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Research Article

SOLUTION COMBUSTION SYNTHESIS OF ALUMINIUM OXIDE NANOPARTICLES BY USING FUEL WEED PLANT PARTHENIUM HYSTEROPHORUS L AND IT'S ANTIBACTERIAL ACTIVITY

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A B S T R A C T

This study aims to synthesis inexpensive and eco-friendly Aluminium oxide nanoparticles from parthenium hysterophorus L. (weed plant) by simple solution combustion method. It is applied to test the antibacterial activity the nanoparticle. Aluminium oxide nanoparticles were characterized by UV–Vis absorption spectroscopy, X-ray diffraction (XRD), scanning electron microscopy (SEM) and energy dispersive X-ray analysis (EDX). The antibacterial activity of the aluminium oxide nanoparticles was performed by using agar well diffusion method against *Pseudomonas areginosa* and *Escherichia coli*.

INTRODUCTION

In recent years implementation of new technologies have led to new era, the nano-revolution of research with tremendous applications for society, industry and medicine which unfolds role of plants in bio and green synthesis of nanoparticles (Anuradha *et al*.,2014; Kavitha *et al*.,2013). Nanoparticles are fundamental building blocks of nanotechnology (Kalaiselvi *et al*., 2013). Nanoparticles exhibit completely new or improved properties based on specific characteristics such as size, distribution and morphology and the new applications of nanoparticles and nanomaterials are emerging rapidly (Veerasamy *et al*.,2011). The non-polluting nanotechnologies have revolutionized the production of nanomaterials as environmentally safe products. Many chemicals used in chemical and physical synthesis of nanoparticles are toxic which leads to environmental pollution. Therefore biological sources can be an alternative for the synthesis of nanoparticles (Anuradha *et al*., 2014). In general, alumina has many interesting properties such as catalyst, as high stability and hardness, insulation, surface protective coatings, as composite materials with tunable mechanical properties, etc (Sutradhar *et al*.,2013).

Parthenium hysterophorus L. from the family of Asteraceae, popularly known as Congress weed, Carrot weed, Star weed, Fever few, White top, Chatak Chandani, Bitter weed and it is one of the 10 worst weeds in the world, which is a poisonous, pernicious and aggressive weed and is reported to have pharmacological properties against many diseases such as rheumatism, hepatic amoebiasis and tumours. Parthenium is also known tocause allergy and toxicity in animals. It causes contact dermatitis in livestock and is reported to be poisonous to sheep. Humans are also affected by this weed with respiratory malfunction and dermatitis. South American Indians use the decoction of roots to cure amiboic dysentery. The ability of its seeds to germinate in any season of the year, makes it a constantly flourishing component of the vegetation (Parashar *et al*., 2009; Rajiv *et al*., 2013; Krishnavignesh *et al*.,2013).

Researchers have (Rajiv *et al*.,2013) synthesized the zinc oxide nanoparticles and tested the antifungal activity many other researchers have synthesized the silver nanoparticles and tested the Anti-Microbial Activity(Ananda, 2013; Srinivasan, 2015) *in vitro* antagonistic applications, (Thombre *et al*.,2013) anti-bacterial and antioxidant activity, (Kalaiselvi *et al*.,2013) and also phyto-chemical screening and antimicrobial activity (Krishnavignesh *et al*.,2013). The current study aims to the synthesis, characterization and antibacterial activity of aluminium oxide nanoparticles.

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MATERIALS AND METHODS

Preparation of the Extract

Parthenium hysterophorus L. was collected from Bioscience Complex Kuvempu University Shankaraghatta, Shivamogga District, Karnataka, India during 2017 after flowering stage, the whole plant. Then it was cut into pieces weighing 25 grams and it was boiled in water for 5 minutes in a 500ml Erlenmeyer flask. Later the whole thing was filtered.

Preparation of Alminium oxide Nanoparticles

For the synthesis of NPs, 50 mL of *Parthenium hysterophorus* L. plant extract was taken and boiled at 60–80°C by using a stirrer-heater. Aluminium nitrate was purchased from Hi-media Chemicals Mumbai. Then, 5g of aluminium nitrate was added to the solution. With slight modification (Ramesh *et al*.,2015), then keep it for 24hrs incubation and color changes to deep yellow colored suspension. After 24hrs incubation the solution was taken in a silica crucible (with volume of $100cm^3$) crucible was then introduced into the muffle furnace for calcination which was preheated to 600°C. The solution boils and undergoes dehydration followed by decomposition along with the release of certain amounts of gases it froths and swells forming foam which ruptures with a flame and glows to incandescence. The product obtained after calcinations, crushed in a mortar to make it amorphous and used for further characterization.

Characterization of Nanoparticles

The synthesized nanoparticles were characterized by UV Absorption spectroscopy, Scanning electron microscopy (SEM), X-Ray Diffractometer analysis, Energy Dispersive X-ray analysis (EDX).

Antibacterial Activity

The antimicrobial activity was tested against Microbial Type Culture Collection such as *Escherichia coli* and *Pseudomonas areginosa*, which were collected from Department, of Botany Kuvempu University, Shankaraghatta, Shivmoga, Karnataka, India. Different concentrations of (25, 50, and 100 µg/ml) of aluminium oxide nanoparticles were suspended in Dimethyl sulfoxide (DMSO) solution. Antibacterial activity was evaluated to determine the minimum inhibitory concentration (MIC) of the aluminium oxide nanoparticles inhibiting the growth of bacteria.

RESULT AND DISCUSSION

Scanning Electron Micrograph (SEM)

The powdered sample was examined by SEM technique which allows to determine the physical morphology of the synthesized aluminium oxide nanoparticles.

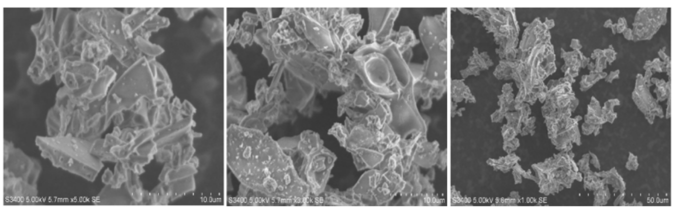

Fig 2 Scanning Electron Micrographs of synthesized nanoparticle

Images obtained by SEM analysis reveal the Sharpe edged, and plate like structures which looks like a colony. The enlarged image shows the uneven size and shape of the nano-particles, which also reveals that, the agglomeration of nano-particles presented in Figure 2.

UV Absorption spectroscopy

The absorbance spectrum of synthesized Aluminium oxide was recorded using UV-VIS spectrophotometer (Ocean Optics DH-2000) over the wavelength range 200-1200nm. The band gap energy of the Aluminium oxide nanoparticle was calculated using the following simple

$E = hC/\lambda$ ----- (4)

h = Planck's constant,

C = Velocity of light,

λ = wavelength,

$h = 4.135\times10-15$ eV,

$C = 3\times108$ m/s, $\lambda= ---\times10-9$nm

Band gap energy (eV) = $4.135\times10-15\times3\times108\times109$

Band gap energy (eV) = 1240/wavelength (nm)

The band gap energy of Aluminium oxide nanoparticle was 3.0eV.

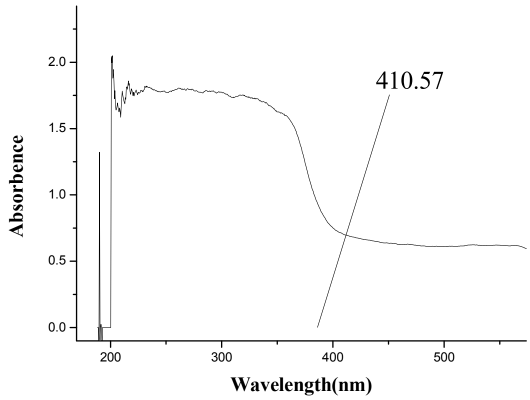

Fig 4 UV-absorption spectra of synthesized Nanoparticles

X-ray diffraction technique (XRD)

X-ray diffraction is a versatile, nondestructive that reveals detailed information about the chemical composition and crystallographic structure of natural and manufactured materials. XRD was performed by Rigaku diffractometer using Cu-K_α radiation (1.5406 Å) in a θ-2θ configuration. According to Debye Scherrer's formula:

$D=K\lambda/\beta\cos\theta$ ------------ (Eq. 2)

Where D = Thickness of the crystallite

K = 0.90 the Scherrer's constant (dependent on crystallite shape)

λ = X-ray wavelength

β = the peak width at half-maximum (FWHM)

θ = the Bragg diffraction angle

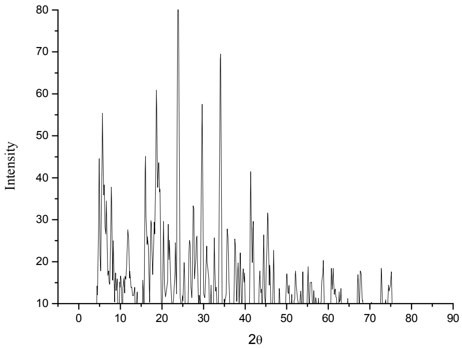

Fig 3 XRD of the synthesized nanoparticles

In the present work, the powdered sample of newly synthesized aluminium oxide nanoparticle was examined by XRD studies and the average crystallite size of aluminium oxide was found to be 24nm.

Energy Dispersive X-ray (EDX)

Energy Dispersive X-ray (EDX) spectrometer analysis is confirmatory presence of elemental aluminium, carbon and Oxygen signals of the aluminium oxide NPs. The vertical axis displays the number of x-ray counts although the horizontal axis displays energy in KeV (Fig. 5). The weight and atomic percentage of carbon, Oxygen, aluminium found to be 26.10%, 52.94%, 17.93%, and 34.92%, 53.16%, 10.68% these corresponds, the spectrum without impurities of potassium peaks was observed (Parthibana and Sundaramurthy,2015; Santhosh *et al*.,2017).

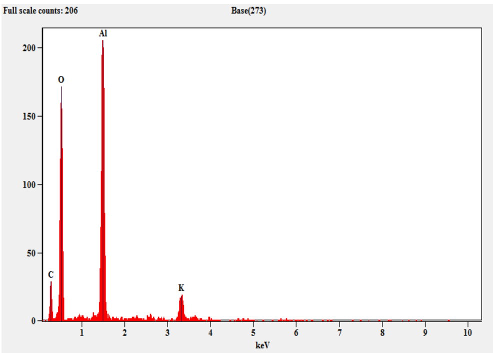

Fig 5 Energy Dispersive X-ray of synthesized Nanoparticles

Antibacterial Activity

Agar well diffusion method

Chemical composition, concentration, size, shape, and photo-activation are some of the factors that influence antimicrobial properties of nanoparticles. (Sudhasree *et al*., 2014) The antibacterial activity of the aluminium oxide nanoparticles was performed by using agar well diffusion method (Chaudhary *et al*., 2015) against *Pseudomonas areginosa* and *Escherichia coli.* Triplicates plates of Nutrient agar were prepared in sterile conditions and spread plate method was finished using sterile L-shaped glass rod with 100 ml of 24 h old broth culture of respective bacterial strains. Wells (6 mm) were made into each petri-plate using the sterile cork borer. (Suresh *et al*., 2015) The zone of inhibition was measured and expressed as millimeter in diameter.

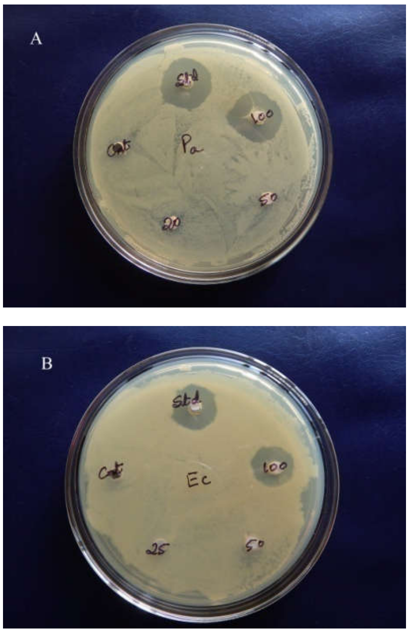

Fig 6 Antibacterial activity of synthesized nanoparticles A (*Pseudomonas areginosa*) B (*Escherichia coli*)

Antimicrobial activity of aluminium oxide nanoparticles were tested against two human pathogens *Pseudomonas areginosa* and *Escherichia coli*. Aluminium oxide nanoparticles inhibited on *Pseudomonas areginosa* by 15mm, while standard showed 20mm inhibition, *Escherichia coli* showed 12mm inhibition, while standard showed 18mm inhibition. These two human pathogens are compared with standard antibiotic Amoxycilin. The result of nanoparticle gives promising antibacterial activity which may be base for new antibiotic development (Chaudhary *et al*., 2015; Venkatesan *et al*.,2015).

CONCLUSION

From this experiment, we successfully synthesized aluminium oxide nanoparticles by using weed plant *Pathenium hysterophorus* L. The obtained aluminum oxide nanoparticles were characterized by SEM, XRD, EDAX and UV Absorption spectroscopy. The results showed that, the average size of nanoparticle was found to be 24nm and band gap was found to be 3.0eV. The antibacterial activity test against two human pathogens *Pseudomonas areginosa* and *Escherichia coli* compared with standard antibiotic amoxycilin. Hence, this experiment is a new route to make mark in the field of antibacterial activity.

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