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Preparation and Characterisation of Silver Nanoparticles of *Ficus Benghalensis* & Its Antioxidant Potential

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Abstract: Plant-mediated synthesis of nanomaterials has been increasingly gaining popularity due to its eco-friendly nature and cost-effectiveness. In the present study, we synthesized silver (Ag) nanoparticles using aqueous extracts of *Ficus Benghaensis* which belongs to family MORACEAE (Mulberry). The banyan tree has been use for many medicinal purposes from ancient times the aerial roots of banyan tree has astringent antibacterial, antioxidant and anti inflammatary property. Aqueous extraction was carried out along with its phytochemical analysis. This method allowed the use of Aqueous extract for synthesis of silver nanoparticles, which was confirmed by ultraviolet-visible (UV-Vis) spectrophotometry. UV-Vis spectra and visual observation showed that the color of the extracts turned into grayish brown, after treatment with Ag precursors. Results for Synthesised silver nanoparticles was confirmed by UV spectra which showed chromatogram at 491nm in aqueous extract.
Keywords: Phytoconstituents, Nanoparticles, *Ficus benghalensis* Linn, antioxidant activity

Introduction

Nanotechnology is a branch of science that deals with objects that are onlya few nanometers in size. The use of nanomaterials in biotechnology brings biology and material science together. Nanoparticles present an essentially useful platform, demonstrating unique properties with potential application across a wide range of fields.

Currently, synthesis of nanoparticles from several Noble metals like palladium, tin, copper, silver and gold etc. Furthermore, silver nanoparticles are useful in the pharmaceutical industry because they act asantibacterial agents with fewer side effects (Vanaja etal., 2014).

Various physical, chemical, and photochemical methods for the synthesis of silver nanoparticles have been reported over time. However, the majority of the available techniques are both costly and environmentally harmful. Various factors such as synthesis methods, temperature, dispersing agent, surfactant, and others have a significant impact on the quality and quantity of synthesized nanoparticles, as well as their properties. It's also worth noting that goal for these silver nanoparticles was not only to synthesize in the nano range, but also to do so in a simple, environmentally friendly, and cost-effective manner.

Silver nanoparticles (1–100 nm materials) have attracted a lot of attentionin recent decades in a variety of fields, including biomedicine, catalysis, energy storage, and sensors, due to their unique physicochemical properties compared to their bulk counterparts (Abou El-Nour etal., 2010).

AgNPs are well-known for their broad-spectrum, high-efficiency antibacterial and anticancer properties. Other biological functions of AgNPs are bone healing and wound repair.

Silver nanoparticles used in herbal plants have important role. The plant *Ficus Benghalensis* Linn was focused for synthesizing nanoparticles.

In research work we have used Aerial Roots of *Ficus benghalensis* Linn. *Ficus benghalensis* Linn is also called Indian banyan or banyan fig. It is unusually shaped tree of the Mulberry belonging to the family *MORACEAE* native to the Indian sub continent. The banyan tree produces aerial roots that hang down and take root where ever they touch the ground(Gopukumar etal., 2015).

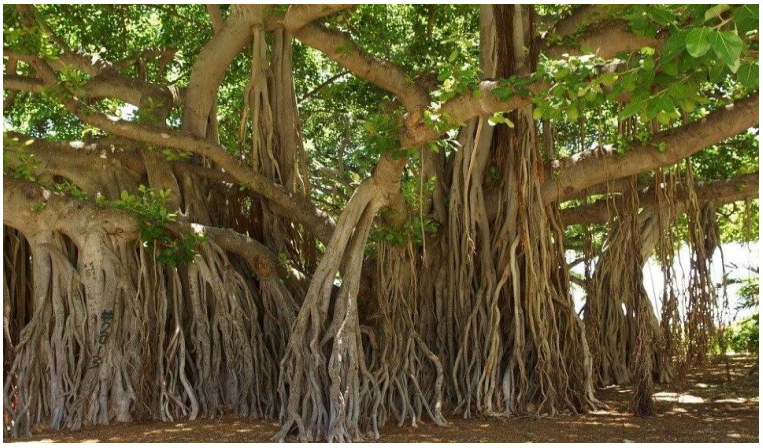


Fig No. 1 Banyan Tree

Fig.No.2 Aerial roots of *Ficus benghalensis* Linn

Plant Profile:-

Botanical Name :- *Ficus benghalensis* LinnFamily :- *MORACEAE*
Kingdom :- Plantae

Order :- Rosales

Genus :- Ficus Tourn

Species :- F. Benghalensis

The great banyan tree is believed to be at least 250 years old . The banyantree has been used for many medicinal purposes from ancient time .The aerial roots of banyan tree having astringent and anti bacterial propertieswhich prevent the bacterial infections and also effective for the oral healthproblems it is helpful to manage the glucose level in the blood .

The major aim of present study was to carry out the synthesis of silver nanoparticles and evaluate using UV-visible spectrometer analysis, FTIR analysis, FE-SEM analysis. DPPH method will be used to check the antioxidant activity, the phytochemical screening of *Ficus benghalensis* Linn will be carried out the most important constituent like alkaloids , glycoside, carbohydrate

,flavanoids ,terpenes ,saponins ,phenols ,tannins
,quinines, cellulose, steroids, gums which interprets its ,medicinal values by managing the insulin secretion because of its antioxidant properties.
The main aim was to carry out synthesis of silver nanoparticles and antioxidant activity in this research project is that synthesis of nanoparticles using herbal plants to check the presence of bioactive molecules on the surface of silver nanoparticles.
Ficus species are rich source of natural antioxidants. There are different researches about antioxidant activity of different parts of this genus. F. benghalensis is one of the species that Indian researches worked on it.
Antioxident activity specially chosen as it is a gateway to variety of different disorders such as cancer,heart diseases etc which prevented by antioxidant drugs.
Hence , in the present investigation of " Synthesis and evaluation of silver nanoparticels from aqueous extract of *Ficus benghalensis* Linn " and their antioxidant activity will be performed.

MATERIALS AND METHODS
Chemicals Required: AgNo3 (Silver nitratein mg) ,Ethanol (For UV spectroscopy) Methanol, 2,2–Diphenyl-1-picryl-hydrazyl-hydrate
Glasswares/Instruments: Magnetic stirrer, UV-visible spectrophotometer of Shimadzu, FTIR spectrophotometer

EXPERIMENTAL WORK
Collection and Drying :-

The aerial roots for *Ficus benghalensis* Linn (Banyan tree) where collected, washed twice with distilled water to remove the dust particles and contaminants and dried for 2 days i.e 48 hrs at temperature 50 – 70 °C and where grinded to fine powder, then used for the further process.

Fig No.3 Collected Aerial root

Fig No. 4 Dried powder of the aerial roots

Preparation of Aqueous Extract

Aerial roots were subjected to aqueous extract. Fresh Aerial roots of *Ficus benghalensis* Linn (Banyan tree) were use to make the aqueous extract 60 gms of fresh aerial roots powder was taken and mixed with 700 ml distilled water was taken in beaker (1000 ml) . The mixture was kept on Hot plate at 60 ◦c for 2 hrs, in this way the aqueous extraction process was carried out .

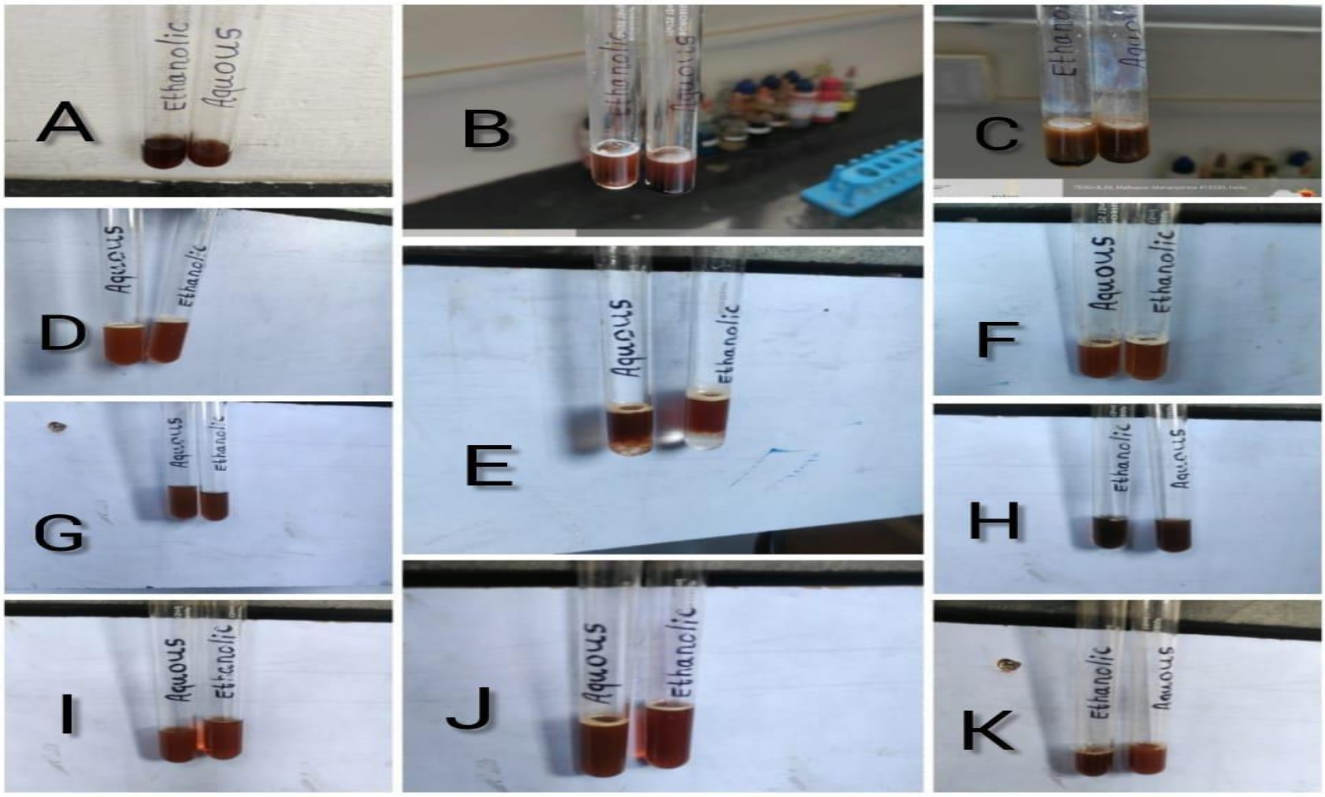


Fig No.5 Aqueous extract.

Phytochemical Qualitative screening of both extract

The phytochemical screening of aqueous and ethanolic extract of *Ficus benghalensis* Linn.(Banyan tree) were analysed by the standard methods test for alkaloids, glycosides, carbohydrates , flavanoids, terpenes , saponins, phenols , tanins , quinones , cellulose , gums (Alwala etal., 2014).

Fig No.6 Showing Phytochemical screening of both the extracts.

Biosynthesis of silver nanoparticles and therecharacterization

In biosynthesis of silver nanoparticles , take drop by drop aqueous extract in 50 ml of prepared 10 mg AgNo3 solution(10 mg AgNo3 + 50 ml deionized water) at temperature 60 -70 °c on magnetic stirrer for 20 minutes , add aqueous extract dropwise very slowly until colour changes to dark reddish brown (Kirthika P etal., 2014).

Fig No.7 Synthesis of silver Nanoparticles.UV Visible spectra analysis

Synthesized silvernanoparticles of aqueous extract were initially characterized by taking into UV Visible spectrophotometer absorption spectra at 400-800 nm using Shimadzu UV – 1900 Spectrophotometer against aqueous extract are used for the baseline scan correction in shimadzu spectrophotometer. The observations are listed in table below (Saware etal., 2014).
UV analysis of silver nanoparticles at 491nm has 0.505 absorbance.

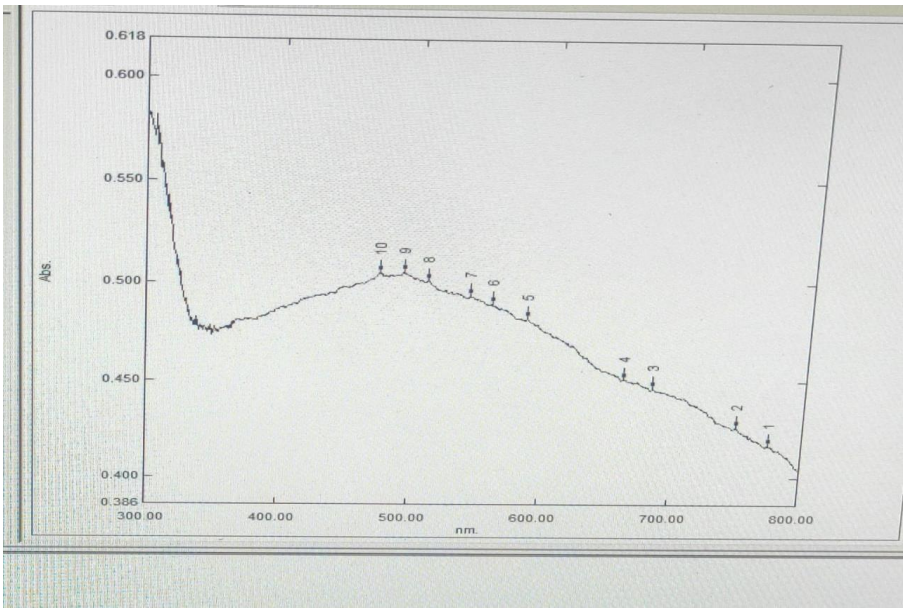


Fig No. 8 Graph UV analysis of silver nanoparticles of aqueous extractFTIR Analysis

FTIR Spectrum of synthesized silver nanoparticles of aqueous extract was firstly carried out to confirm the functional group of the silvernanoparticles the FTIR was carried out in Diya labs scientific and reference laboratory, Mumbai. The FTIR Spectra's of silver nanoparticles were recorded using carry 630 FTIR Spectrophotometer operation and scanning was carried out in the range of 4000 -650 cm $^{-1}$ at room temperature(Awwad etal., 2010).

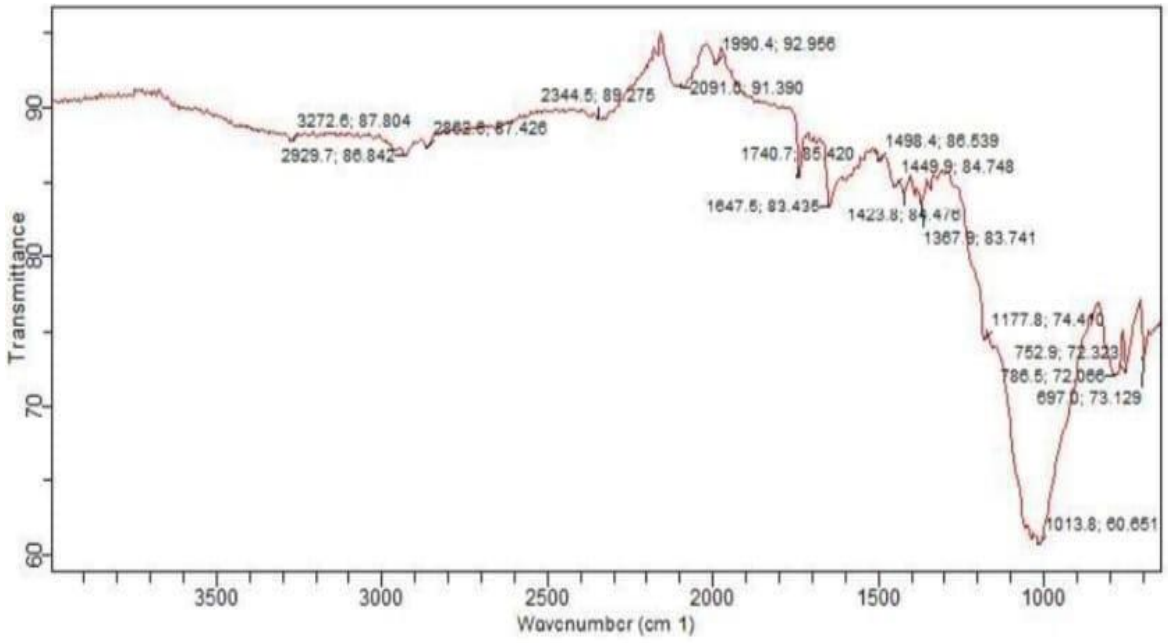


Fig No.9 Graph- FTIR analysis of silver nanoparticles
Table No.1 FTIR Interpretation of silver nanoparticle solution

Frequency	Group	Type of compound	Wavelength
3272	O-H stretching	Hydrogen bonded alcohol and phenols	2.94-3.11
2344	O-H bending	Hydrogen Bonded	2.94-3.11
2862	HC=O stretching	Aldehydes	3.47-3.77
1740	-C=O bending	Aldehydes,Ketones, Carboxylicacid ,Esters	5.68-5.95
1647	C=C stretching	Alkanes	5.95-6.95

FE-SEM Analysis

The FESEM image of silver nanoparticle of aqueous extract of *Ficus benghalensis* Linn carried out in Diya labs scientific and research laboratory Mumbai , silver nanoparticles were subjected to FESEM in room temperature synthesized sample , diameter of nanoparticles lies between
50 – 60 nm . This technique visualize the size of particles and result obtained was particle are in the spherical shape and averagely distributed in 60nm range(Sudhakar etal., 2017).

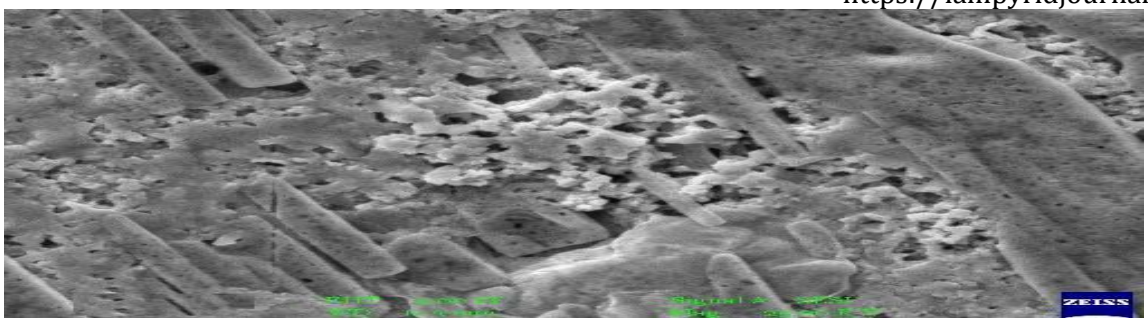
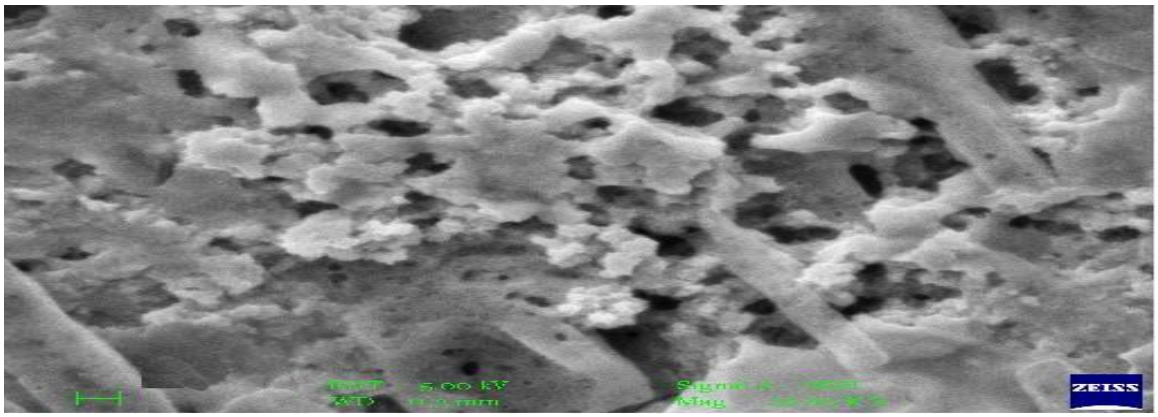


Fig No.10 FESEM Analysis of silver nanoparticles.(50 -60 nm)Img.

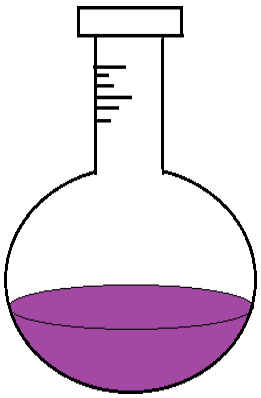


DDPH assay of silver nanoparticles using aqueous extract

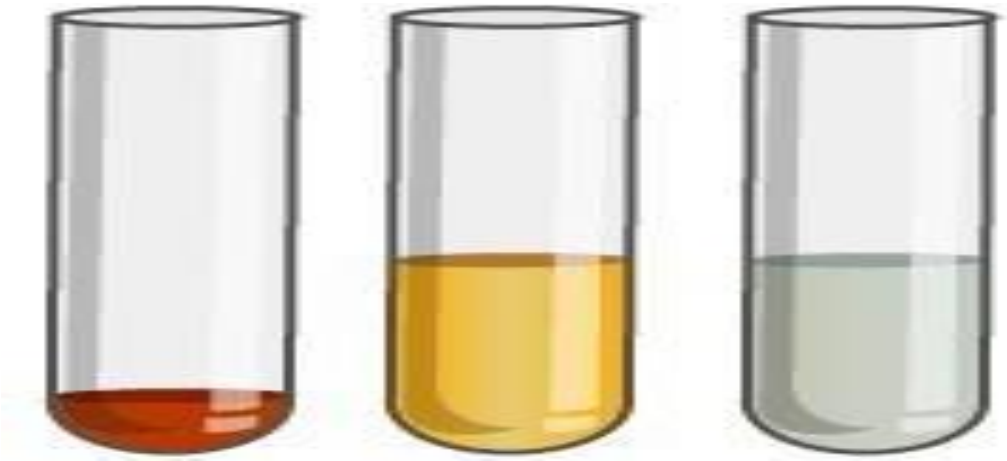
In the DPPH assay , the antioxidant activity analysis is based on the inhibition of the DPPH radical by the antioxidants. The optimal initial concentration of the DPPH was evaluated first to determine the assay sensitivity. The violet color intensity increased rapidly with the DPPH concentration from 0-2 Mm . When the DDPH concentration was higher than 2 Mm , however the color intensity only slightly increased , and had almost become saturated at 4 Mm . Therefore , 2 Mm DPPH was considered to be the optimal value to allow for a sensitive response analysis of antioxidants.

Procedure for the assay (Yadav etal., 2011, Tharini etal., 2018) :-

Control :- DPPH Solution(1.2 mg) + Methanol (30 ml) . Andkept aside in the dark room for 30 minutes.



SILVER NANOPARTICLES SOLUTION



0.5 ml Silver nanoparticle sol+ 1.5 ml DPPH + 3 ml methanol	1 ml silver nanoparticles sol+ 1.5 ml DPPH sol + 3 ml methanol	2 ml silver nanoparticles sol+1.5 ml DPPH sol + 3 ml methanol

SHAKEN FOR 30 MINUTES

ALL THE THREE SOLUTIONS WERE ANALYSED FOR UVABSORBANCE ONE BY ONE IN SHIMADZU UV SPECTROPHOTOMETER AT 517 nm

% INHIBITION WAS CALCULATED AND GRAPHS WHEREOBTAINED VIAMICROSOFT EXCEL LATEST VERSION MS OFFICE

Table No.2 DPPH assay of Silver Nanoparticles

Sample name	Concentration	Absorbance	% Inhibition
Blank		0.087	
ascorbic acid	500	0.1	75
ascorbic acid	1	0.4	54
silver sol 1	0.5	0.158	72
silver sol 2	1	0.168	70
silver sol 3	2	0.065	22
Std			22.01817431
P value			0.569

The result are represented in a more comprehensible manner graphically below.

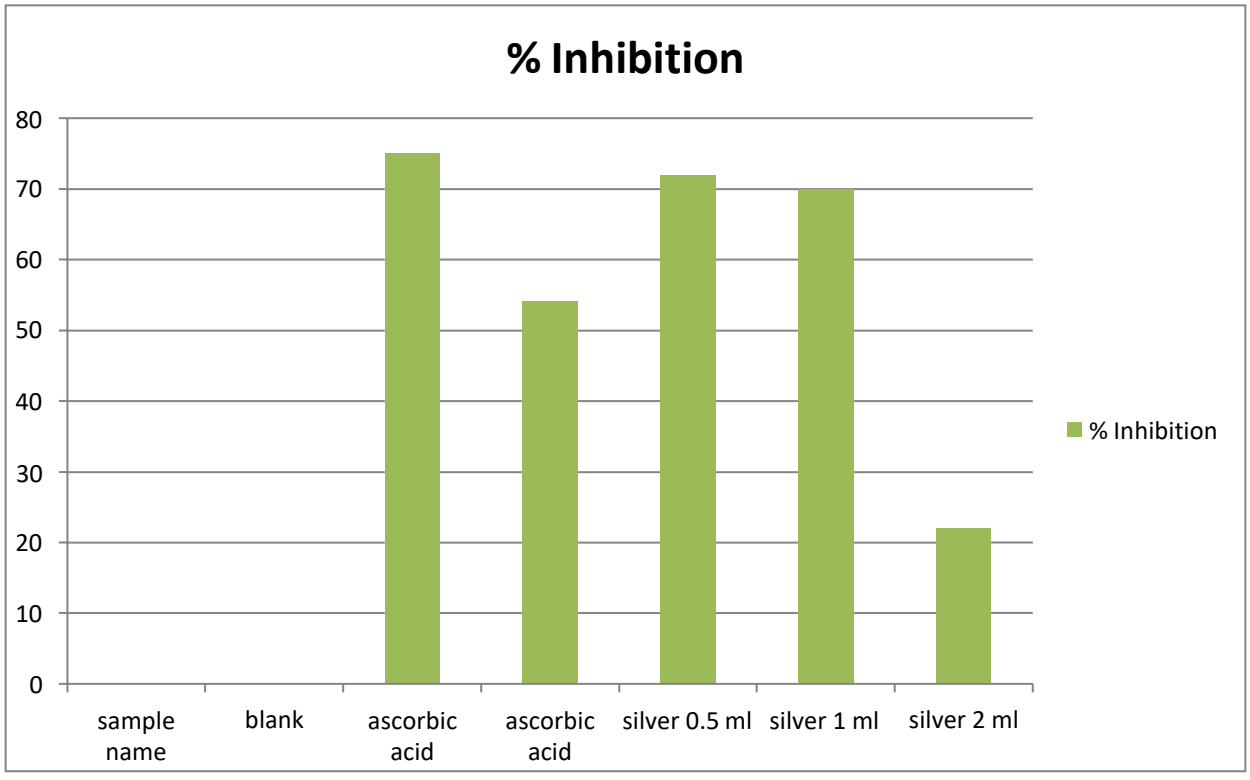


Fig no. 11 Graph DPPH assay of silver nanoparticles

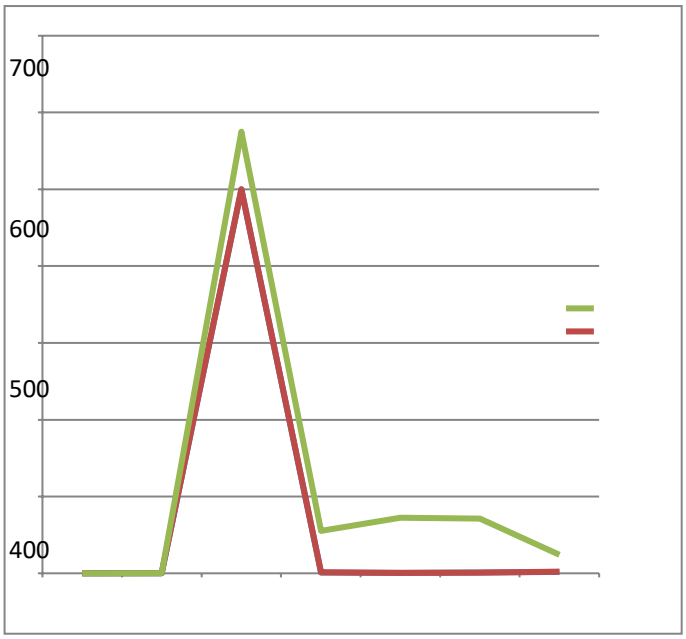


Fig no.12 Graph DPPH assay of silver nanoparticles

From the above experiment it could be concluded that Silver Nanoparticle solution have good antioxidant activity .RESULT AND DISCUSSION

The silver nanoparticle solution were successfully synthesized from aqueous extract of aerial roots of *Ficus benghalensis* Linn (Banyan tree) and characterized by phytochemical screening activity , UV ,FTIR, and FESEM Spectroscopy. Further their antioxidant activity was determined using DPPH free radical scavenging assay and they were shown have a good antioxidant activity. Result of phytochemical screening of aqueous and ethanolic extracts of aerial roots of *Ficus benghalensis* Linn.*(+)*indicates the presence of the constituents and (-)indicates the absence of constituents.

Table No3 .showing result of phytochemical screening of aqueous and ethanolic extract

Sr.NO	Primary and Secondary Metabolites	Aqueous Extract	Ethanolic Extract
1	Alkaloids	-	-
2	Glycosides	+	+
3	Carbohydrates	-	+
4	Terpenes	+	+
5	Saponins	+	+
6	Phenols	+	+
7	Tannins	+	+
8	Quinones	-	_

9	Cellulose	+	+
10	Flavonoids	-	-
11	Gums	+	-

Synthesis

Silver nanoparticles were synthesized , which results in the color changeof extract to dark reddish brown and powder was prepared.
UV analysis of silver nanoparticle solution

Synthesized silver nanoparticle was analyzed by UV spectra which showed wavelength at 491 nm .
FTIR of Silver Nanoparticles solution

-O-H Stretching peak at wavelength 2.94-3.11 m

-O-H Bending peak at wavelength 2.94-3.11 m

H-C=O Stretching peak at wavelength 3.47-3.77 m

-C=O Bending peak at wavelength 5.68-5.95 mC=C Stretching peak at wavelength 5.95-6.2 m
FE-SEM Analysis

Silver nanoparticles were subjected to FESEM in room temperature synthesized sample, of diameter of nanoparticles lies between 50 – 60 nm . This technique visualize the size of particles and result obtained was particle are in the spherical shape and averagely distributed in 60 mm range.DPPH assay of silver nanoparticle solution
Silver nanoparticle solution showed good antioxidant activity at 72%,70% and 22 % at 0.5 mg/ml,1 mg/ml and 2mg/ml concentration respectively. Although it was less than that of the standard(ascorbic acid) . Silver Nanoparticle solution at 0.5 mg/ml concentration showed 72% inhibitionis the best antioxidant activity compared to the rest(ascorbic acid).

Conclusion

The present study concludes the preliminary phytoconstituents of both the aqueous and ethanolic extracts of the aerial roots of *Ficus benghalensis* Linn
The biologically established ecofriendly and rapid synthesis of silver nanoparticles using *Ficus benghalensis* Linn of aqueous extract were shownto produce particles of fairly uniform size and shape providing easy , cost effective and proficient way for synthesis . The developed silver nanoparticles was observed by appearance of color change in the solution and by UV spectrophotometry. The FTIR analysis was meant to identify the function groups present in the silver nanoparticles containing aqueous extract which are responsible for reduction the synthesized particles ranged in size from 50-60 nm and where spherical in shape are confirmed by FE-SEM finally synthesized silver nanoparticles were emphasized the plant mediated synthesis with antioxidant effect of silver nanoparticle solution .It is however anticipated that the usage of nanotechnology will reinforce the future aspects to raise our knowledge with forceful declines in cost of nano- based food and medicine .

Acknowledgment

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