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RESEARCH ARTICLE

COMPARATIVE STUDY OF GREEN SYNTHESIZED MAGNESIUM OXIDE NANOPARTICLES FROM *AMARANTHUS BLITUM* AND *ALOE VERA* AND ITS APPLICATION IN WATER TREATMENT

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ABSTRACT

Green synthesis is an effective concept towards ecofriendly synthesis, as chemical synthesis is toxic and harmful. The work focuses on the green synthesis of magnesium oxide nanoparticles from red spinach and *Aloe vera* with magnesium nitrate as precursor of magnesium. The UV-Visible Spectroscopy and Scanning Electron Microscopy (SEM) were performed for characterization of nanoparticles. The synthesized magnesium oxide nanoparticles are implemented in the treatment of polluted water. The bacteria were isolated from polluted water and antibacterial susceptibility test was performed to measure the zone of inhibition. Thus, the present study mainly focuses on the treatment of polluted water using magnesium oxide nanoparticles.

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INTRODUCTION

Water is necessary for sustaining life on Earth. About 70% of Earth's surface is water of which 97.5% is salty water and 2.5% is fresh water. Less than 1% of this 2.5% amount of fresh water is accessible. Pollution reduces the availability of water for human use. Chemical pollutants, microbial contamination and increase concentration of organic mattes can result health problems (Mishra, 2015). The major microbial pathogens in water are bacteria, virus, fungi and protozoan parasites. Bacterial pathogens are mostly present in feces and wide variety can be present in waste water due to fecal contamination (Tomilola Debby olaolu, 2014). The discharge of untreated or inadequately treated waste water into environment can have negative impact on human health due to release of pathogenic microorganisms into water which could lead to serious health diseases (Rosario *et al*., 2009). The main aim of this project is use of nanotechnology in polluted water treatment. Nanotechnology has provided innovative solutions for water treatment. Nanoparticles can be synthesized by chemical methods and biosynthetic method. The green synthesis of nanoparticles is safer compared to harmful chemical methods. In the current project, magnesium oxide nanoparticles were synthesized from*Amaranthus blitum* (red spinach) and *Aloe vera*. Magnesium oxide nanoparticles are very effective biocides against Gram positive and Gram-negative bacteria and bacterial spores (Stoimenov *et al*., 2002). Halogens such as chlorine (Cl) and bromine (Br) are well known and widely used as antibacterial agents, but direct use of halogens as bactericides has many problems because of their high toxicity and vapour pressure in pure form (Nagappa, 2007). Nanomaterials reveal good result then other techniques used in water treatment because of its high surface area (surface/volume ratio) (Mamadou, 2005). The synthesized magnesium oxide nanoparticles were characterized by UV-Visible absorption spectroscopy and scanning electron microscopy and used for water treatment.

MATERIALS AND METHODS

Sample Collection:*Amaranthus blitum* (red spinach) and *Aloe vera*was purchased from Koyambedu market, Chennai. The polluted water collected from Ambattur lake, Chennai.

Synthesis of magnesium oxide nanoparticles: The aqueous extracts of red spinach and *Aloe vera* were prepared. 50ml of *Amaranthus blitum* extract or *Aloe vera* extract was added to

50ml of 1N magnesium nitrate solution and subjected to magnetic stirring at 80°C. 2ml of sodium hydroxide solution was added and filtered. The residue was dried completely to obtain magnesium oxide nanoparticles.

Characterizationof magnesium oxide nanoparticles

UV-Visible absorption spectroscopy: The UV-visible absorption spectrum of magnesium oxide nanoparticles was analyzed using Infra-Digi Microprocessor UV-Vis Double beam spectrophotometer IR-513D. UV-Visible spectra were recorded at range of 240-780nm and the absorption peak was obtained and maximum absorbance was noted.

Scanning electron microscopic analysis: The scanning electron microscopic study was carried out for magnesium oxidenanoparticles. The size and shape of the nanoparticles were predicted.

Water treatment using magnesium oxide nanoparticles: The bacteria were isolated from the polluted water by serial dilution method and sub cultured. The pure culture was obtained by streak plate technique. The susceptibility test was carried out for the isolated bacterial strains with the synthesized magnesium oxide nanoparticles with net concentration of 250mg/ml for different volumes of 10µl, 20µl, 30µl and 40µl. The zone of inhibition was measured.

RESULTS

The synthesis of magnesium oxide nanoparticles in *Amaranthus blitum* extract was predicted by the colour change from red to yellow. Similarly, in the *Aloe vera* extract by the colour change from yellow to whitish brown. The UV-Visible absorbance spectral peak for *Amaranthus blitum* was obtained at wavelength of 240nm. Similarly, the UV-Visible absorbance spectral peak for *Aloe vera* was obtained at 325nm (Figure.1a, b). The morphological features of synthesized MgO nanoparticles from *Amaranthus blitum* and *Aloe vera* were analyzed by SEM with different magnification and the images are shown in Figure 2a,2b.

Shperical shaped nanoparticles were observed and sizes of MgO nanoparticles were around 26-50nm. The surface analysis revealed the presence of synthesized nanoparticles in aggregated form. Five bacterial strains were isolated from the polluted water (Table 1). The green synthesized magnesium oxide nanoparticles from *Amaranthus blitum* and *Aloe vera* possesses good antibacterial activity. The susceptibility test of magnesium oxide nanoparticles from*Amaranthus blitum* and *Aloe* vera resulted 21mm and 18mm in diameter respectively as maximum zone of inhibition at volume of 40µl for thin filamentous bacterial colonies (Figure3).

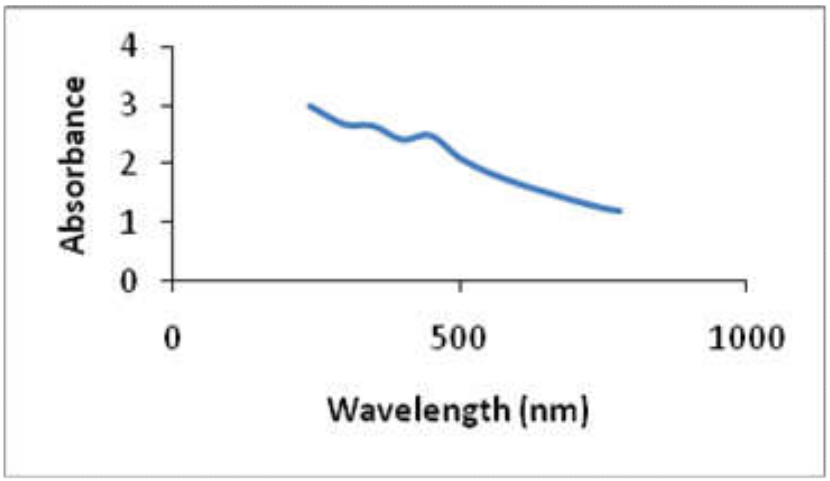

Figure 1a. UV- Visible Spectrum of *Amaranthus blitum*

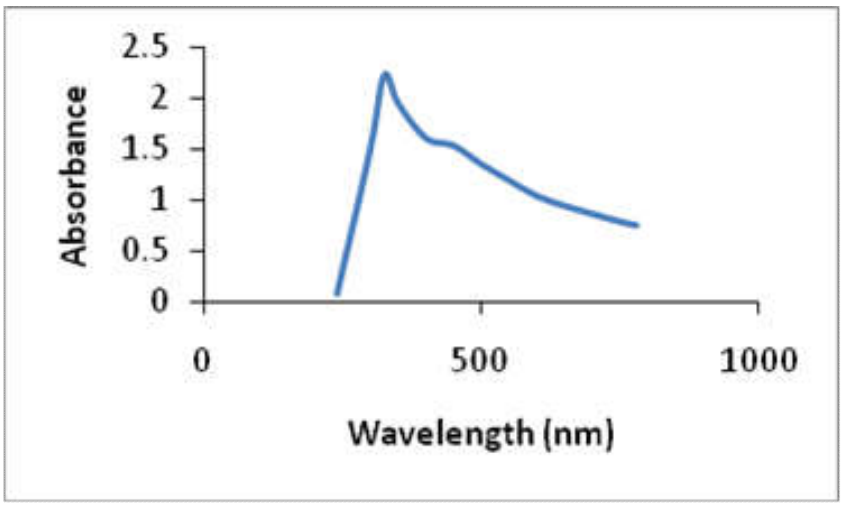

Figure 1b. UV- Visible Spectrum of *Aloe vera*

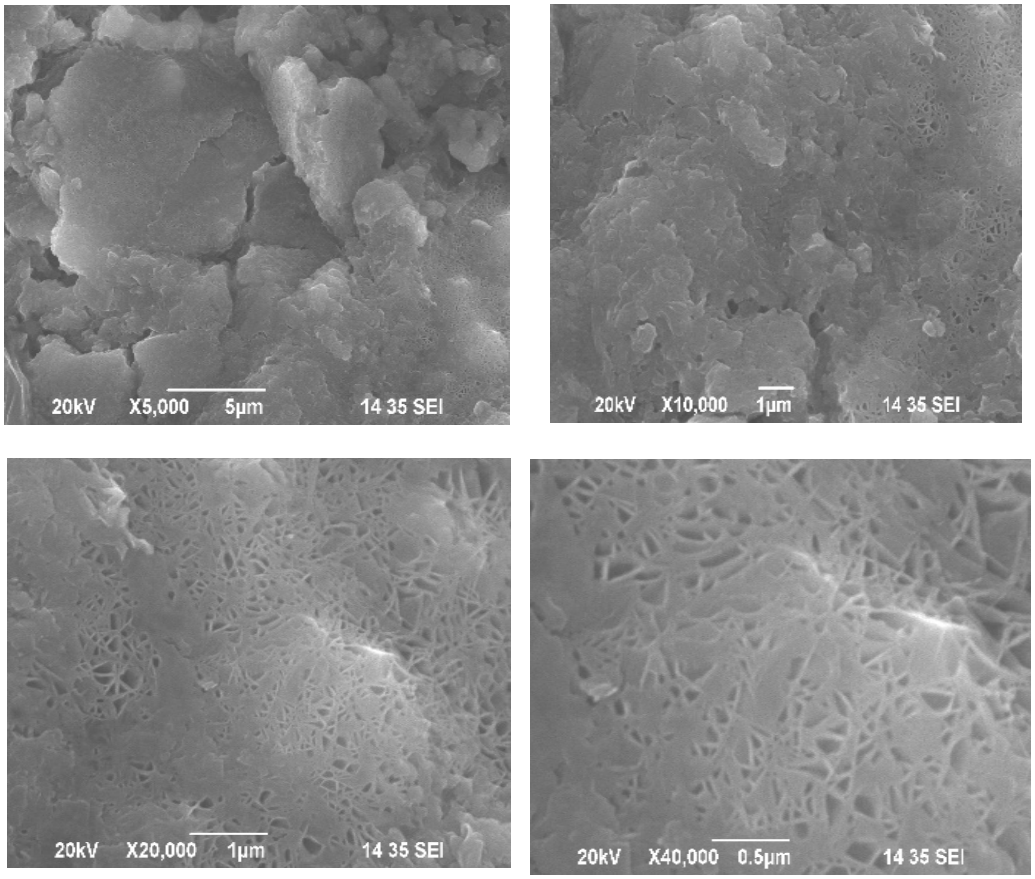

Figure 2a. SEM image of magnesium oxide nanoparticles from *Amaranthus blitum*

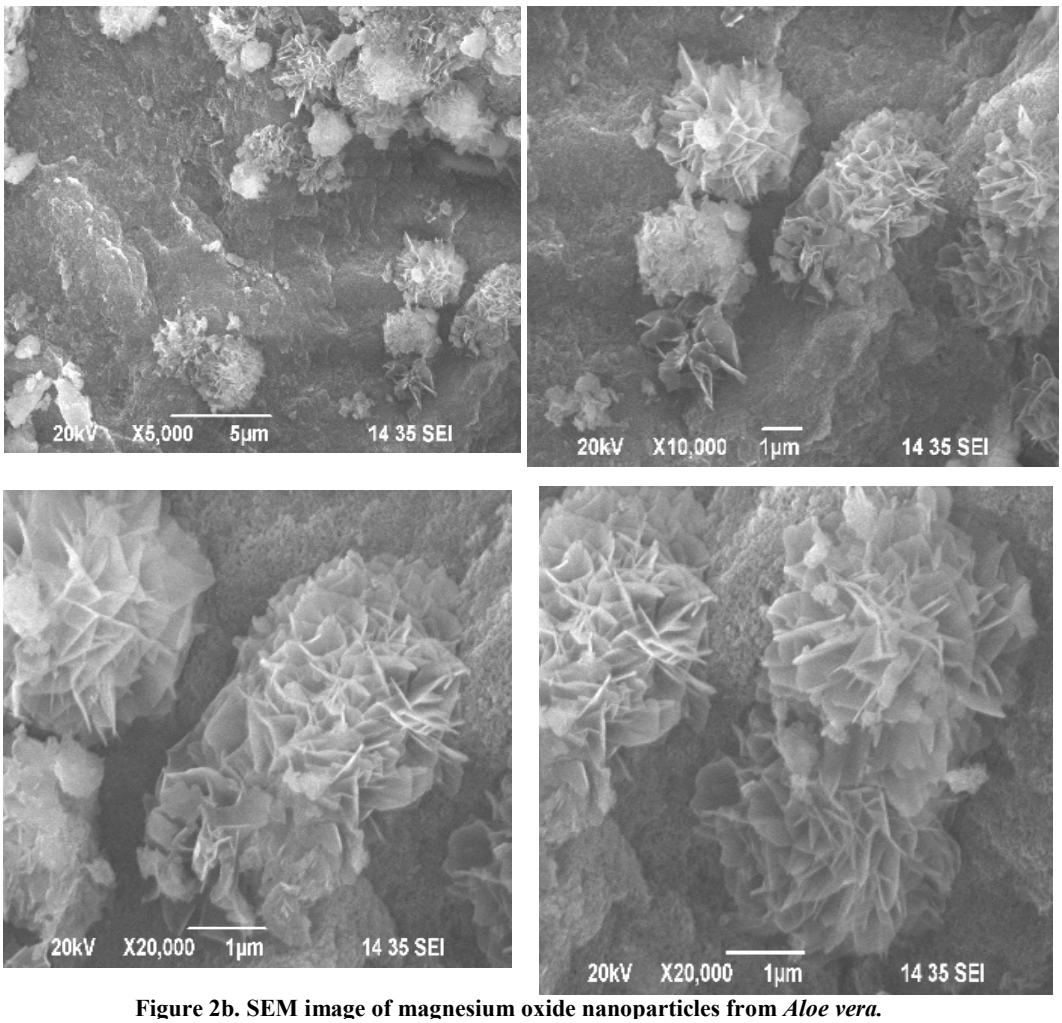

Figure 2b. SEM image of magnesium oxide nanoparticles from *Aloe vera.*

Figure 3. Antibacterial susceptibility test

Table 1. Isolated bacteria and their antibacterial activity

Bacterial colonies	Zone of inhibition (mm in diameter)							
	10µl		20µl		30µl		40µl	
	1	2	1	2	1	2	1	2
Thin filamentous	6	3	11	6	13	13	21	18
Orange	3	0	6	7	9	9	13	12
Filamentous	2	2	6	10	10	8	13	14
White concentric	1	5	3	8	9	10	16	15
White sticky	3	8	2	10	10	11	13	14

*1 - *Amaranthus blitum* 2- *Aloe vera*

DISUCSSION

Suresh J. *et al.,* reported the surface morphology of magnesium oxide nanoparticles synthesized from *Nephelium lapaceum* were in form of assemblies of nanoparticles having round shape which were uniformly distributed over the entire surface (Suresh *et al*., 2014). Renata Dobrucka concluded the presence of magnesium oxide nanoparticles from *Artemisia abrotanum* with UV-Visible spectral peak at 300nm and synthesized magnesium oxide nanoparticles were dispersed as agglomerated clusters from SEM micrography (Renata Dobrucka, 2016). SEM analysis showed the presence of MgO nanoparticles, which consist of either single or cluster of particles and they have nonuniform distribution of spherical particles (Devaraja *et al*., 2014). Cubic shaped uniform MgO nanoparticles are in between 30 and 55nm and appeared as dense particles (Suresh, 2013). Sharma Gaurav *et al.,* reported the photo assisted synthesis of magnesium oxide nanoparticles with *Swertia chirayaita* and its antibacterial activity against Gram positive andGram-negative bacteria. The maximum inhibition of growth occurred at dose of 40µl and also reported the spherical shaped magnesium oxide nanoparticles from SEM micrography (Sharma Gaurav *et al*., 2017).

Anantharaman Ashwini*et al.,* reported the synthesis of magnesium oxide nanoparticles using *Aloe vera* and surface morphology of magnesium oxide nanoparticles as aggregated dense rock shaped flakes uniformly distributed on the entire surface (Anantharaman Ashwini *et al*., 2016).

Conclusion

The present study focused on the green synthesis of magnesium oxide nanoparticles from *Amaranthus blitum* and *Aloe vera*. The synthesized nanoparticles were characterized by UV visible spectophotometry and SEM and its application such as antibacterial susceptibility test was observed for water treatment. From the antibacterial susceptibility test it is concluded that the magnesium oxide nanoparticles from *Amaranthus blitum* showed more antibacterial activity than compared to *Aloe vera*. Thus magnesium oxide nanoparticles from *Amaranthus blitum* can be used for the treatment of polluted water.

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