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Catalytic and Antibacterial Activity of Silver Nanoparticles using *Pithecellobium Dulce* Bark Extract

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Abstract:- The biosynthesis of nanoparticles has been proposed as an environmentally responsible and cost-effective alternative to chemical and physical approaches. In the current investigation, Pithecellobium dulce bark extract was used to synthesis silver nanoparticles. The bark extract has the ability to stabilise and reduce silver nitrate. UV-visible spectrometer, FT-IR spectroscopy, XRD analysis and scanning electron microscope (SEM) were used to characterise the synthesised silver oxide nanoparticles catalytic activity in reducing p-nitrophenol (4-NP) to p-aminophenol (4-AP) was examined. The antibacterial activity against gram-positive and gram-negative was found.

Keywords:- *Biosynthesis, Plant Extract, Silver Oxide Nanoparticles, Catalytic and Antibacterial Activity*.

I. INTRODUCTION

Nanotechnology is a highly emerging field that has vast applications in many Industries Medicine cosmetics etc. Nanoscience is the study and creation of materials at the nanoscale level with exclusive properties. [1] The Properties of nanomaterials are related to the size of materials and differ significantly from the bulk materials. [2]. Synthesis of metal nanoparticles has been an area of interest in the recent past as nanoparticles show unusual Structural, electrical, optical, and magnetic properties. Due to its broad range of applications in microbiology, chemistry, food technology, cell biology, pharmacology, and parasitology, silver nanoparticles are among the metal NPs that are attracting the most attention from researchers. [3, 4] Nanoparticles can be synthesized by various methods like physical and chemical methods are complicated, expensive and also generate hazardous by-products. [5] A lot of research has recently been done on the biogenic synthesis of silver nanoparticles (AgNPs), which use biomaterials like plant extract and microorganisms as reducing agents. [6, 7] In the current study, Pithcellobium Dulce bark **Figure.1** The extract acts as a both bioreductant and a capping agent for the green synthesis of silver nanoparticles. The synthesized silver nanoparticles were characterized by several techniques such as UV–Vis, FT-IR, XRD and SEM. Moreover, the catalytic activity and Antibacterial activity were examined against Bacteria.

Fig 1:- *Pithecellobium dulce* tree

II. MATERIALS AND METHODS

- *Preparation of Pithecellobium Dulce Bark Extract:*

25g of finely cut Pithecellobium Dulce bark was weighed in 100ml distilled water and allowed to boil at 60-800 C for 10 min stirring for 2 Hrs. Then it was cooled to room temperature. The clear solutions were obtained by the filtration of the extract using Whatman No. 1 filter paper. The filtrate was stored at room temperature for future work. **Figure. 2**

Fig 2:- *Pithecellobium Dulce* Bark Extract

➢ *Synthesis of Silver Nanoparticles from Pithecellobium Dulce Bark Extract :*

To 75ml of 1mM AgNO3 solutions, 25 ml of Pithecellobium Dulce bark extract was added and the reaction mixture was stirred for 2 Hrs. After this reaction mixture was kept for 24 Hrs. The reduction of Ag+ was indicated by a colour change from light brown to dark brown colour, which indicates the formation of Silver nanoparticles as shown in the **Figure. 3**

The absorption peak at around ~420 nm is observed, which is the characteristic of Silver nanoparticles.

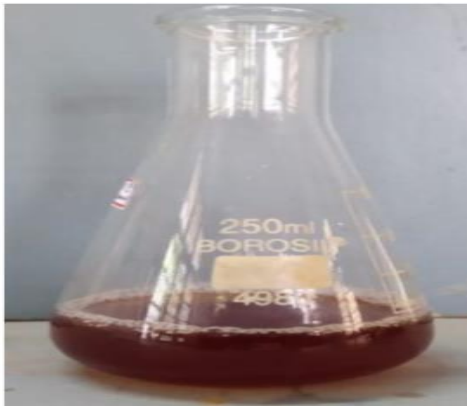


Fig 3. *Pithecellobium Dulce* Bark Extract after addition of $AgNO_3$ solution

III. RESULTS AND DISCUSSION

➢ *Uv - Visible Spectrum*

Uv-Visible spectra of Borassus Flabellifier Bark Extract were recorded using double distilled water as solvent. The absorption band observed in the region of 249 nm was due to the π-π^* transit***ion.*** The adsorption band at 351 nm, 410. 501, was due to the n-π* transition as shown in the **Figure. 4.** [8]

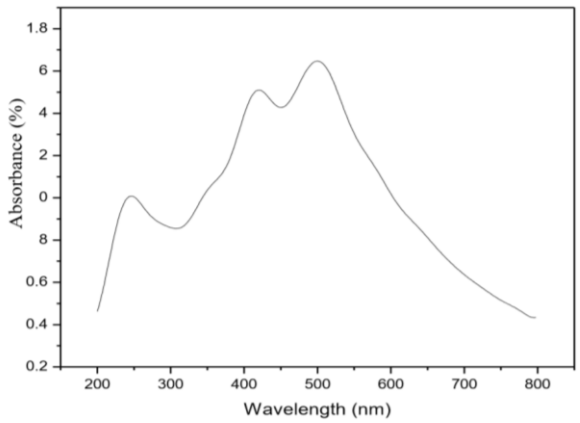


Fig 4. UV- Visible Spectrum of Silver nanoparticles

➢ *FT-IR Spectrum*

The IR spectrum for Silver nanoparticles of *Pithecellobium Dulce* bark extract is given in the **Figure. 5.** The peaks that appeared at 3454, 1637 and 1024 cm^{-1} imply OH stretching vibrations with strong intensity, C=O stretching vibrations and C-OH stretching vibrations. The peaks at 2100 cm-1 were observed due to Silver stretching vibrations. [9]

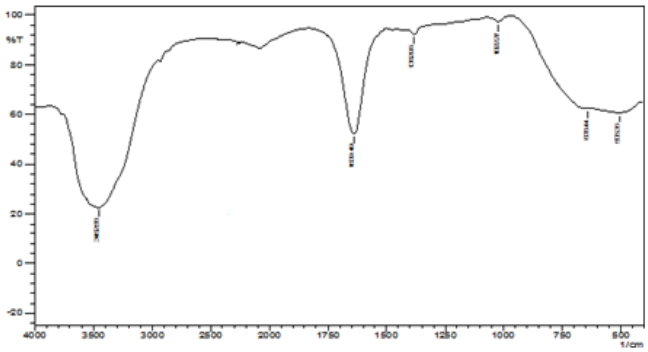


Fig 5. FT-IR Spectrum of Synthesis of Silver nanoparticles UsingPithecellobium Dulce Bark Extract

➢ *XRD pattern of Silver nanoparticles using Pithecellobium dulce Bark Extract*

Figure. 6. the Xrd pattern of AgNo3 nanoparticles. Xrd diffraction patterns of silver nanoparticles on comparison with the JCPDS data [04-0783] fairly matched with the structure for Ag nanoparticles. The major peaks of nanoparticles so obtained at in 2θ [28.31, 40.80, 66.47, 74.14] values between and can be attributed to the miller Indices of the (211) (111) (222) (311) and planes of the crystalline structure of Ag nanoparticles. Average particle diameter D for a different specimen as obtained from the main peak using Debye-Scherrer (1) for the peak width broadening as a function of the size of the particles.

$D = 0.89\ \lambda / \beta \cos \theta\ \varepsilon = \beta / 4 \tan \theta$

Here λ is the x-ray wavelength (Ka = 1.5406 A0) ε micro strain K is the machine constant (0.89), β is the full width at half maximum of the peak and θ is the peak position using the above method we obtained and the average size of particle for silver sample shown **Table 1**. The average size of silver nanoparticles is found to between 23-30 nm this is clearly confirmed the formation of plant extracts dispersed silver nanoparticles. [10]

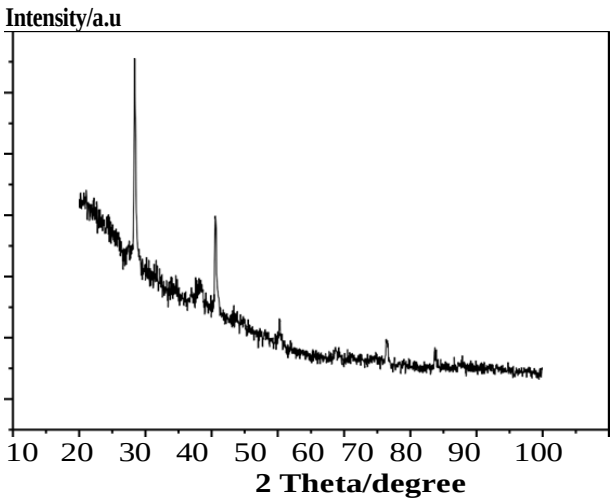


Fig 6. XRD Spectrum of Synthesis of Silver nanoparticles.

2θ of theintense peak (deg)	θ of the intense peak (deg)	FWHM ofintense peak (β) radians	Size of theparticles (D) Nm	d spacing	Plane hkl	ε Microstrain
28.31	14.11	0.29	28.29	3.1379	211	0.0121
40.80	20.40	0.28	30.33	2.2100	111	0.0194
66.47	33.23	0.40	23.76	1.4056	222	0.0516
74.14	37.07	0.39	25.67	1.7953	311	0.0791

Table-1: The particle size of SynthesisSilver nanoparticles

➢ *Scanning electron microscope Analysis*

The scanning electron microscope is one of the most powerful tools to identify the morphology of the synthesized nanoparticle. The silver nanoparticles synthesized by the Pithecellobium dulce bark extract that has been magnified in the range 0.5 µm, 1 µm and 2 µm are predominantly fine flake-like structures.

SEM analysis was done for these Silver nanoparticles as shown in **Figure.7.** all distribution and size of the particles were in the range of 61.46 nm, 78.03 nm, 80.00 nm, 101.76 nm, 107.70 nm and 143.60 nm obtained particle size [11]

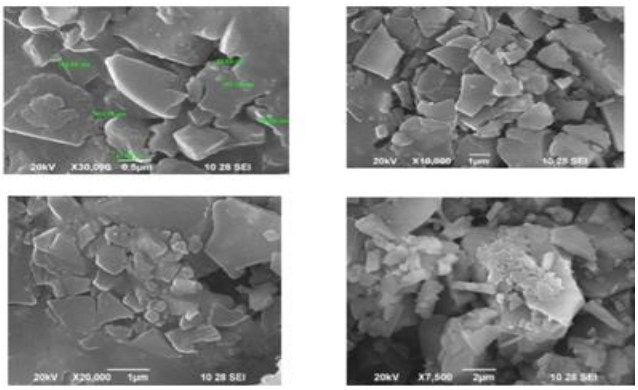


Fig 7. SEM image of Silver Nanoparticles

❖ *Applications*

➢ *Synthesis of P-Nitrophenol to P-Aminophenol Ag nanoparticles as a catalyst (Pithecellobium Dulce bark Extract).*

The reduction of 4-Nitrophenol to 4-Aminophenol was done in the presence of sodium borohydride and silver Nanoparticles as a catalyst. 0.013g of 4-Nitrophenol was taken and 0.036g of NABH4 was added to the reaction mixture heated at 80°c for 2hrs in an ultrasonicator bath. A color change from light yellow to light green was observed. The reaction was spectrophotometrically monitored in the wavelength range of 200-800 nm. [12]

➢ *The UV-Visible spectrum of 4-Aminophenol using silver nanoparticles as a catalyst (Pithecellobium Dulce bark extract)*

The catalytic activity of silver nanoparticles in the reduction of 4-Nitrophenol to 4- Aminophenol was explained with the help of sodium borohydride. 4- Nitrophenol shows its **Figure. 8.** Characteristic absorption peak at 250 and 360nm indicating the formation of para nitro phenol ion show in 430nm and the phenol ion peak was unchanged 4- Nitrophenol solution was added to phenol ion and placed in UV-vis spectrophotometer. The peak of phenol ions slowly decreased. The reaction observed a decrease in the intensity of the peak was observed and a new peak was observed at 235 nm shown in **Figure. 9 (a-b).** It clearly indicates the formation of 4-amino phenol without any product showing an absorption peak at the appearance of 400 nm. [13]

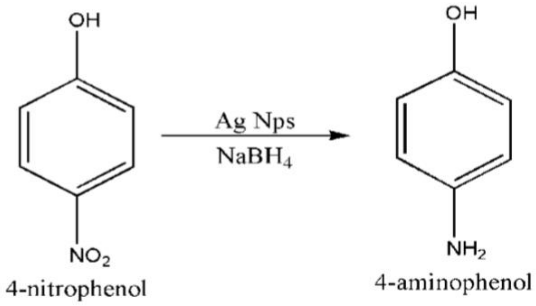
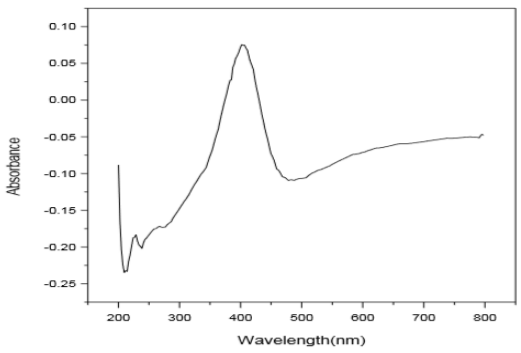
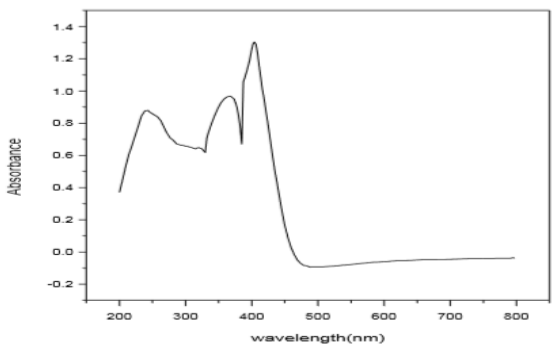


Fig 8. Reduction 4-nitrophenol to 4-aminophenol



(a)



(b)

Fig 9. (a). (b). UV-Visible spectrum of 4-Aminophenol using silver nanoparticles as acatalyst (Pithecellobium Dulce bark extract)

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➢ *Antibacterial Activity*

The antibacterial activity of silver nanoparticles using selected plants was found to exert inhibitory effects on different species of bacteria three Gram-positive bacteria and three Gram-negative bacteria were taken for the study. Ciprofloxacin was used as a control. as shown in Figure. (10-11).

Fig 10. Zone inhibition against gram-positive bacteria

GRAM POSITIVE BACTERIA:

1. Staphylococcus aureus
2. Enterococcus faecalis
3. Streptococcus pneumoniae

GRAM-NEGATIVE BACTERI :

1. Escherichia coli
2. Proteus mirabilis
3. Pseudomonas aeruginosa

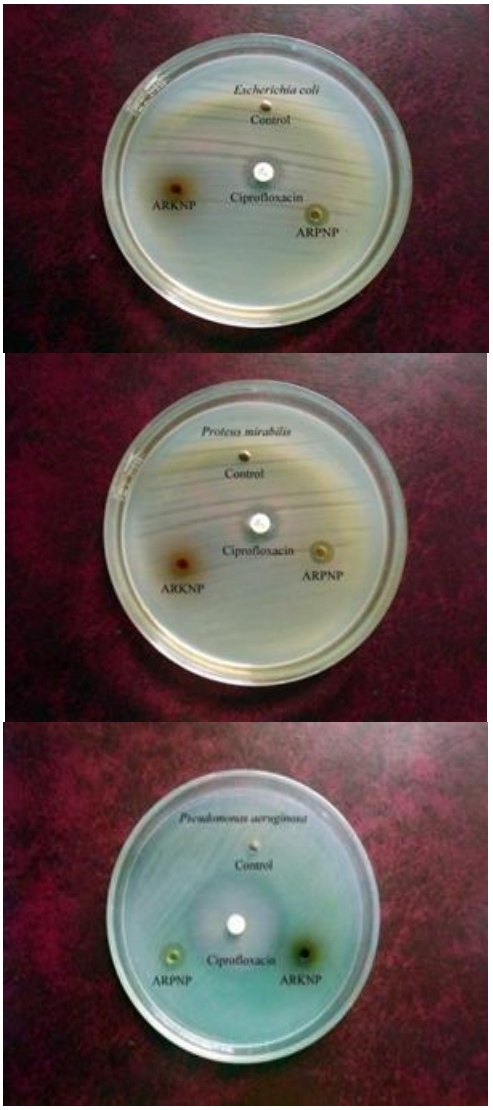

Fig 11. Zone of inhibition against gram-negative bacteria

The biosynthesized silver nanoparticles have antibacterial activity. The Gram-positive bacteria are more susceptible than Gram-negative bacteria, according to this result. Numerous investigations have demonstrated the bactericidal action of silver nanoparticles against a wide variety of microorganisms. This ability supports their multimodal approach to bacteria exposure. The binding of this bark extract-based silver nanoparticles to the cell wall and the production of free radicals are most likely the causes of the bactericidal activity.

IV. CONCLUSION

The silver nanoparticles were prepared from Pithecellobium Dulce Bark extract. It was characterized by UV, IR Spectroscopy, XRD and SEM analysis. The shift in characteristic, frequencies towards lower sides confirm the interaction between silver nanoparticles with bark extract. UV spectrum shows the increase in absorbance towards the higher wavelength side indicating the role of bark extract which was also confirmed by XRD data. It was observed that the Silver nanoparticles exhibited enhanced catalytic activity and antibacterial activity.

CONFLICT OF INTEREST

We know of no conflicts of interest associated with this publication, and there has been no significant financial support for this work that could have influenced its outcome.

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