GREEN SYNTHESIS OF NANOSILVER PARTICLES FROM FLESH EXTRACT OF *TERMINALIA CATTAPA*. LINN.

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A B S T R A C T

The branch of technology that deals with science, engineering and technology conducted at the nanoscale, which is about 1 to 100 nm is called nanotechnology. It provides the tools and technology platform for the investigation and transformation of biological system. Nanotechnology is the most captivating area of research in the field of material science. Nanosilver particles have been found tremendous application in the field of high sensitivity biomolecular detection , diagnostics, antimicrobials, therapeutics, catalysis and microelectronics. Synthesis of nanoparticles by using plant extract is the most adopted method of green , ecofriendly production of nanoparticles and also has a special advantage that the plants are widely distributed, easily available, much safer to handle and act as a source of several metabolites. *Terminalia cattapa* also known as Indian almond or tropical almond is the native throughout the tropical asia belongs to family. Combretaceae. It is widely cultivated and naturalized tree. Fresh flesh containing fruit of *Terminalia cattapa* was collected and aqueous extract was prepared. 1mM aqueous solution of silver nitrate was prepared. Silver nanoparticles were prepared by taking 1% of flesh extract and 9% of 1mM aqueous solution of silver nitrate solution. Through uv spectroscopy and scanning electron microscopy analysis the nanoparticles were characterize. And the antimicrobial activity test of silver nanoparticles of aqueous extract was studied. The silver nanoparticles of fruit flesh of *Terminalia cattapa* were synthesized. And characterization of the nanoparticles shows the 388 nm on uv spectrum. The SEM image shows the cylindrical shape and size of nanoparticles shows 10 to 35 nm. The antimicrobial test shows the pronounced effect on gram positive bacteria i.e. staphylococcus. aurieus bacterial strains.

Keywords:Nanotechnology ,Silver Nanoparticles,Terminalia cattapa linn.,Ultra violet spectroscopy,Scanning electron microscopy.

1. Introduction

The branch of technology that deals with science, engineering, and technology conducted at the nanoscale, which is about 1 to 100 nm, is called nanotechnology. Nanoparticles have unique properties as a consequence of their size, distribution, and morphology and therefore are a very important component in the rapidly developing field of nanotechnology (S.Sree Gayathri, Dr. Rachel Regi Danial, Dr. Shenbagaradhai,2015). Metal nanoparticles have a high specific surface area and a high fraction of surface atoms. Over the past few decades, the synthesis of metal nanoparticles is an important topic of research in modern material science.(Tamasa.Panighari,2013). It is broadly applied in products that are directly comes in contact with the human body, such as shampoos, soaps, detergents, shoes, cosmetics products and toothpaste besides the medical and pharmaceutical application such as optical receptors, polarizing filters, catalysts, in chemical reaction , biolabelling and as antimicrobial agents. Use of silver nanoparticles is relatively new because of their high reactivity and large surface area to volume ratio. Silver nanoparticles are obtained by using conventional or unconventional methods, using two different approaches: “top-down’’and “bottom-up’’. (Shakeel Ahmed, Mudasir Ahmed , Babu Lal Swami , Saiqa Ikram,2016) (Figure 1). Chemicals used for nanoparticles synthesis and stabilization are toxic and lead to non-ecofriendly by-products. The need for environmental non-toxic

synthetic protocols for nanoparticles synthesis leads to the developing interest in biological approaches which are free from the use of toxic chemicals as a by-product. Thus, there is increase in demand of GREEN TECHNOLOGY. Synthesis of nanoparticles by using plant extract is the most adopted method of green, ecofriendly production of nanoparticles and also has a special advantage that the plants are widely distributed, easily available, much safer to handle and act as a source of several metabolites. Very recently plant extract of marigold flower, ziziphorateniour, solanumtricobatum, beet root, meliadubia, etc shows high level of antibacterial activity. (Shakeel Ahmed, Saifullah, Mudasir Ahmed, Babu Lal Swami, Saiqa Ikram.,2016)

Terminalia cattapa also known as Indian almond or tropical almond is a native throughout the tropical Asia belongs to family Combretaceae. It is widely cultivated and naturalized tree. The various parts used for this plant are leaves, fruit, bark, seed kernels. The chemical constituent present in this plant are Tannins, Cardiac glycosides, Saponins, Flavonoid, Alkaloids, Steroids, Saponins glycoside and Anthraquinone. The various extracts of leaves and bark and fruits of the plant have been reported to be anticancer, antioxidant.(Lin CC, Chen YL, Lin JM, Ujiie T, 1997) ,anti-HIV reverse transcriptase (Tan GT, Pezzuto JM, Kinghorn AD, Hughes SH,1991), hepatoprotective, anti-inflammatory (Pawar SP, Pal SC, Kasture VS,1997) ,anti-hepatitis , aphrodisiac(Ratnasooriya WD, Dharmasiri MG, 2000), antimicrobial(Chen PS, Li JH, Liu TY, Lin TC, 2000, Neelavathi P, Venkatalakshmi P, Brindha P, 2012) , nephroprotective (Vijayaprakash S, Langeswaran K, Jagadeesan AJ, Revathy R, Balasubramanian MP, 2012), antitumor (Venkatalakshmi P, Brindha P, Induja K, 2013). The fallen leaves of *Terminalia catappa* have been used in the management of sickle cell disorders . The moderate consumption of the seed kernel is useful in the treatment of men with sexual dysfunctions, primarily from premature ejaculation. Meanwhile, *Terminalia catappa* Linn, a medium sized tree has been identified with potent antioxidant activity which has been exploited as curative agents against a number of pathological conditions. Its fruits have been used for the treatment of asthma and diabetes (Teotia S, Singh M,1997). Nuts are very nutritious and contain a significant amount of high-quality proteins and vital minerals (Sessa G,1968). The nuts are good sources of edible oils and fats. Considering the significance, it was decided to study the secondary metabolites and antioxidant activities of *Terminalia catappa* nuts .

Antimicrobial property of silver nanoparticles: Silver metal has been widely used across the civilization for different purpose. Silver has a long history of antimicrobial use to discourage contamination of microbes. Silver is well known antimicrobial agent against a wide range of over 650 microorganism from different classes such as gram-negative and gram-positive bacteria, fungi, or viruses. More recently the metal is finding use in the form of silver nanoparticles. Silver nanoparticles synthesized using plant extract have been used for analyzing their antimicrobial activities against different microbes (R.Nair and Sumitra Chandra, 2008).

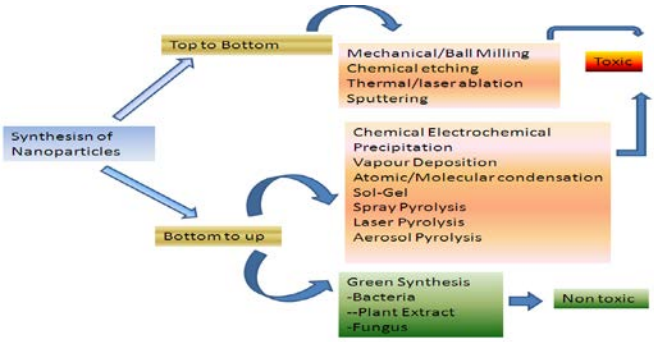

Fig.1. Different approaches of synthesis of Silver Nanoparticles.

2. Experimental work

2.1. Collection and Authentication of Plant :

The fruits of *Terminalia cattapa* were collected from college campus of Kamla Nehru College of Pharmacy, Butibori, Nagpur Maharashtra. Plant material was identified and authenticated in the department of Botany, RTM Nagpur University Nagpur, Maharashtra. The collected materials were cleaned and flesh were removed for further processes extraction.

2.2. Preparation of Extract :

Fresh flesh containing fruit of *Terminalia cattapa* were collected and aqueous extract was prepared. 15g of powdered *Terminalia cattapa* was dissolved in 200 ml of distilled water. The mixture was heated on hot plate with continuous stirring at 30 – 40 c for 20 minutes.

Then the water extract was filtered through filter paper. The filtrate was kept in a beaker and allowed to dry by heating in a boiling water bath. The gummy residue obtained was used for quantitative and qualitative determination.

2.3. Preparation of Silver Nitrate Solution :

1mM aqueous solution of silver nitrate ($AgNO_3$) was prepared and used for synthesis of nanoparticles. To prepare 100 ml of 1mM solution, 0.01698g of $AgNO_3$ is added to 100 ml of distilled water**.**

2.4. Synthesis of Silver Nanoparticles :

For the preparation of silver nanoparticles of flesh extract, 1% of flesh extract was taken and in that 9% of 1mM aqueous solution of silver nitrate was added. The colour change from reddish brown to blackish brown precipitate was checked frequently. They were incubated at 37c for 24 hours. The colour change indicates the formation of silver nanoparticles.

2.5. Ultra- violet Visible Spectroscopy :

The reduction of pure silver ions were monitored by measuring the UV-Vis spectroscopy at wavelength range (200-400 nm) of reaction medium for $AgNO_3$ along with flesh extract after diluting small aliquots of sample with distilled water .UV-Vis spectral analysis was done by using UV-VIS spectrophotometer (SCHIMADZU-1800). The metal-plant interaction was observed after 24 hrs and measured at wavelength ranged from 200-400 nm.

2.6. Scanning Electron Microscopy Analysis

Scanning electron microscopy (SEM) analysis of the particles were made using JOEL-JSM 6390 SEM machine. Thin films of the sample were arranged on a carbon coated copper grid, extra solution was detached using blotting paper and then the film on the SEM grid were allowed to dry by putting it under a mercury lamp for 5 min.

2.7. Agar Disc Diffusion Method :

The antimicrobial activity of the extract was determined using disc diffusion method . In this human pathogenic staphylococcus aurieus was subculture to the nutrient agar and were incubated at 37°C for 24 hrs. The antimicrobial activity was measured based on the inhibition zone around the disc impregnated with plant extract and synthesized silver nanoparticles. The media (Nutrient agar media) and the test bacterial culture were poured into petri dishes. The strain (200 µl) was inoculated into the media (inoculam size 108 cells/ml) when the temperature reached 40-42 ^{0}C, care was taken to ensure proper homogenization. After the medium was solidified; a ditch was made in the plates with the help of a cup-borer (8.5mm) the test compound (100 µl) was introduced into the well and the plates were incubated over night at 37^{o}C. The experiment was performed under strict aseptic conditions. Inhibition of microbial growth was determined by measuring the diameter of the zone of inhibition. The experiment was performed triplicates and the mean values of the results was drawn.

3. Result and Discussion

3.1. Visual Observation :

Addition of flesh extract of *Terminalia cattapa* into the beaker containing aqueous solution of silver nitrate led to the change in the colour of the solution to reddish brown to colloidal blackish brown within reaction duration.

3.2. UV- Visible Spectroscopy

Silver nanoparticles were synthesized at different concentration of flesh extract such as 1-5 ml using 1 mM of silver nitrate were analyzed by UV spectra observed at 388 nm.

3.3. SEM Analysis

Scanning Electron Microscopy image showed the morphological character of silver nanoparticles of flesh of *Terminalia Cattapa.* The SEM image shows the cylindrical or rod shape. And the size of nanoparticles shows 10 to 35 nm.

3.4. Antimicrobial Activity

Silver nanoparticles, due to their antimicrobial properties have been used most widely in the health industry, medicine, textile coatings, food storage, dye reduction, wound dressing, antiseptic creams and a number of environmental application. The flesh extract and those mediated silver nanoparticles were immediately tested for respective antimicrobial activities towards the gram positive (s.aurieus) bacterial strains showing the zone of inhibition. Based on zone of inhibition produced, synthesized silver nanoparticles prove to exhibit good antimicrobial activity.

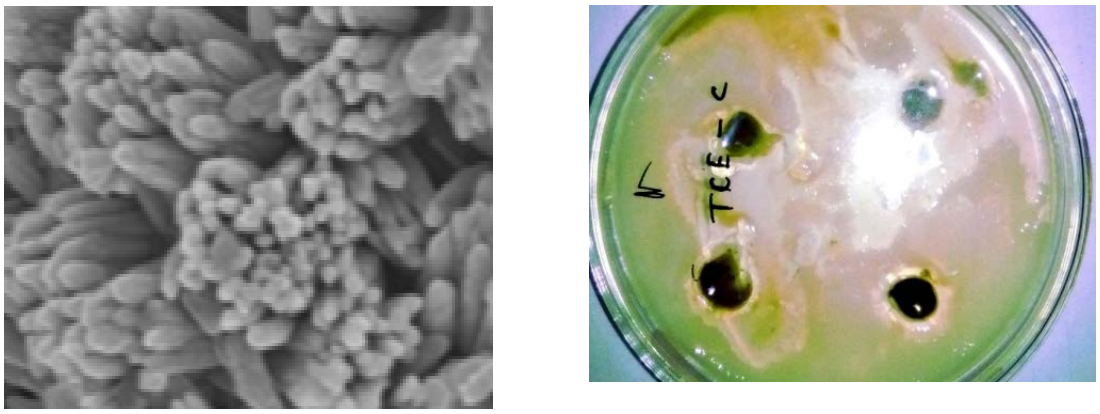

Fig.2.(A) Scanning Electron Microscopy of Silver Nanoparticles, (B) Petriplate Showing Antimicrobial Property.

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