IJASRM

International Journal of Advanced Scientific Research and Management, Special Issue 4, ICAMA-18, Apr 2019

www.ijasrm.com

ISSN 2455-6378

Photo Catalytic Activity and Antimicrobial Activity OF Undoped TIO_2 and Ag Doped TIO_2 Nanoparticle Assisted By *Cicer Arietinum*

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Abstract

Nanotechnology holds an important area in recent research due of its immense use in the different field of sciences. The small size, large surface area, orientation, and physical properties make them appropriate to be used in medical sciences, physics, and chemistry. The biological approaches to preparing nanoparticles have drawn the attention of researchers due to eco-friendly nature, low cost, and easier steps for synthesis. To synthesize titanium dioxide nanoparticles *Cicer arietinum* legumes were powdered and used and the effectiveness of biologically synthesized titanium dioxide nanoparticles against clinical pathogens and anticancer activity were checked. Green synthesis of titanium dioxide nanoparticles is carried out in simple steps. The extract of *Cicer arietinum* legumes was used for the biological synthesis of the titanium dioxide nanoparticles which was characterized by UV-Vis spectroscopy, Fourier transform infrared spectroscopy, scanning electron microscopy and EDX. Antibacterial activity and photo catalytic activity of Titanium dioxide has also been studied. Spongy and crystalline shaped titanium dioxide nanoparticles were biologically synthesized. The particles showed effectiveness against both Gram-positive and Gram-negative bacteria. *Cicer arietinum* has been confirmed to be a good source for biosynthesis of titanium dioxide nanoparticles.

Keywords: Green synthesis, Titanium dioxide, *Cicer arietinum*

1.Introduction:

Nanotechnologies are a set of method and techniques for the treatment of matter and aimed at obtaining materials, with novel functionalities and improved characteristics. An overwhelming interest on the studies with Nano materials has been noticed in the recent days. Nano particles exhibit remarkable physicochemical and optoelectronic properties due to bounding electrons within their 1nm dimensions the applications of Nano materials are now extended to areas of optoelectronics, catalysis, reprography, light emitters, and single electron transistors. Among the various materials, nanoparticles play a special role in a wide range of applications and, in particular, there are a large number of studies related to titanium dioxide Nano particles. Numerous studies have reported the properties of titanium dioxide and its use for the degradation of substance in an aqueous solution and the reduction of inorganic ions. Not many works have been reported on the biosynthesis of rare metal nanoparticles such as lanthanum and titanium.

2. Materials and Methods:

The *Cicer arietinum* seeds were washed in water.50g of dried *Cicer arietinum* were crushed and boiled with 500ml of distilled water for 30 minutes. The extract was brought to room temperature, filtered, stored for biosynthesis of TiO_2 Nanoparticles. Aqueous solution of TiO_2 was prepared and kept in orbital shaker for 2hrs. 80 ml of filtered extract of *Cicer arietinum* was mixed with TiO_2 solution at room temperature and stirred for

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ISSN 2455-6378

24hrs. Then the mixture was filtered in a Buchner funnel, white precipitate of the Nanoparticle obtained was then dried in an muffle furnace at 500^0c. Then the Nanoparticle was powdered, characterized and further analysis was carried out. The same procedure was carried out with excess of silver nitrate solution and stirred for 24 hours. Black precipitate of the silver doped TiO_2 Nanoparticle obtained was then dried.

3.Results and discussion:

3.1 UV-Visible spectra:

The UV-Vis spectrum of undoped TiO_2 nanoparticles synthesized using *Cicer arietinum* extract. An absorption band at 305nm and378nm is observed which is effectively blue shift compared to bulk TiO_2 which is observed at 380nm. This blue shift is attributed to the smaller size of nanoparticles. This indicates the formation of smaller particles**.** Here the absorption band is observed at 306nm and 448nm. The extent of red shift was found to increase with increasing levels of silver which signifies the improvement in optical activity of the photo catalyst towards visible light.

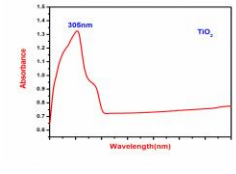


Fig: 1 UV-Vis spectra of undoped TiO_2

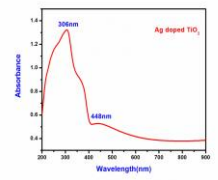


Fig: 2 UV-Vis spectra of Ag doped TiO_2

3.2 FT-IR Spectra:

The FT-IR spectrum was measured in range 0f 4000-500/cm^{-1}. Peaks observed at 23d1az5x f54.37cm^{-1} and 2333.53cm^{-1} which is prominent, it indicates O-Ti-O bond . **Figure:3** shows the IR band at 515.26cm^{-1} corresponds to C-Br stretching and 664.63cm^{-1} corresponds to C-H stretching bond due to metal oxide present in biosynthesized nanoparticles. **Figure:4** shows the vanishing of peaks at 2354.54 and 2354.37 in Ag doped TiO_2 and decrease in carbonyl stretching bond resembles the metal ion doped inTiO_2.

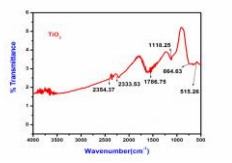


Fig:3 FT-IR Spectrum of undoped TiO_2

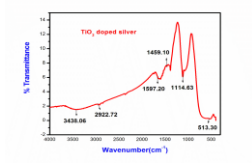


Fig:4 FT-IR Spectrum of Ag doped TiO_2

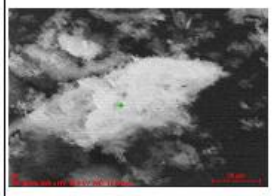
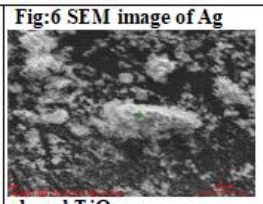


Fig:5 SEM image of Undoped TiO_2



3.3 SEM-EDX Analysis

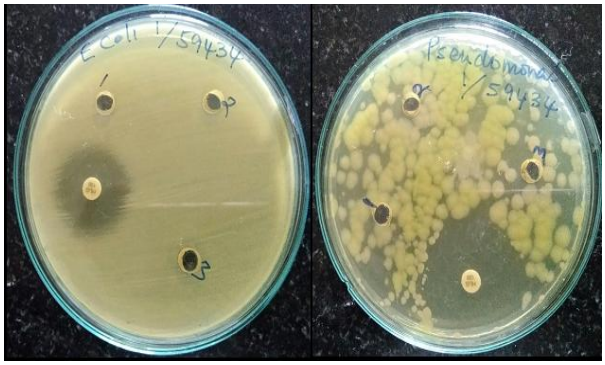
Scanning Electron Microscopy was employed to analyze the morphology and the growth features of the as prepared nanoparticles. To check the composition of the grown undoped TiO_2 nanoparticles and Ag doped TiO_2 nanoparticles EDX analysis was performed. It is confirmed from the EDX analysis that the nanoparticles are composed of Titanium, oxygen and silver and the grown nanoparticles are very pure. **Figure:5** shows this picture substantiates the approximate shape to the TiO_2 nanoparticles with spongy nature. **Figure:6** shows the SEM image of Ag doped TiO_2 nanoparticles synthesized using *cicer arietinum* extract and it exhibited crystalline morphology

3.4 Antimicrobial Activity:

Both Gram positive and Gram negative bacteria include *Staphylococcus aureus* Escherichia *coli*, *Klebsiella pneumoniae* and *Pseudomonas aeruginosa* were used for his study. All these 4 pathogens were resistance to TiO_2 nanoparticle (30 µl) when compared to the standard drug Gentamycin.

From these results, it is accomplished that the use TiO_2 nanoparticle and Ag doped TiO_2 Nanoparticle has less potential of antibacterial activity against Gram positive and negative bacteria. However, further studies are required to screen the biologically active compounds and to evaluate the efficiency of this compound used against pathogenic

microorganisms associated with various human diseases.



3.5 Photocatalytic activity:

The UV visible absorbance values of Rosaniline dye solution shows absorption wavelength at 570nm.The characteristic absorbance value at 570nm was used to track the photo catalytic degradation process in the presence and absence of TiO_2 nanoparticles. There is no significant changes of the concentration of pure Rosaniline dye after 3 hrs irradiation, which indicated that pure Rosaniline dye solution cannot be easily degraded by UV light. But the degradation has been done with undoped and silver doped TiO_2 nanoparticles within 40 minutes. From the **figure:8** is clear that the Ag doped TiO_2 has shown higher photo catalytic degradation than undoped TiO_2.

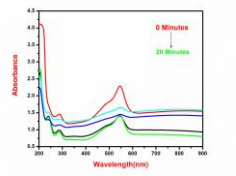


Fig:7 Dye degradation with undoped TiO_2

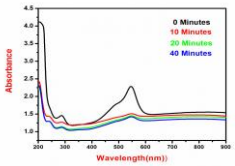


Fig:8 Dyedegradation with Ag doped TiO_2

4. Conclusions:

Titanium dioxide, Ag doped Titanium dioxide nanoparticles are synthesized by green method using of *Cicer arietinum*. This prepared undoped and doped TiO_2 nanoparticles were characterized using several techniques such as UV-Vis, FTIR, SEM-EDX. The Antimicrobial activity and photo catalytic activity also studied.

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