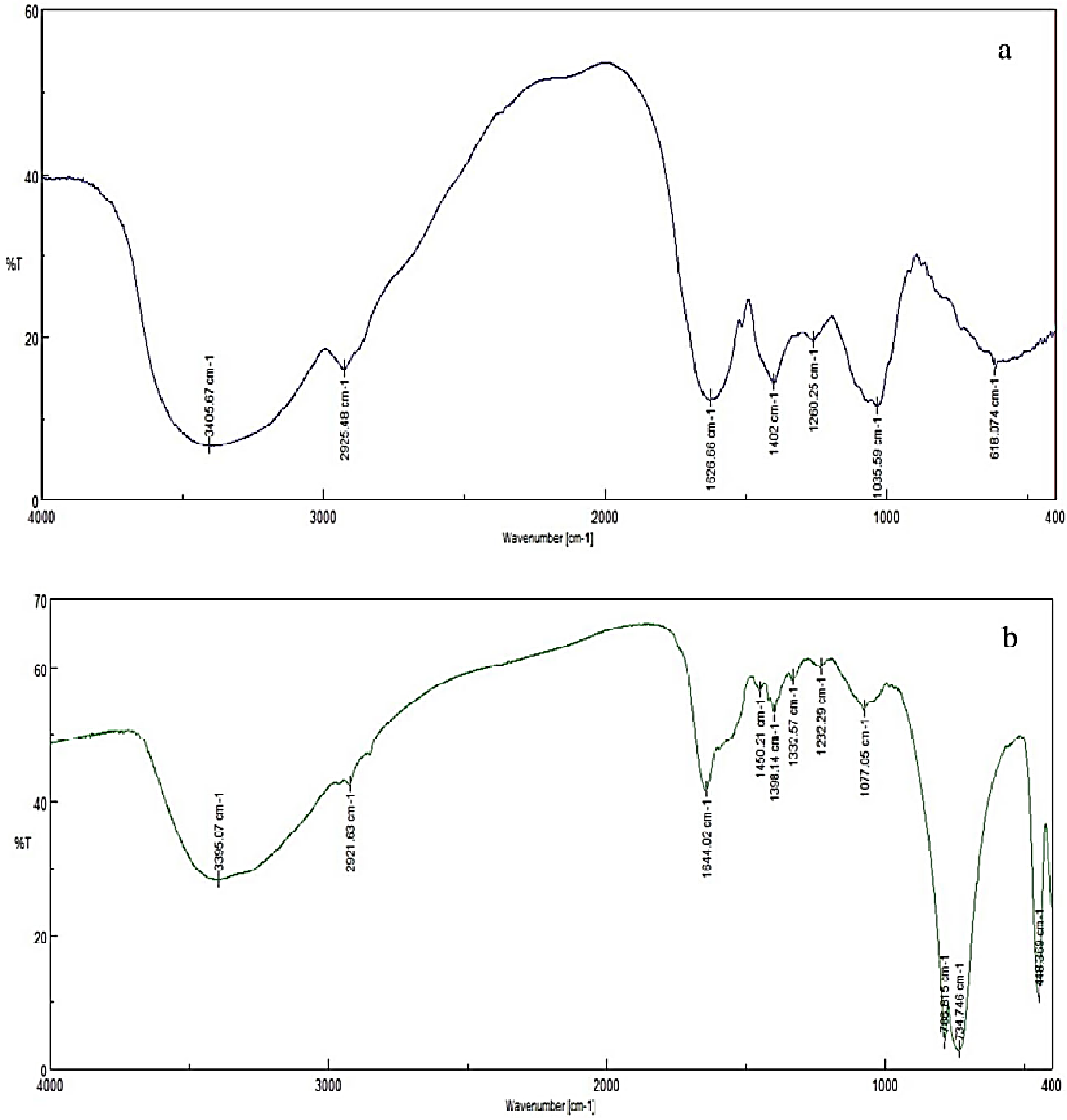


Figure 4: FTIR Analysis of MgONPs: (a) extract of *R. lamarckii* and (b) MgONPs synthesized with *R. lamarckii*

### *SEM analysis*

It is critical to understand the morphological features of the formed nanoparticles by analysing size and shape of the created copper nanoparticles. Scanning electron microscopy was used to analyse the morphological shape and structure of the MgONPs that were created (17). Figure 5 depicts the image produced for SEM investigation of MgONPs. The resultant nanoparticles are generally rod and sphere shaped.

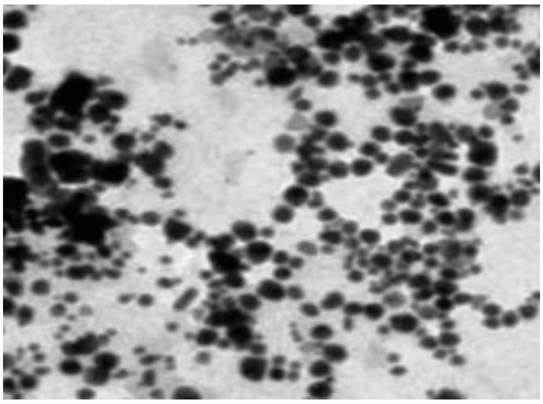

Figure 5: SEM analysis of MgONPs

## 3. CONCLUSION

Nanoparticle agglomeration can be achieved with a variety of regularly used synthetic substances and techniques. In this study, the amalgamation of copper oxide nanoparticles was explored utilising an environmentally friendly process involving *Rhizophora lamarckii* leaf extracts. Finally, we created a skilled, simple, and successful approach for green amalgamation of MgONPs that employs *Rhizophora lamarckii* leaf extract as a reducing and balancing agent. In compared to the intended MgO NPs, the plant-based MgO nanoparticles were found to be more stable and ejected less particles. Furthermore, whereas hydrodynamic size and accumulation grew over time, plant-blended MgO NPs were smaller and had a lower overall expansion than designed NPs. The proposed MgO NPs were more soluble than plant-interacted MgO NPs, and their particle discharge rate outperformed plant nanoparticles. Plant-incorporated CuO nanoparticles have been demonstrated to be more stable than manufactured nanoparticles. Plant-incorporated MgO NPs were found to be less hazardous than manufactured MgO NPs, making it a better way for releasing more nanoparticles into the environment for a variety of purposes. However, it is uncertain whether the detrimental effects of plant and produced magnesium oxide are caused by particle disintegration or by MgONPs and their interactions with the environment. SEM, XRD, and UV-visible examinations reveal that the MgONPs produced have potential environmental benefits.

**Acknowledgment**

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