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Antibacterial Activity of Cadmium Oxide Nanoparticles

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Abstract

In this study Antibacterial activity of Cadmium oxide nanoparticles were investigated by using various pathogenic bacteria. Cadmium Oxide nanoparticles were synthesized by using *Cassia auriculta* flower extract. The flower extract acts as both reducing and stabilizing agent for the synthesized nanoparticles.TEM analysis revealed rod shape of cadmium Oxide nanoparticle.EDAX analysis proved the presence of cadmium and oxygen and atomic percentage of Cadmium and oxygen is 12.43% and 87.57% respectively in cadmium Oxide nanoparticles.

Keywords Cadmium Oxide, Nanoparticles, *Cassia auriculata*, Antibacterial

1.Introduction

Nanotechnology is naturally very broad including fields of science such as surface science, organic chemistry,molecular biology,semiconductor physics,energy storage,[1,2] micro fabrication,[3] molecular engineering,.[4],Opto electronic [5] etc.Metal oxides such as CdO, TiO_2 play a important role in many areas of chemistry, physics and materials science [6,7]. The metal elements are able to form a large diversity of oxide compounds [8]. CdO nanopowders possess excellent photocatalytic and antimicrobial activities due to their surface characteristics, shape and size[9].The pathogen-sized proportions make the nanoparticles prime candidates for the fight against various unwanted invaders of the human body. They can be injected into bloodstream to fight viruses and bacteria in much the same way as immune system's helper-Tcells.Many researchers used green synthesis methods for different metal nanoparticles due to their eco-friendly properties [10].In this work,we report synthesize of CdONPs using the Flower extract of *Cassia auriculata.*

2. Materials and Methods

2.1. Materials

In the present work all the chemicals used were analytical grade are obtained from E-Merck chemicals.Whatman no.40 filter papers were used for filtration purpose. Double distilled

water was used for dilution purpose. All Glasswares were washed well, rinsed with double distilled water and dried in hot air oven before starting the experiment.

2.2 Methods

2.2.1. Preparation of the *Cassia auriculata* Flower extract

The collected *Cassia auriculata* were incised into small pieces, washed well with double distilled water to dirt and other foreign materials. About 10 grams of thus dried *Cassia auriculata* were weighed and transferred into 250mL beaker containing 100mL of Ethanol and boiled well for 30 minutes. The extract obtained was filtered through Whatman No-40 filterpaper and the filtrate was collected in a 250mL beaker and stored in refrigerator for further use. All the experiment was carried out using this extract.

2.2.2. Green synthesis of Cadmium Oxide nanoparticles:

In this method Cadmium nitrate was used as a precursor and *Cassia auriculata* flower extract as a reducing and stabilizing agent for the synthesis of Camium Oxide nanoparticle. For the green synthesis of Cadmium Oxide nanoparticles, 50mL of previously prepared *Cassia auriculata* flower extract was taken in a 100mL beaker. To this 5g of $CdNO_3$ solution was added and the solution in the beaker was stirred in a heating magnetic stirrer at70^oC until the brown paste was obtained. Then the paste was collected in a ceramic crucible and calcinated in Muffel Furnace at 350^oC. A brown coloured powder of CdO nanoparticles was obtained and this was carefully collected and preserved in the air-tight sample tubes for further studies.

2.2.3.Energy Dispersive X- Ray Spectroscopy (EDS)

EDX was used for identifying the elemental composition of specimen. The Energy Dispersive Spectra was operated at operating voltages 0 to 8KeV. EDS was recorded at Gandhigram University, Dindigul.

2.2.4. Transmission Electron Microscopy (TEM)

TEM technique was employed to visualize the size and shape of the synthesized Cadmium Oxide nanoparticles. TEM grids were prepared by placing a drop of the particle on a carbon- coated copper grid and drying under lamp. The TEM measurements were made on a Transmission Electron Microscope, PHILIPS model CM200 instrument operated at an operating voltages 20- 200kV and the resolution was 2.4 Å.TEM was recorded at SAIF, IIT Bombay.

Application

2.2.5.Antimicrobial activity of Cadmium Oxide nanoparticles

Cadmium Oxide is well known as one of the most universal antimicrobial substances. The Cadmium Oxide nanoparticles produced by using microbes, plant extracts are known to exhibit potent antimicrobial activity.Antibacterial activity of Biosynthesized Cadmium Oxide nanoparticles against *Bacillus cereus ,Bacillus subtilis, Staphylococcus aureus, Escherichia coli, Klebsiella pneumonia ,Salmonella typhi* is investigated at Nallamani Yadav college of pharamacy, Thenkasi.

2.3. Result and Discusion:

2.3.1. Energy Dispersive X-Ray analysis (EDX)

Energy dispersive X-Ray analysis was carried out to find out the elemental composition of the synthesized cadmium oxide nanoparticles. The EDX graph of CdONPs is shown in fig1.and the EDX data of CdONPs was shown in Table 1. Indicate elemental composition of the cadmium oxide nanoparticle synthesis using *Cassia auriculata* flower extract.

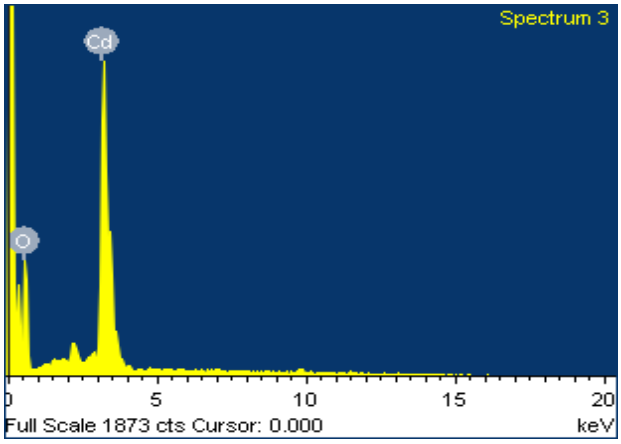

Fig.1. EDX graph of CdONPs synthesized from *Cassia auriculata* flower extract

Table 1. EDX data of CdONPs synthesized from *Cassia auriculata* flower extract

Element	series	App Conc.	Intensity corrn	Weight%	Weight%	Atomic%
O	K	19.85	0.4501	50.07	1.09	87.57
Cd	L	38.84	0.8835	49.93	1.09	12.43
					Total	100.00

EDX analysis proves the presence of elemental cadmium and oxygen and atomic percentage of Cadmium and oxygen is 12.43% and 87.57% respectively.

2.3.2.Transmission Electron Microscopy analysis:

The size, shape and morphology of synthesized cadmium oxide nanoparticles was characterized by Transmission electron microscopy (TEM)

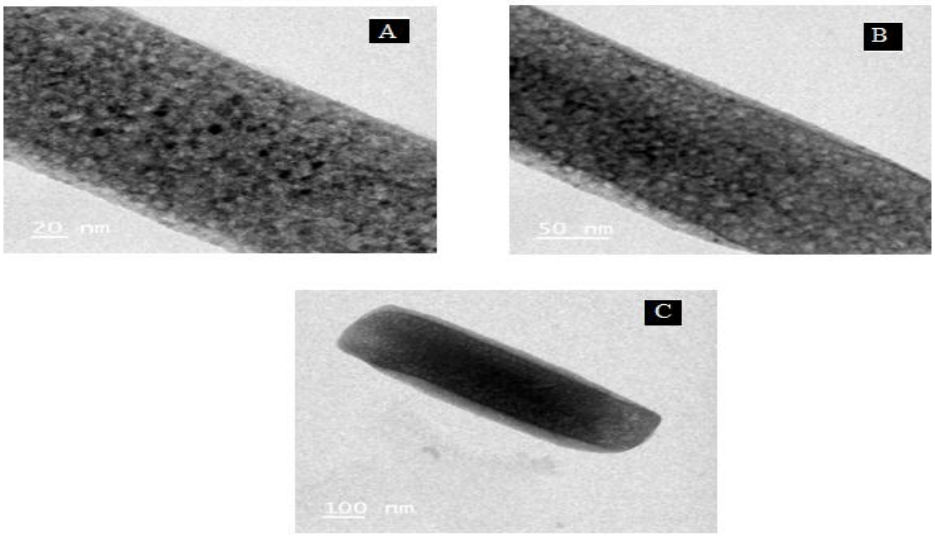

Fig.2(A-C)TEM image of cadmium oxide nanoparticle synthesized using *Cassia auriculata* flower extract at different magnification

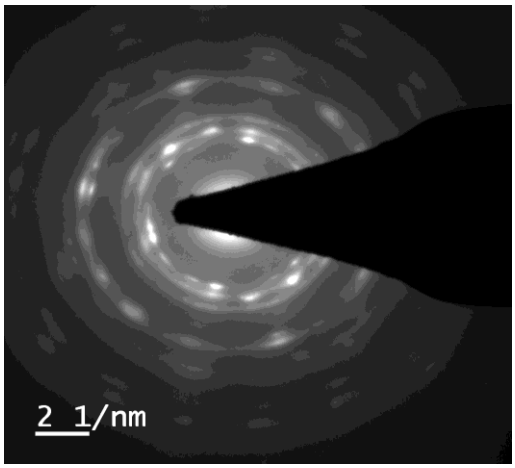

Fig.3.SAED pattern CdO nanoparticles synthesized usingb*Cassia auriculata* flower extract

The TEM image of CdO nanoparticles synthesized using ethanolic flower extract of Cassia auriculata at different magnification are shown in (Fig.2 A-C).TEM image clearly shows rod like shape of CdO nanoparticles. The layer of other material seen on surface of the nanoparticle may be due to capping of phenolic compound from *Cassia auriculata* flower extract. Crystalline nature of CdO nanoparticles was further evidenced by SAED pattern (Fig3.) with bright circular spots.

Application

2.3.3. Antimicrobial study on CdONPs

The antimicrobial activity of green synthesized CdONPs were established against pathogenic microbes such as *Bacillus cereus,Bacillus subtilis, Staphylococcus aureus, Escherichia coli, Klebsiella pneumonia ,Salmonella typhi* using disc diffusion method[11].The antimicrobial activity of CdONPs was tested by using various extract. The antimicrobial activity increased in the presence of extract of ethanol and water. The antimicrobial activity in terms of inhibition zone significantly varied with test microbes. The antimicrobial activity of cadmium oxide nanoparticles can be increase in *Klebesilla pneumonia* and *Salmonella typhi* when compared to other microbes.Table.**2** shows the values of zone of inhibition of cadmium oxide nanoparticles against microbes.

Table:2. Inhibition zone of microbial Species

Name of the organism	Zone of Inhibition (mm)										
	Petroleum ether (40^0-60^0C)		Benzene		Chloroform		Methanol		Water		Standards
	DIZ*	AI#	DIZ*	AI#	DIZ*	AI#	DIZ*	AI#	DIZ*	AI#	
Bacillus cereus	-	0	-	0	-	0	5	0.42	6	0.50	12[a]
Bacillus subtilis	-	0	-	0	-	0	3	0.19	2	0.13	16[a]
Staphylococcus aureus	-	0	-	0	-	0	18	1.06	14	0.82	17[a]
Escherichia coli	-	0	-	0	11	0.64	19	1.12	16	0.94	17[a]
Klebsiella pneumonia	-	0	-	0	-	0	23	1.21	20	1.05	19[a]
Salmonella typhi	-	0	-	0	9	0.56	19	1.19	22	1.38	16[a]

*DIZ- Diameter of zone inhibition; #AI- Active Index

a- Ofloxacin ; - No inhibitory effect.

Conclusion

The cadmium oxide nanoparticles was successfully synthesized by using the extract of *cassia auriculata* which provides cost effective, easy and proficient method for synthesis of CdONPs.. The synthesized cadmium oxide nanoparticles was characterized using EDAX, TEM. TEM analysis shows the morphology of Cadmium oxide nanoparticles. The synthesized CdONPs showed antimicrobial activity against bacteria. CdO nanoparticles were effective against the studied bacteria. The maximum ZOI was found *Klebesilla pneumonia* and *Salmonella typhi* when compared to other bacteria. In future CdO nanoparticle synthesized from *Cassia auriculata* can be utilized for removal of organic pollutant and anti cancer studies.

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