International Journal of Innovative Studies in Sciences and Engineering Technology (IJISSET)

ISSN 2455-4863 (Online) www.ijisset.org Volume: 5 Issue: 8 | 2019

# Preparation and Characterization of Nanocrystaline Magnesium Oxide Using Datura Stramonium Leaves and Its Antibacterial Activity

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**Abstract:** *In the present work we have used Datura stramonium leaves extract which has medicinal value and we have synthesized MgO nanoparticles from it by green synthesis method. The green synthesized MgO nanoparticles was characterized by X-ray Diffraction, FT-IR, SEM and antibacterial activity. The XRD shows that formation of nanocrystalline MgO nanoparticle which was also confirmed by FTIR spectra. The surface morphology shows MgO nanoparticles has globular morphology. The antibacterial activity of MgO nanoparticles obtained from Datura stramonium leaves against E.Coli and S. aureus were studied. The antibacterial activity also shows good zone of inhibition.*

**Keywords:** *Biosynthesis, Datura stramonium leaves, magnesium oxide nanoparticles.*

## INTRODUCTION

Nanotechnology is mainly concerned with synthesis of nanoparticles of variable sizes, shapes, chemical compositions and controlled dispersity and the potential use for human benefits [1]. Use of biological organisms such as microorganisms, plant extract or plant biomass could be an alternative to chemical and physical methods for the production of nanoparticles in an eco-friendly manner [2]. The green method of synthesis of nanoparticles is easy, efficient and eco-friendly in comparison to chemical-mediated synthesis [3-5].

Metal oxides such as NiO, ZnO, MgO and CuO are of particular interest as they are not only stable under harsh process conditions but also generally regarded as safe materials [6-8]. Though numerous chemical methods are available for metal nanoparticles synthesis, copious reactants and starting materials are used in these reactions that are toxic and potentially hazardous. Nanostructured mesoporous MgO is also of research interest because of its diverse properties, which originate from its structural characteristics [9]. Recently, there have been some methods for the synthesis of nanostructured mesoporous MgO, e.g., gel-templated technique [10], modified citrate precursor technique [11], microwave plasma torch technique [12] and combustion technique [13].

In this present study it has been found that the Datura stramonium leaves extract which has medicinal value and we have synthesized MgO nanoparticles from it by green synthesis method These green synthesized nanoparticles were examined by and X-ray analysis (XRD) a to determine their size and shape; FTIR analysis were also performed to confirm the structural arrangemaent. The antibacterial activity of MgO nanoparticles obtained from Datura stramonium Leaves against E.Coli, S. aureus were studied. The antibacterial activity also shows good zone of inhibition.

## MATERIAL AND METHODS

### Materials

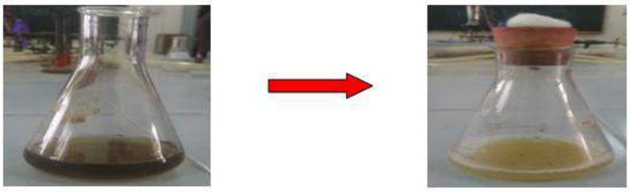
All the reagents used in the study were of analytical grade. Magnesium nitrate (Mg $(NO_3).3H_2O$) and NaOH was obtained from Sigma Aldrich. Datura stramonium fresh leaves were collected from the botanical garden of Shri Shivaji Science College, Amravati. All Solutions prepared from double distilled water.

### Preparation of Datura Stramonium leaves extraction

The collected Datura Stramonium leaves about 20-25 g were taken and thoroughly washed with distilled water and cut into small pieces then heated the leaves in 500 ml glass beaker along with 300 ml of distilled water for 30 minutes at $50^0$ C on magnetic stirrer with hot plate. After heating, the color of the aqueous solution changed from watery to brown color and then the solution allowed to cool at room temperature. The aqueous extract of Datura stramonium leaves were separated by filtration with Whatman No.42 filter paper. The filtrate were used for the synthesis of Magnesium Oxide nanoparticles.

### Synthesis of Magnesium Oxide nanoparticles

The precursor used for the synthesis of MgO nanoparticles are magnesium nitrate (Mg $(NO_3).3H_2O$), and NaoH. The MgO nanoparticles were synthesized by biosynthesis method. For the synthesis, the concentration of (Mg $(NO_3)._3$ $H_2O$) 0.1M, solutions were mixed with volume (20 ml) of the datura stramonium leaves extract. After few minutes added drop wise added 20 ml of 0.1 M NaoH. Then the solution kept in dark for overnight .The color of the solution changed from brown to yellow (Fig. 1) indicating the formation of magnesium oxides nanoparticles. The solid product was filtered and washed and then respective powder was exposed to reaction conditions by placing it in the furnace at 50° C for about 60 min, then it was allowed to cool at room temperature and obtained powder was crushed in motor and pestle.



Before adding Mg $(NO_3).3\ H_2O$ After adding Mg $(NO_3).3\ H_2O$

**Figure 1:** *Coloration obtained before and after adding Mg $(NO_3).3\ H_2O$*

## RESULT AND DISCUSSION

### X-ray diffraction

The XRD pattern of MgO nanoparticles obtained from sol-gel method were as shown in (Fig. 2). The existence of strong and sharp diffraction peaks located at the 2θ value of 37.10, 43.10, 62.50 corresponding to (1 1 1), (2 0 0) and (2 2 0) planes respectively indicated the formation of MgO. The result showed that the structure was in cubic structure and these results were matched with JCPDS data [JCPDS file: 45-0946]. The crystalline size of MgO calculated using Debye Scherrer formula,

$$D = \frac{0.89\,\lambda}{\beta \cos\theta}$$

Where K is a constant equal to 0.89, β is the full width half maximum height of the diffraction peak at an angle θ and λ is wavelength. The average particle size of the MgO nanomaterials was found to be ~70 nm.

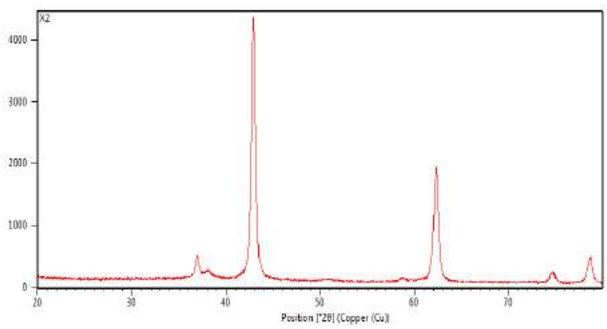



**Figure 2 :** *X-Ray diffraction pattern of biosynthesized MgO nanoparticles derived from Datura Stramonium leaves extract*

### FT-IR

FT-IR spectra of MgO particles are shown in (Figure. 2). In the wave number range 4000 to 400 $cm^{-1}$. The region between 3000- 4000 $cm^{-1}$ shows the stretching mode of vibration in hydroxyl group (O-H). Peak at 3698 $cm^{-1}$, 3616 $cm^{-1}$ and 3357 $cm^{-1}$ corresponding to the O-H stretching mode of hydroxyl groups. Peak at 1633 $cm^{-1}$ was attributed to the bending vibration of water molecule. The major peaks at 641 $cm^{-1}$, 659 $cm^{-1}$, 863 $cm^{-1}$ which confirmed the presence of Mg-O vibrations.

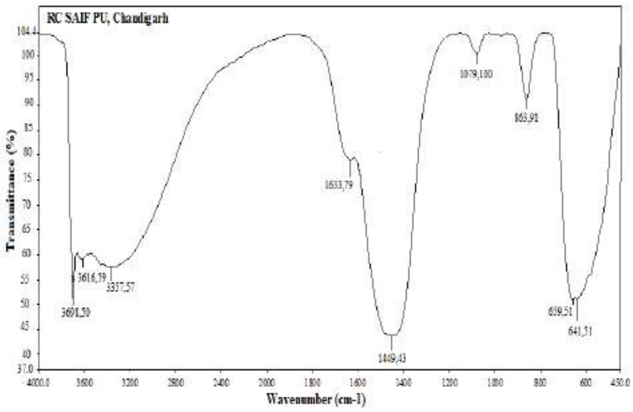



**Figure 3:** *Fourier transformed infrared spectroscopy ofbiosynthesized MgO nanoparticles derived from Datura stramonium leaves extract*

### Scanning electron microscopy (SEM)

Scanning Electron Microscopy (SEM) is a well-established technique used to study the topography, texture and surface features of powders. The SEM produces a three dimensional view of specimen and this is very useful in examining the shape and structure of a specimen.

FESEM images were measured and topographical analysis was performed based upon the surface study. The morphology of the biosynthesized MgO nanoparticles ware determined by scanning electron microscopy (SEM).

As shown in Fig. 4 (a,b) the SEM micrographs of these materials at different magnification indicate rod like structure and no agglomeration was found.

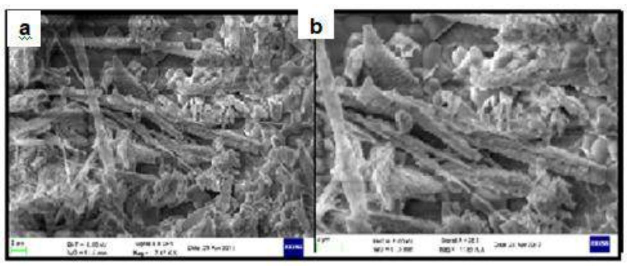



**Figure 4:** *Scanning electron microscopy of biosynthesized MgO nanoparticles derived from Datura Stramonium leavese xtract at different magnification*

### Antibacterial Activity Studies

The antibacterial activity of MgO nanoparticles derived from Datura stramonium leaves extract were done for Gram-negative *Escherichia coli* and Gram-positive bacteria *Staphylococcus aureus* by paper disc diffusion method. Nutrient agar media were used to cultivate bacteria.

### Preparation of inoculums

The test bacterial strains were transferred from the stock cultures as streaked on nutrient agar (NA) plates and incubated for 24 h. Well separated bacterial colonies were then used as inoculums. Bacteria were transferred using bacteriological loop to autoclaved nutrient agar that was cooled to about 450$^0$C in a water bath mixed by gently swirling the flasks. The medium was then poured to sterile Petri plates, allowed to solidify and used for the bio test.

A fresh culture of inoculums of each culture was streaked on nutrient agar media in a petridish. 10µL, 20 µL,30µL and 40µL aliquots containing 5 mg/mL as-synthesized titanium oxide nanoparticles were impregnated using micropipette on paper discs of 6 mm in diameter.

### Growth profile of Bacteria

After incubation to study the growth of bacteria inoculations were taken from fresh colonies. We tested the cultural broth solution was observed for turbidity and maintain the OD (Optical density) at 600nm in between 0.08- 0.1.

### Preparation of media

The growth media utilized in this study incorporate nutrient agar and nutrient broth. For sterilization the nutrient agar was sterilize at 15 Ibs pressure at 121$^0$C for 15 minutes and then cool at room temperature.

### Evaluation of antibacterial activities properties

All the dishes were sterilized in an autoclave and dry it in dry oven before the experiment. The ability of antibacterial agent to rupture the bacterial cell is tested by Kirby- Bauer disc diffusion method using the suspension of bacteria spread on nutrient agar. The tests done in triplicate set for excellent result. 25 ml of cooled nutrient agar media wear poured in the sterilized petri dishes and the plates wear left overnight at room temperature to check contamination to appear. Dip the swab in test organisms and remove excess fluid. Use the swab to prepare bacterial lawn on nutrient agar plate in three directions.

The discs can be placed on investigated agar surface using dispenser and the discs in each plate were loaded with 20 ul concentration of prepared nanoparticle. The inoculated plates were incubated at 370$^0$C in incubator for 24 hours. The antibacterial activity was by measuring zone of inhibition. Antibacterial activity of pure MgO nanoparticles was determined by Kirbey Bauer Disc diffusion method which shown in figure 5 and zone of inhibition obtained shown in following table 1.

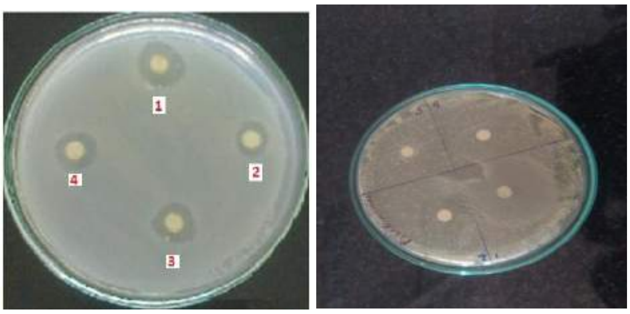



**Figure 5:** *Antibacterial activity of MgO nanoparticles against E.Coli and S.aureus*

**Table 1:** *Concentration and zone of inhibition of E.Coli and S. aureus*

| Concentration | E.Coli | S.aureus |
|---|---|---|
| 10 µl | 8.5 mm | 2 mm |
| 20 µl | 6 mm | 12 mm |
| 30 µl | 7 mm | ND |
| 40 µl | 8 mm | ND |

## CONCLUSION

The bio synthesis of MgO nanoparticleswas carried out in aqueous medium using Datura stramonium leaves extract. The prepared bio synthesized nanoparticles of MgO nanoparticles are confirmed by colour changes and it has been characterized by XRD, FTIR, SEM and antibacterial activity. Its size approx.70nm was confirmed by X-ray diffraction study. The bonding was confirmed from FTIR study as it has shown different peaks confirming the presence of different functional groups and bonding. SEM shows that the bio synthesized nanoparticles were rod like structure, The Antibacterial activity shows that the bio synthesized nanoparticles shows the bacterial activity against Gram-negative Escherichia coli and Gram-positive bacteria Staphylococcus aureus by paper disc diffusion method and shows good zone of inhibition. This results shows that the bio synthesized nanoparticles found to have some medical application and are eco-friendly.

## ACKNOWLEDGEMENT

The authors are also indebted to Principal, Dr. V. G. Thakare, Shri Shivaji Science College Amravati, India for his kind cooperation during this project work.

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