International Journal of ChemTech Research
CODEN (USA): IJCRGG, ISSN: 0974-4290, ISSN(Online):2455-9555
Vol.10 No.5, pp 748-753, 2017

Biogenic Synthesis of Silver Nanoparticles from Medicinal Plant and its Antimicrobial Activity

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Abstract : Plant mediated biologically synthesized of nanoparticles is gaining importance due to its eco-friendliness. The synthesized metal nanoparticles are an expanding research area due to the potential applications for the development of novel technologies and very less toxic applications. In our research work, we describe a cost effective and environment friendly technique for green synthesis of silver nanoparticles and evaluate their Antibacterial activity. Synthesis and characterization of silver nanoparticles was carried out by using bark extract of *Moringa pterygosperma* plant reducing agent as well as capping agent. The Synthesized nanoparticles were characterized with UV-Visible spectrometry (UV-Vis), Fourier transform infrared spectroscopy (FT-IR), Scanning electron microscopy (SEM) and X-ray diffraction spectroscopy (XRD).The antibacterial activity of silver nanoparticles has been observed.
Keywords : *Moringa pterygosperma* plant extract as a reducing agent, Antibacterial activity, $AgNO_3$ salt.

Introduction

The prefix “nano” is a Greek word “nanos” which signifying “dwarf” (one billionth of meter 10^{-9}m),is becoming extensively common in scientific literature. The natural world abound with lots of examples of the system with nanoscale structure, such as milk (nanoscale colloid), proteins, bacteria, cells, viruses etc. Furthermore, so many materials have complex structure at nanoscale state and are seems smooth to the naked eyes.

The prospect of exploiting natural resources for metal nanoparticle synthesis has become to be a competent and environmentally beneficent attain [1]. Green synthesis of nanoparticles is an Eco-Friendly approach which might have the way for researchers across the globe to explore the potential of disparate herbs in order to synthesize nanoparticles[2].

Here, we did research on medicinal plant. Synthesis and characterization of silver nanoparticles was carried out by using bark extract of *Moringa pterygosperma* plants reducing agent as well as capping agent. The Synthesized nanoparticles were characterized with UV-Visible spectrometry(UV-Vis),Fourier transform infrared spectroscopy (FT-IR),Scanning electron microscopy (SEM)and X-ray diffraction spectroscopy (XRD).The antibacterialactivity of silver nanoparticles has been observed.

Materials and Method

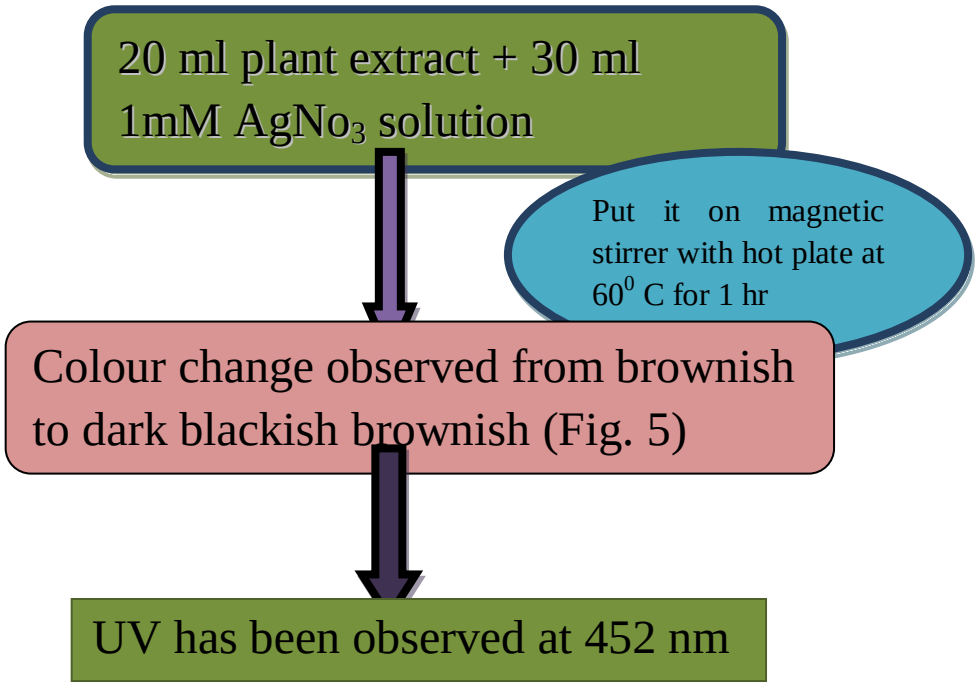
Chemicals and reagents

Silver nitrate was purchased from Himedia.

Plant Materials

Plant (*Moringa pterygosperma*)used in the present study was collected from north Gujarat region mounted areas. Fresh bark was collected and washedwith tap water followed by double distilled water then dried it in oven for 1 hour at 60^0 C and grind it in mixture. Now 10gm powder of plant portion (bark) mixed with 100 ml double distilled water. The mixture was boiled for 30 min. at 60^0 C. The solution was filtered through Whatman filter paper No.1 and filtrate was stored at 4^0 C and used as stock solution for AgNPs synthesis.

Synthesis of Nanoparticles



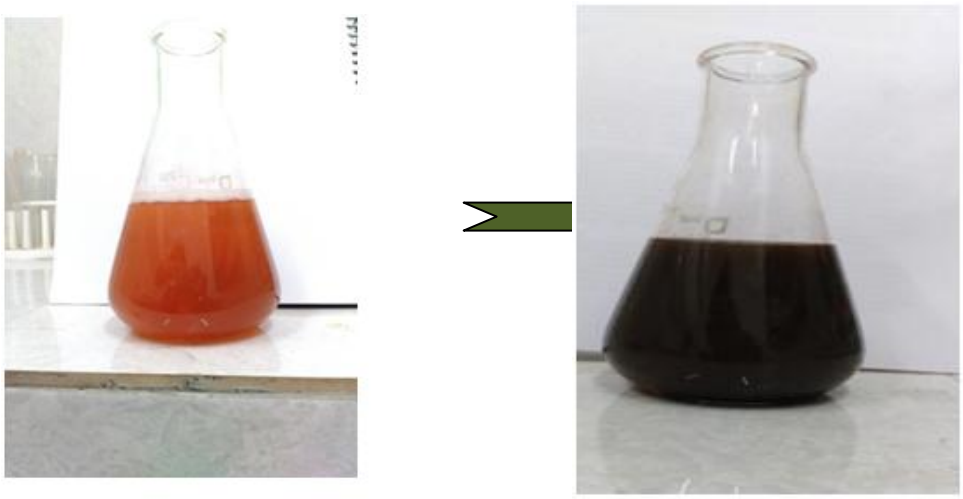
The colour change indicates the synthesis of the silver nanoparticles. Then this coloured solution was centrifuged at 12,000 rpm for 20 min. The separated nanoparticles settled at the bottom were collected and washed with double distilled water, then dried in an oven at 60^0 C for two hours. The stabilized powder form of the nanoparticles was stored at 4^0 C for further characterization.

Characterization of Silver Nanoparticles

UV-visible spectroscopy measurements (Shimadzu UV 1800) were carried out at room temperature in the region 800–200nm as a function of time of the reaction. FTIR spectroscopy analysis was carried out to identify the biomolecules responsible for the reduction of Ag+ ions. X-ray Diffraction (XRD) measurement of the bio reduced silver nanoparticles carried out using AnnX'pert pro P analytical X-ray diffraction instrument. Scanning Electron Microscopic (SEM)analysis was done using Hitachi S-4500 SEM machine. The antibacterial activity of silver nanoparticles was calculated against Bacillus Pumilus MTCC 9584, Bacillus cereus MTCC 9762, Proteus mirabilis MTCC 9242 and Escherichia coli (E.coli) MTCC 600 using Agar Well Diffusion method and zone of inhibition was measured. The nanoparticles showed zone of inhibition against all the studied bacteria.

Results and Discussion

Synthesized silver nanoparticles was calculated and characterized by using four advanced analysis techniques. These included UV-visible Spectrum analysis (Fig. 3), X-ray Diffraction Spectroscopy (XRD) (Fig. 4), Scanning Electron Microscopic (SEM) (Fig. 1) and Fourier Transforms Infrared spectroscopy (FTIR) (Fig. 2).



(a) **(b)**

Fig.(a) Plantextract of *Moringa pterygosperma* without $AgNo_3$ solution and (b) plant extract + $AgNo_3$ solution.

Antibacterial Activity of Synthesized Silver Nanoparticles

The antibacterial activity of silver nanoparticles was carried out by agar Cup plate method from department of microbiology, HNGU, Patan. The antibacterial activity of silver nanoparticles was calculated against *Bacillus Pumilus* MTCC 9584, *Bacillus cereus* MTCC 9762, *Proteus mirabilis* MTCC 9242 and *Escherichia coli* MTCC 600 (gram positive and gram negative). Fresh overnight culture of each strain was swabbed uniformly onto the individual plates containing sterile Luria Bertani agar and 4 wells were prepared by cup borer with diameter of 6 mm. Then 50 µL of purified silver nanoparticles (in various concentrations) added into each well and commercial antibiotic discs are placed as control. Then incubate it for 24 hr at 37°C. After incubation zones were showed around the wells and it was measured [Fig. 6]. This experiment was repeated for three to four times for a good result.

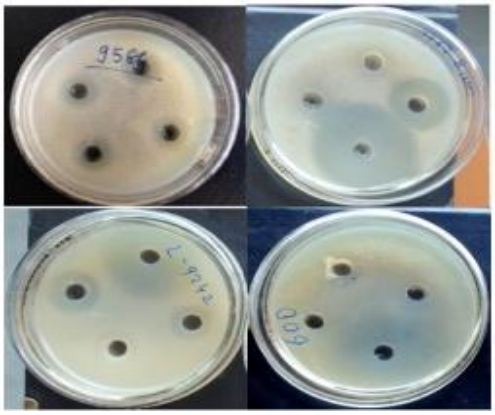


Fig.6 Antibacterial activity of silver nanoparticles anti selective bacterial species.

Table:-Antibacterial activity of different concentration of Ag nanoparticles against selective bacterial species.

Silver nanoparticles concentration (µL)	**Bacterial species and zone of inhibition in mm.**			
	***Bacillus Pumilus* MTCC 9584**	***Bacillus cereus* MTCC 9762**	***Proteus mirabilis* MTCC 9242**	***Escherichia coli* MTCC 600**
20	10	11	10	08
40	12	14	13	13
60	13	12	12	15
80	11	13	14	17
Ciprofloxacin	60.0(32)	60.0(33)	60.0(29)	60.0(28)
Erythromycin	80(34)	80(34)	80(37)	80(32)

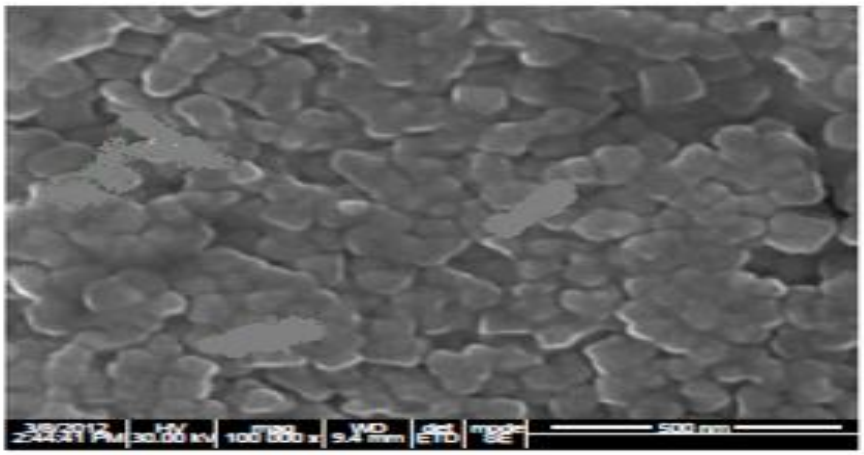


Fig. 1 SEM of silver nanoparticles

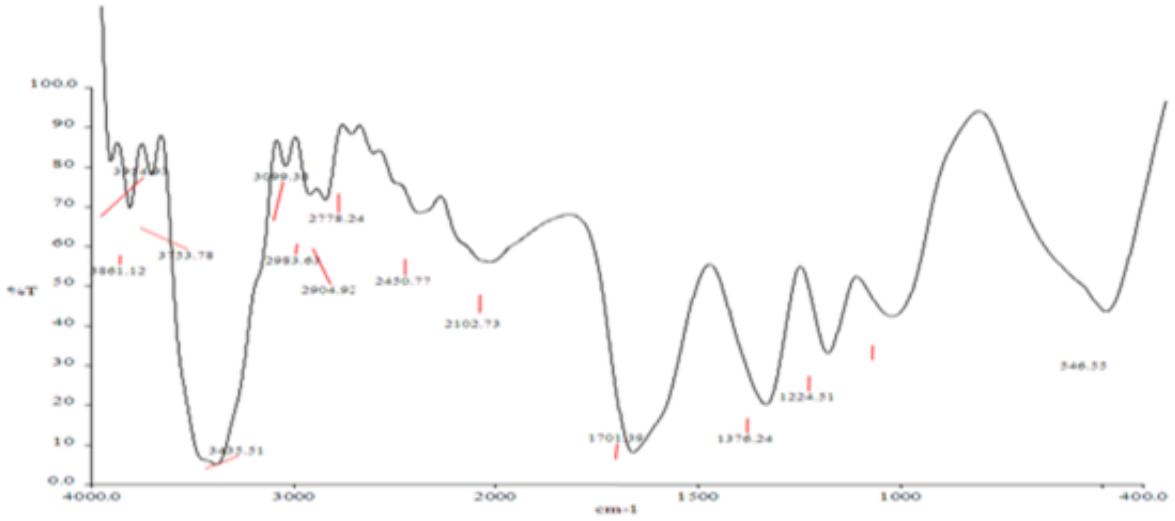


Fig. 2 FTIR of synthesized silver nanoparticles

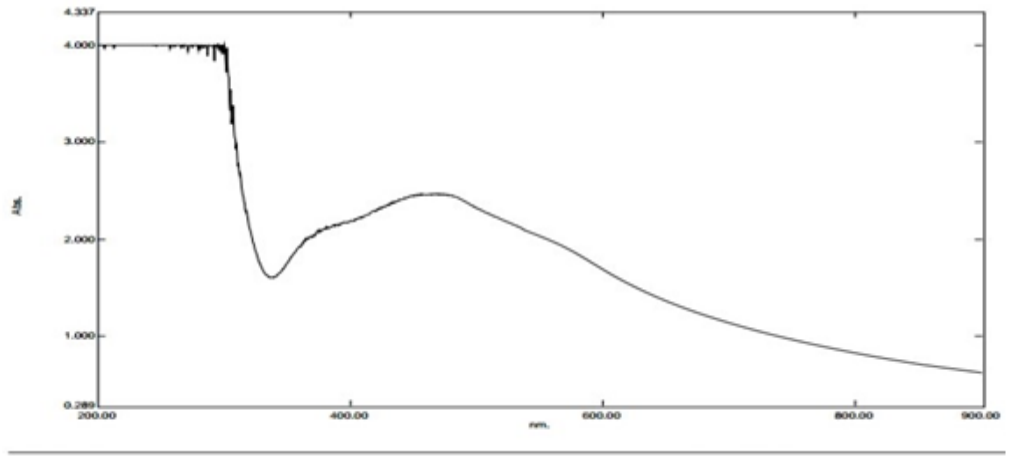


Fig. 3 UV visible of silver nanoparticles

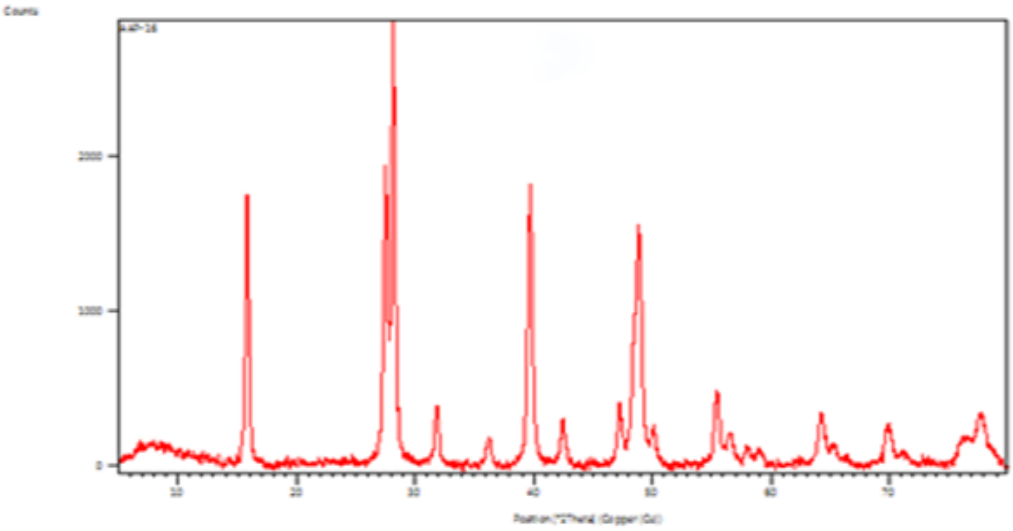


Fig. 4 XRD of silver nanoparticles

Conclusion

In the present investigation, green synthetic route is used for synthesis of silver nanoparticles. The Phytosynthesis of silver ions by using extract of *Moringa pterygosperma* without involvement of toxic chemicals. The metal ions reduced very rapidly, the reduction of Ag ions was completed within 1 hr. They show particle size between 35-60 nm. Water soluble natural heterocyclic compounds such as phenol, flavones, and terpenoids were mainly responsible for the reduction and stabilization of nanoparticles. The synthesized silver nanoparticles showing good antibacterial activity against above mentioned bacteria.

Acknowledgement

Department of Microbiology, HNGUniversity, Patan, Gujarat for Antibacterial experiments.

References

1. Bhattacharya, D. and Gupta, R.K., Nanotechnology and potential of microorganisms. Critical reviews in biotechnology,2005, 25(4),199-204.

2. Mohanpuria, P., Rana, N.K. and Yadav, S.K., Biosynthesis of nanoparticles: technological concepts and future applications, Journal of Nanoparticle Research,2008, 10(3),507-517.
3. Begum, N.A., Mondal, S., Basu, S., Laskar, R.A. and Mandal, D., Biogenic synthesis of Au and Ag nanoparticles using aqueous solutions of Black Tea leaf extracts. Colloids and surfaces B: Biointerfaces,2009, 71(1),113-118.
4. Huang, J., Li, Q., Sun, D., Lu, Y., Su, Y., Yang, X., Wang, H., Wang, Y., Shao, W., He, N. and Hong, J., Biosynthesis of silver and gold nanoparticles by novel sundried Cinnamomum camphora leaf. Nanotechnology,2007, 18(10),105104.
5. Shankar, S.S., Ahmad, A. and Sastry, M., Geranium leaf assisted biosynthesis of silver nanoparticles. Biotechnology progress,2003, 19(6),1627-1631.
6. Jha, A.K. and Prasad, K., Green synthesis of silver nanoparticles using Cycas leaf. International Journal of Green Nanotechnology: Physics and Chemistry,2010, 1(2), 110-117.
7. Manikandan, D., Prakash, D.G. and Gandhi, N.N., A Rapid and Green Route to Synthesis Of Silver Nanoparticles from Plectranthus barbatus (Coleus Forskohlii) Root Extract for Antimicrobial Activity. International Journal of ChemTech Research,2014, 6,4391-4396.

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