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# Green synthesis, Characterization and anti microbial activity of silver nano particles –Review Paper

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**Abstract**
The exploitation of various plant materials for the biosynthesis of silver nano particles is considered a green technology. Because it does not involve any harmful chemicals. Nanotechnology field is one of the most attractive researches. The field of nanotechnology is applied to bio materials. This review focuses on the green synthesis of silver nanoparticles using various plant sources. A detailed study on the reduction of silver ions to silver nanoparticles from medical plant leaves extract were demonstrated with a brief experimental procedure. Characterization of the synthesized nanoparticles performed through UV spectroscopy, Fourier Transform Infra Red spectroscopy analysis, X-Ray Diffraction analysis, Scanning Electron Microscopy and Transmission Electron Microscopy. This review mainly focus on anti microbial activities of synthesized silver nano particles.
**Key Words:** Silver Nano particles; nanotechnology; SEM; TEM; XRD; FT-IR; UV-VISIBLE; leaves extract.

## I. Introduction

Nano structured materials are used in recent years due to they show good valuable and unusual remarkable properties, compared to conventional poly crystalline materials. Nano particles play a major role in all fields particularly in medical field, it is used to skin cancer, reduce bleeding in trauma patients. (1).

Silver Nano particles are used to deactivating HIV at low concentration with less toxicity. They are also used in anti viral agents (2), antimicrobials, anti proliferative agents and many more.

Generally Nano particles are synthesized and stabilized by using chemical methods such as chemical reduction, electro chemical technique, photo chemical reactions in reserves micelles and now a day's via green chemistry route. Recent studies have indicated that bio molecules like phenols, proteins , flavonoids and alkaloids not only play a role in reducing the ions to the nano size but also play an important role in the shaping the nano particles.

There are many reports have been studied on the synthesis of Ag-NP's using extracts of many parts of medical plants such as leaf, root , bark , seed , fruits , flowers , stem as reducing agents. Recent reports on the use of leaf extract for the synthesis of Ag-NP's. they are lakshmi tulasi(*osmium sanctum*), *Crob leaf*(3), *Argemonemexicana*(4), *Catharanthus rosesus. Linn*(5), *Achyranthes aspera*(6) , *Azhadirachta indica*(7) , *Ocimom basilicum(*L)(8), *Alternanthera sessilis*(9) , *Impatiens balsamina*(10) , *Mulberry leaves*(11) ,*Bocopa monnieri* (LINN)(12) , *Eruca sativa*(13), *Spinacia oleracea*(13) , *Allmanoanadiflor*(14),,*Bryophyllum pinnatum*(15) , *Cajanus cajan*(16) ,*Ricinus communis* L.(17) , *Datura metal*(18) , *Bovine serum albumin*(19), *Annona squamosa*(20), *breynia retusa* (21), *Cochlos penmum religiosum* (22).

## II. Material and Methods

### *2.1. Collection of leaves*

A major source of plant materials is forest and also occur from rural areas, agriculture land. First collect the plant and separate the good and healthy leaves. They are washed with several times with tap water and washed srveral times with distilled water, after they dried at room temperature for removal of moisture.

### *2.2 Preparation of leaf Extract:*

10-15gm of leaves were weighed and sliced in to small pieces, and then 100-200ml of double distilled water was added and then boiled. after boiling the solution it is cooled. After cooling the extract was filtered with what man no.1 filter paper. The extract was stored at $4^0$c for further assuage.

### *2.3. Preparation of $AgNO_3$ Solution*

Required molar $AgNO_3$ solution was prepared by accurate amount of silver nitrate was dissolved in required volume of water .generally for the preparation of silver nano particles we use 1mM silver nitrate solution. The solution was stored at ambered color bottle for prevent to auto oxidation.

**2.*4. Green Synthesis of leave Silver Nano Particles***

Generally 80 or 90 ml of $AgNO_3$ was added to 20 or 10 ml of leaf extract and follow some physical techniques like heat, stirring then the solution was incubated some time. The color change was observed, it is indicated by formation of silver nano particles, which was confirmed by uv-visible spectrophotometer. The formed silver nano particles were centrifuge separated and dried.

## III. Characterization

***3.1. U.V-Visible Spectral Study***

Formation and stability of AgNP's sterile distilled water is confirmed using UV-Visible spectrophotometer in a range of wavelength from 200 to 800 nm. The production of silver nano particles by reduction of silver ions due to the addition of leaves extract. The band observed in spectrum, confirmed by silver nano particles. Various plants leaves extracts were giving peaks at different wave length. Most of the plants give band at 400-490nm region. (3-22).Different plant leaves show following absorption values.

| s.no | Name of the plant | $\Lambda_{max}$ |
|---|---|---|
| 1 | Crob leaf | 420nm |
| 2 | *Argemonemexicana* | 440nm |
| 3 | *Catharanthus rosesus.Linn* | 420nm |
| 4 | *Achyranthes aspera* | 424nm |
| 5 | *Azhadirachta indica* | 420nm |
| 6 | *Ocimom basilicum(*L) | 480nm |
| 7 | *Alternanthera sessilis* | 420nm |
| 8 | *Impatiens balsamina* | 456nm |
| 9 | *Mulberry leaves* | 425nm |
| 10 | *Annona squamosa* | 444nm |
| 11 | *Eruca sativa* | 435nm |
| 12 | *Spinacia oleracea* | 435nm |
| 13 | *Allmanoanadiflor* | 450nm |
| 14 | *Bryophyllum pinnatum* | 418nm |
| 15 | *Cajanus cajan* | 470nm |
| 17 | *Ricinus communis* L | 415-420nm. |
| 18 | *Datura metal* | 410nm |
| 19 | Krishna tulsi(Ocimumsanctum) | 409nm |
| 20. | *Cochlos penmum religiosum.* | 260nm |

***3.2. FT-IR Spectral Study***

To investigate the functional groups of mulberry leaves extract, a FT-IR study was carried out and the spectrum is complex nature due to leaves extract giving a number of peaks. The peaks arising from -NH stretching of amino group, and bonded –OH group , -CH stretching vibrations of $-CH_3$ and $-CH_2$ functional groups, C=O stretching frequencies of carboxylic acid functional groups, and finger frint region peaks of C-O, O-H ,C-N are observed clearly FTIR study indicates that the carboxyl (-C=O), hydroxyl (-OH) and amine (N-H) groups of leaves extract are involved in the reduction of silvers ions in to silver nano particles.

***3.3 SEM Analysis***

SEM analysis shows uniformly distributed silver nano particles on the surfaces of the cells. The suspended silver nano particles in sterile distilled water were used for scan electron microscope analysis by fabricating a drop of suspension onto a clean electric stubs and allowing water to completely evaporate. SEM analysis gives size of silver nano particles. Majority cases a large size silver nano particles was observed due to agglomerisation of smaller ones.

***3.4. TEM Analysis***

TEM analysis give the information about the morphology of the silver nano particles .generally silver nano particles are spherical or crystal structures. Tem also give average mean size of silver nano particles.

***3.5. XRD Analysis***

Analysis through X-ray diffraction was carried out to confirm the crystalline nature of the particles, and the XRD pattern showed numbers of Bragg's reflections that may be indexed on the basis of the face cantered cubic structure of silver. The xrd coming from leaf was compare with standard spectrum. The peaks at 2θ v values corresponding to the (111), (200), (220), (311) respectively Bragg reflections of silver. The X-ray diffraction results clearly show that the silver nano particles formed by the reduction of Ag+ ions by the leaves extract are crystalline in nature. The average particle size of silver nano particles synthesized by the present green method can be calculated using Debye-Scherer equation.

$D = K\lambda / \beta \cos \theta$

Where D= the crystallite size of Ag-NP's

$\lambda$ = the wavelength of the X-ray source used in XRD.

$\beta$ = the full width at half maximum of the diffraction peak.

K = the Scherer constant with a value from 0.9 to 1.

$\theta$ = the Bragg angle

## IV. Anti Microbial Activity

The anti microbial activity of biosynthesized silver nano particles was tested by Disc diffusion method .the silver nano particles formed from different medical plants leaves extracts show different biological activity. Some plants and its biological activities are given below.

| S.NO | PLANT NAME | BIOLOGICAL ACTIVITY. |
|---|---|---|
| 1 | *Crob leaf* | Show strong antibacterial activity against *Escherichia coli.* |
| 2 | *Argemonemexicana* leaf | Show strong antibacterial activity against *Escherichia coli* and *Pseudomonas aeruginosa.* And show anti fungal activity against *Aspergillums flavus.* |
| 3 | *Catharanthus rosesus* | Show antibacterial activity against gram positive *Staphylococcus aureus ,Lacto bacillus,* gram negative *Escherichia coli* |
| 4 | *Achyranthes aspera* | Show antibacterial activity against gram positive and gram negative bacteria. |
| 5 | *Azhadirachta indica* | Show antibacterial activity against Salmonella *typhi* and *Klebsiella pneumonia.* And show antioxidant property. |
| 6 | *Ocimom basilicum(L),* | Show antibacterial activity against gram positive and gram negative bacteria. |
| 7 | *Alternanthera sessilis* | Show antibacterial activity against human eye pathogen. Ocular drugs investigated .*Pseudomonas aeruginosa.* and *Staphylococcus aureus* |
| 8 | *Impatiens balsamina* | Show antibacterial activity against gram positive bacteria namely *Staphylococcus aureus, Bacillus subtillis, Pseudomonas putida. Escherichia coli, Klebsiella pneumonia.* |
| 9 | *Mulberry leaves* | Antibacterial activity against *Staphylococcus aureus and Shigalla sp. Bacteria.* |
| 10 | *Bocopa monnieri* | Protecting them against pathogen attacks. |
| 11 | *Eruca sativa* | Lower anti bacterial activity against gram positive and gram negative bacteria. |
| 12 | *Spinacia oleracea* | Lower anti bacterial activity against gram positive and gram negative bacteria. |
| 13 | *Allmanoa nadiflora* | Antibacterial activity against *Micrococcus lutes, Escherichia coli, Klebsiella pneumonia, Staphylococcus aureus.* |
| 14 | *Bryophyllumpinnatum .* | Antibacterial activity against *Escherichia coli* and *Staphylococcus aureus.* |
| 15 | *Cajanus cajan* | Show antibacterial activity against gram positive bacteria namely *Staphylococcus aureus* and gram negative *Staphylococcus auras.* |
| 16 | *Ricinus communis L* | Show antibacterial activity against gram negative *Escherichia coli and* gram positive Bacillus *fusiformis.* |
| 17 | *Bovine serum albumin* | Show antibacterial activity against gram positive *Streptococci* and *Bacillus subtilis.* And gram negative bacteria *Escherichia coli, Brevibacterium.* |
| 18 | *Annona squamosa* | They are used to Brest cancer cell lines (MCF-7). |
| 19 | *Cochlospermum religiosum* | showed effective inhibitory Activity against *Bacillus, E.coli, Pseudomonas, Klebsiella* and *Staphylococcus*. They are highly toxic to *E.coli* and *Staphylococcus*, moderately toxic to *Bacillus, Pseudomonas* and *Klebsiella.* |

## V. Conclusions

From this review, we concluded that silver nano particles prepared from medicinal plant leaves was show potential anti microbial applications. The Characterization analyses give results in Nano form of silver. They are equally effective as antibiotics and other drugs in pharmaceutical field.

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