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Synthesis and Characterization of MgO Nanoparticles by Orange Fruit Waste through Green Method

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Abstract: *The synthesis of metal oxide nanoparticles with the use of fruit waste is a promising alternative to traditional chemical methods. Generally various synthesis techniques are available to prepare MgO nanoparticles. Present work focus on synthesis of magnesium oxide nanoparticles by orange fruit waste from green method. It acts as reducing agent for synthesis of MgO because orange fruit contain Citric acid, as main source in its peel. This method is non-toxic and eco-friendly. The biologically synthesized MgO nanoparticles were characterized by UV–Visible spectroscopy to analyse the absorption patterns, Fourier transform infrared spectroscopy (FTIR) is used for analysing the functional groups and scanning electron microscopy (SEM) and transmission electron microscopy (TEM) for morphological studies. MgO nanoparticles also exhibit very good antimicrobial and antibacterial properties.*

Keywords: *Green Synthesis, Magnesium oxide nanoparticles, Orange peel extract*

1. INTRODUCTION

Green nanoscience and nanotechnology are growing very fast today. Scientist and chemist are focusing on this, and their applications. Nanoparticles are those particles which has dimension between 1 and 100 nanometers in size [1]. An important aspect of nanoscience is related to the design of experimental methods for the synthesis of nanoparticles (NPs) of different chemical composition, size, shape and properties. Recently, researchers have tried to find biological methods for the synthesis of nanoparticles that will be the alternative to chemical or physical methods. Biological methods for the production of NPs are considered safe and environment friendly; they are also cost effective and ensure the complete elimination of toxic chemicals [2, 3].

Green synthesis of nanoparticles is eco-friendly [4] avoiding traditional harmful practices and so many people have success in the synthesis of nanoparticles using extracts from different parts of plant (leaves, stem, flowers, and fruits) [5-7]. In this current literature, MgO nanoparticles were synthesized using Green synthesis method in which magnesium acetate is used as initial precursors and Orange fruit waste (peel). Plant extract may be act as oxidising as well as reducing agent [8]. By Nature Orange peel is light yellow in colour, which gives absolute protection for the inner part of fruit from outer world. It can acts as reducing agent for synthesis of various metal oxides like MgO, TiO_2, ZnO etc, as it contains Citric acid as main source [9]. Water is used for the synthesis process to reduce the harmful effect of traditional chemicals like methanol [10-13] ethanol [14,15]and ethyl acetate[16].Orange peel can be used in a range of products viz bath oil, room freshen air, face creams, mosquito repellent and weight loss products.

2. METHODOLOGY

All the chemicals used in our research work were of analytical grade and were purified before use.

Synthesis of MgO-NPs

The synthesis Procedure consists of three simple steps:

(i) Preparation of Orange Peel extract

(ii)Preparation of Magnesium nitrate solution

(iii)Green synthesis of MgO-NPs

2.1. Preparation of Orange Peel Extract

Orange peel was collected and converted it into the powdered form by crushing (figure 1). 10g of orange peel powder and 100ml of deionised water were taken into a 250ml beaker. Then, the solution was refluxed for 1hr. The extract was filtered through Whatman filter paper.

2.2. Preparation of Magnesium Nitrate Solution

A magnesium nitrate solution was prepared by adding 5g of magnesium nitrate in 100ml deionized water.

2.3. Synthesis of MgO-NPs

Peel extract was added into the magnesium nitrate solution (figure 2) and then sodium carbonate solution was added drop wise into it. The magnesium nitrate solution was reduced to Magnesia or Magnesium oxide which was indicated by colour change (figure 3). Particle formation takes place within the solution and stirring was continued for 4 hrs by using magnetic stirrer. The pH of the solution was maintained 12 by addition of sodium carbonate solution. In this period, nanoparticles formation occurs and they were settled at the bottom of the flask. After that, the solution was centrifuged for 5 minutes at 5000rpm/min. Then, nanoparticles were filtered and air dried for overnight.

Fig1. *Collected Orange peel powder and its abstract*

3. RESULT AND DISCUSSION

The white coloured Magnesium Oxide nanoparticles were obtained by green synthesis method using Magnesium Nitrate **(**Mg $(NO_3)_2$**)**, Sodium Carbonate **(**Na_2CO_3**)** and Orange peel extract. The synthesized nanoparticles were characterized by different analytical techniques such as UV-Vis, FTIR, SEM and TEM.

3.1. UV-Visible Absorption Spectroscopy

UV-Vis absorption spectroscopy is most widely used analytical technique for characterizing the electronic structure of the optical band gap of the nano material. The UV-Vis spectra of metal nanoparticles were recorded in the wavelength range 200nm to 800nm used to characterizing the size of nanoparticles in the range of 5-100nm.Ethanol was used as a solvent in absorption spectrum of MgO nanoparticles (fig.2). The spectrum shows (figure) a strong band in the UV region due to the charge transfer transition between energy states. Firstly the absorbance decreases sharply with increases in the wavelength near the band edge 250nm indicated the size of MgO nanoparticles.

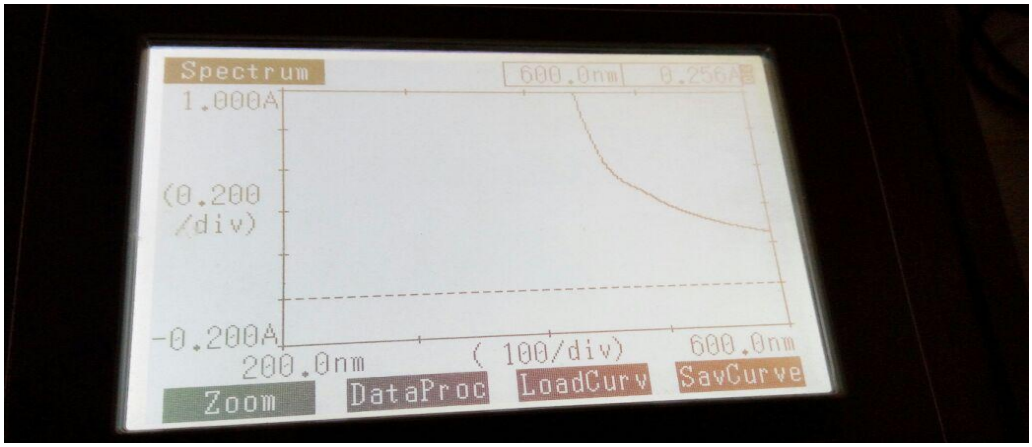

Fig2. *UV-Vis spectra of metal nanoparticles*

3.2. Fourier Transform Infrared (FTIR) Spectroscopy

The FTIR spectroscopy used to determine the vibrational frequency of stretching and bending modes of the molecules as well as possible bio molecules which are responsible for the reduction and capping of MgO NPs. The spectra of MgO nanoparticles shown in the figure and the analysis done in the range of 400-4000cm^{-1} (fig.3). The peaks at 3415cm^{-1}, 2925cm^{-1} represents the stretching vibration of O-H group. The peak at 1633cm^{-1} represents the stretching vibration of aromatic C=C bond. The peak observed at 434cm^{-1} represents the formation of MgO-NPs.

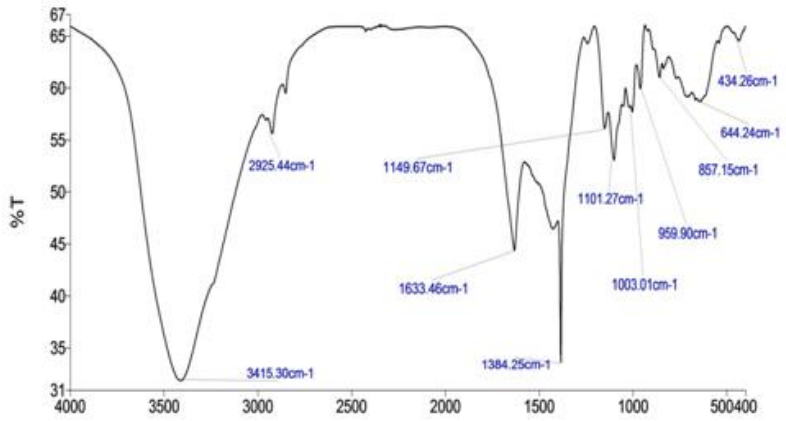

Fig3. *FTIR spectra of MgO nanoparticles*

3.3. SEM and TEM Characterization

The (figure 4) presents the scanning electron microscopic (SEM) image for the characterization of MgO NPs synthesis using orange peel extract , where the scale bar is 500 nm and the nano particles

formed are agglomerated forming cluster. The (figure 5) present the transmission electron microscopy (TEM) for the characterization of MgO nanoparticles synthesised by orange peel extract, as TEM is a very important methodology to define the particle size distribution, mean particle size and shape of NPs. TEM analysis confirm that the synthesised nanoparticles are spherical and size less than 10 nm.

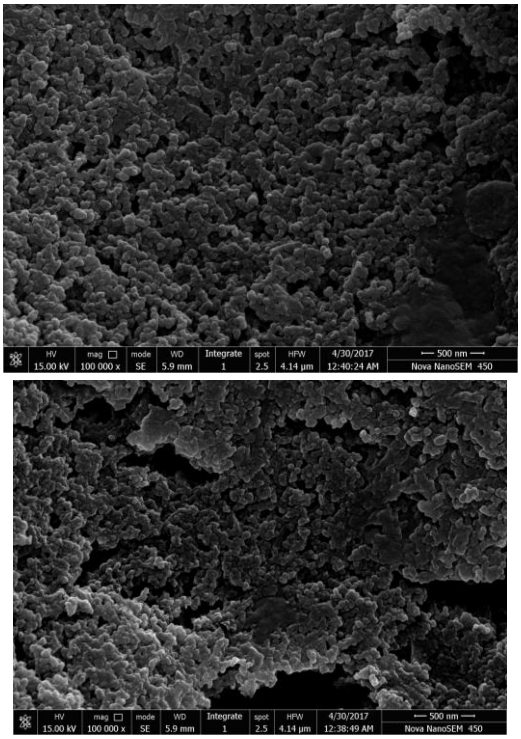

Fig4. *SEM images of MgO nanoparticles*

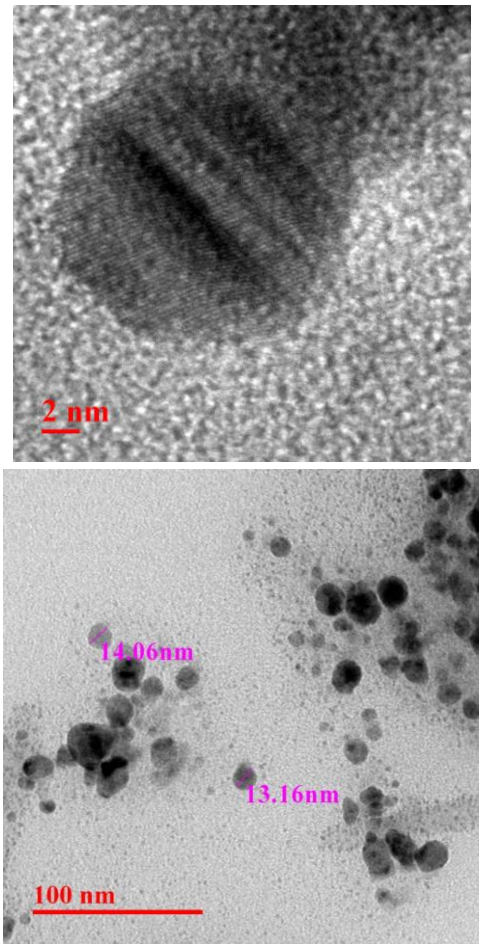

Fig5. *TEM images of MgO nanoparticles*

3.4. Antimicrobial Activity

The agar diffusion assay is a fast and simple to estimate the susceptibility of microorganisms toward an antimicrobial agent such as MgO. This test is based on the diffusion of the Nonmaterial's from high concentrations (disk or filter paper) to the agar surface. It allows only a qualitative result about the susceptibility of the microbial strain. For fast grower microorganisms such as what we used in this study, the results interpreted after 24 h. incubation at 37°C, if the MgO has activity, clear zones (no growth of microorganism) will be observed around the disk or filter paper.

Fig6. *Antimicrobial activity of MgO nanoparticles*

The presence or absence of growth inhibition zone was interpreted as sensitive or resistant of microorganisms to the MgO agent. E. coli and P. aerogenosa are Gram negative bacteria, facultative anaerobic, motile, non-sporulation and cells are typically rod-shaped while S. aureus and S. faecalis are Gram positive bacteria, facultative anaerobic, nonmotile, non-sporulation and cells are typically spherical-shaped. The cell wall is different between both types; Gram negative bacteria possess a thin peptidoglycan layer with another layer structured called the outer Lipopolysaccharide membrane (LPS) whereas Gram positive bacteria possess a thick peptidoglycan layer and no outer lipopolysaccharide membrane. The cell wall is very important because it can serve as a resistant barrier to some particles and other cells or it can be serve as a target for many antibiotics. A cell wall lets a bacterial cell have its defining shape. The results shows that MgO (both if it was apply as disk or filter paper immersed into MgO solution) affected more on Gram positive bacteria, which not have the outer lipopolysaccharide membrane in their cell wall, than Gram negative bacteria and fungi.

3.5. Antibacterial Activity

First of all prepare antibiotic assay media and autoclave it. Wait till it comes at room temperature. Inoculate culture of *E.coli* which is in slant (add 0.9 percent peptone in slant and mix it). After that add culture in media and pour plates, when plates will be solidified prepare cavity on it with the help of borer. Prepare four cavities in each plate this is procedure of plating, pouring and cavity formation. We have to prepare that compound dilution or ex-streptomycin drug dilution against *E.coli*.

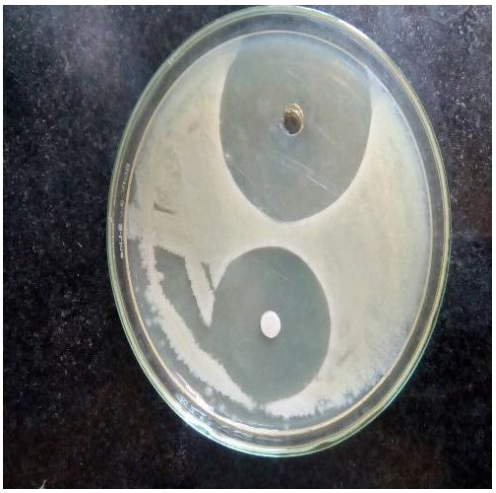

Fig7. *Antibacterial activity of MgO nanoparticles*

Take 50 mg of sample of standard and take 50 mg of sample of test. Prepare 1:4 or 1:2 ratio of that dilution(20-40 mcg or 20-80 mcg), and inject these dilution into the cavity in plate and inject 100 micro liter sample into each cavity but mention the test higher or test lower and also mention the

standard higher or standard lower. After that inoculation, incubate the plates into the incubator temperature is 30-35^{0C} or incubate for 24 hrs. After that incubation zone arises in the plate at the position in which we inject that dilution in four corners of plates on that cavity. First of all it should be confirm that the inject 20 mcg dilution is lower otherwise inject 80 or 40 that is higher one and have bigger zone than lower one because of the dilution concentration is more in higher. After that measure the zone in mm from scale.

4. CONCLUSION

Biocompatible and rapid synthesis of silver nanoparticles using the orange peel extract is demonstrated with possible role of different phytochemicals as reducing and stabilizing agent. The present investigation provides a new possibility for synthesis of silver and antimicrobial activity using natural product.

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