Plant Mediated Synthesis of Gold Nanoparticles from Litchi Seeds and its Antimicrobial Activity

Nayana V[1], Leela G R[1], Shwetha D Shetty[2], E. Jenitta Emima Packiyam[3]*

[1]P. G. Department of Biotechnology, Alva's college, Moodbidiri, Karnataka.
[2]UG Department of Biotechnology, Alva's college, Moodbidiri, Karnataka.
[3]Alva's centre for Research in Nano technology (PG Department of Biotechnology, Alva's college), Moodbidiri, Karnataka.

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1. Abstract

Green synthesis of nanoparticles has wide range of uses in various fields like pharmaceutical science, cosmetics, chemistry and biotechnology. In compare to other methods of nanoparticles synthesis, plant mediated synthesis of nanoparticles considered as informal, eco-friendly and also more effective. Gold nanoparticles are non-toxic to the human and also effective agent against several microorganisms. In the present study gold nanoparticles were synthesized by litchi seeds aqueous extract. Color changes from light yellow to purple color were observed was the primary conformation of the reduction process and the formation of gold nanoparticles. UV-Visible spectrometer analysis, Transmission Electron Microscopy (TEM), Fourier Transform Infrared Spectroscopy (FTIR) characterization techniques and antimicrobial activity were performed. The result reviews that UV-Vis spectrum absorption was at 528 nm. FTIR analysis reveals the presence of alcohol, carbonyl-carbon, sulphur, carbon with halogen groups. Size and morphology of the synthesized gold nanoparticles ranges 5-23 nm obtained by TEM analysis. The *Streptococcus spp* shows high sensitivity.

2. Key words: Gold nanoparticles, Litchi seeds, Fourier Transform Infrared Spectroscopy (FTIR), Transmission Electron Microscopy (TEM).

3. Introduction

Nanoparticles are very minute sized particles of having diameter about 1-100 nm. At present gold nanoparticles are very important and widely using nanoparticles metal in biomedical application because of its high therapeutic and medicinal properties. Gold nanoparticles which dispersed in water are known as Colloidal gold. Gold nanoparticles are the efficient carrier molecules for drug and gene delivery. Compare to other metals gold nanoparticles have several advantages for cellular imaging compare to other agents [Parvathy R. C *et al.,* 2015]. In case of DNA and RNA transfer, silencing and therapeutic purpose gold nanoparticles are more efficient [Goldic Oza *et al.,* 2016]. Gold nanoparticles are effective oxidation catalyst in both gas and liquid phase [Fatme Kerdi *et al.,* 2010]. Synthesis of nanoparticles from plant extract is more efficient method. Synthesis of gold nanoparticles by plant extract has advantage over physical and chemical methods because it is ecofriendly and simple [Saiqa Ikram et al., 2015].

Nanoparticles can synthesised by other various chemical and physical methods but, such method are dangerous to environment because of stabilizers used to stabilize the synthesized nanoparticles. Plant extract yield the large quantities of nanoparticles [Shaked Ahmed et al., 2015]. In present study gold nanoparticles are synthesized by Lychee seeds aqueous extract. *Litchi chenensis*is the botanical name of Lychee fruit which belongs to Sapindaceae family. Litchi fruit rich in Vitamin C, litchi fruit contains a polyphenol called Oligonol which acts as a excellent antioxidant. Ultimately the gold nanoparticles enhance the tumor killing property in anticancer drug.

4. Materials and Methods

4.1 Plant material collection

Litchi fruits (*Litchi chinensis*) were purchased in the local market of Moodbidiri, Karnataka, India in the month of April, 2019. Seeds were separated from the pulp they were washed with distilled water thrice and subjected for shade dry for 15-20 days. Dried seeds were grounded into fine powder using motor and pestle.

4.2 Synthesis of gold nanoparticles from Litchi seeds (Jayachitra A *et al.,* 2015)

Aqueous extract of seed was prepared by adding 2.5 gram of seed powder into 100 ml and kept in water bath at 60°c for 30 minutes; 0.002 M of auric chloride solution was prepared simultaneously. 5 ml of seed aqueous extract and 45 ml of auric chloride solution was mixed together and color change was occurred in the solution, indicates the nanoparticles synthesis. The obtained nanoparticles solution was stored at 4°C for further use.

5. Characterization of synthesized gold nanoparticles

5.1 UV-Vis spectroscopy (Tuzun B S *et al.,* 2017)

UV-Vis spectroscopy measures the weakening of strength of a stream of light when it passing through the sample. Optical property of nanoparticles is quite different they are sensitive to the size, shape, concentration and refraction index which makes UV-Vis spectroscopy a valuable tool to characterize and study the nanoparticles. The reduction of Au^{+} ions was monitored measuring the UV-Vis spectrum of the reaction medium at 8 hours after dilution of small amount of the sample in distilled water. UV-Vis spectral analyses performed by using UV-Vis spectrometer, gold nanoparticles were known to exhibit absorption maximum in the range of 400-700 nm.

5.2 Fourier Transform Infrared Spectroscopy

Fourier Transform Infrared Spectroscopy (FTIR) helps to reorganize the different functional groups in the synthesized nanoparticles solution. The lyophilized powder sample was preferred and spectral range is of 5000-4000cm^{-1}.

5.3 Transmission Electron Microscopy

Transmission Electron Microscopy was performed to study the morphology, particles size and crystal structure of synthesized gold nanoparticles. Technique that uses an electron beam to image a nanoparticles sample, providing much higher resolution than light based imaging techniques.

5.5 Antimicrobial activity (Henry F *et al.,* 2019)

Well diffusion method was followed to test out the antimicrobial activity. Antimicrobial activity of synthesized gold nanoparticles was tested against *Streptococcus .sp.* Muller Hinton agar plates were prepared than test organism was spread over the media and 7 mm cork borer was used to bore the wells. Wells were dispensed with different concentrations of synthesized nanoparticles solution i.e., 100 mg/ml and 200 mg/ml. Aurichloride was taken as positive control and aqueous extract of seed was used as negative control whereas antibiotic Pencillin G of 10 µg/ml as standard. The plates were incubated at 37°c for 24 hours later zone of inhibition was measure.

6. Results

In the present study the process of reduction of the gold ions from the litchi seed extract can be observed, color of the solution was changed from light yellow to purple color (Plate :01). The uniqueness was seen in this interaction, shading change in arrangement noticed quickly the auric chloride arrangement was blended with aqueous extract of litchi seed which demonstrates the gold nanoparticles development. Whereas the gold ions present in the reaction mixture has been converted into elemental gold particles with nano metric size.

Plate 01: Color changed after adding auric chloride

The formation of the gold nanoparticles was affirmed by means of UV – Visible spectroscopy where ingestion range was 400-700 nm. The arrangement of gold nanoparticles was at first affirmed by UV-Visible spectroscopy. The greatest absorption was at 528.4 nm (Fig: 01).

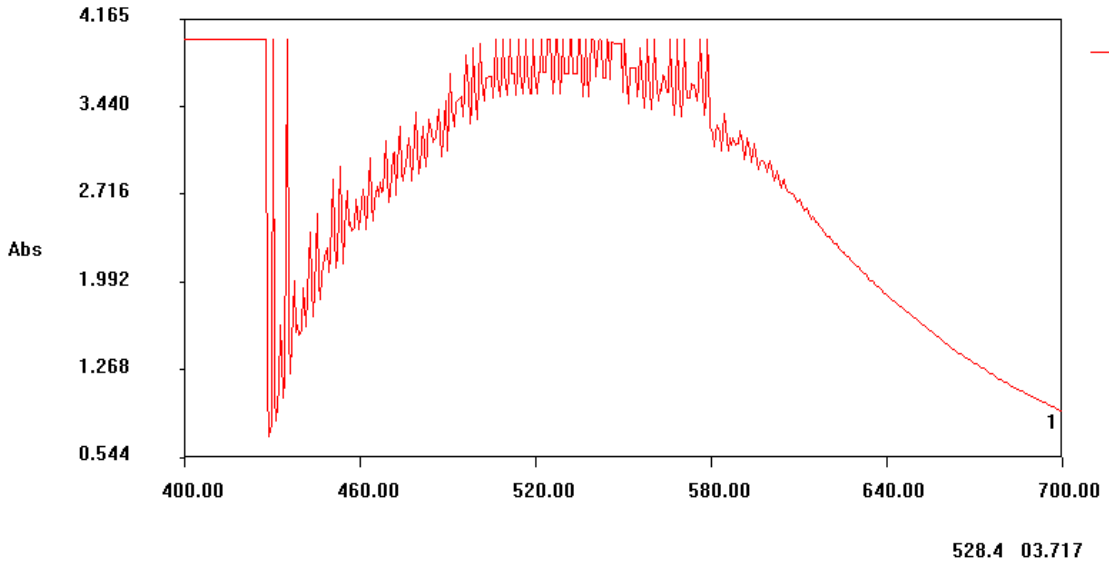

Fig 02: UV-Visible spectroscopy

In the present study lyophilized sample was used for FTIR analysis for the identification of the functional groups present in the sample. The peak appears in 3000 – 3500 cm^{-1} range reflects the presence alcohol group, 1708.93 cm^{-1} assigned carbonyl-carbon group, 1033.85 cm^{-1} assigned sulphur and may be carbon with halogen and 1201.65 cm^{-1} assigned ether groups (Fig: 02).

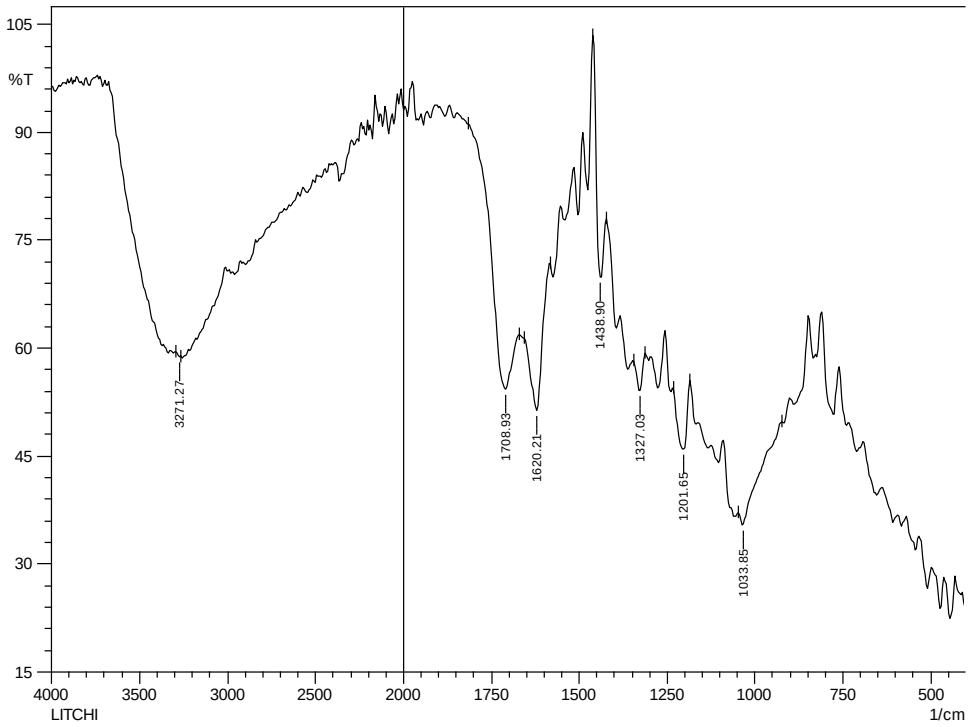

Fig 02: Fourier Transform Infrared Spectroscopy (FTIR)

The morphology and size of the synthesized nanoparticles was investigated by using Transmission Electron Microscopy. Average size the nanoparticles was 5-23 nm (Plate: 03) with spherical shape.

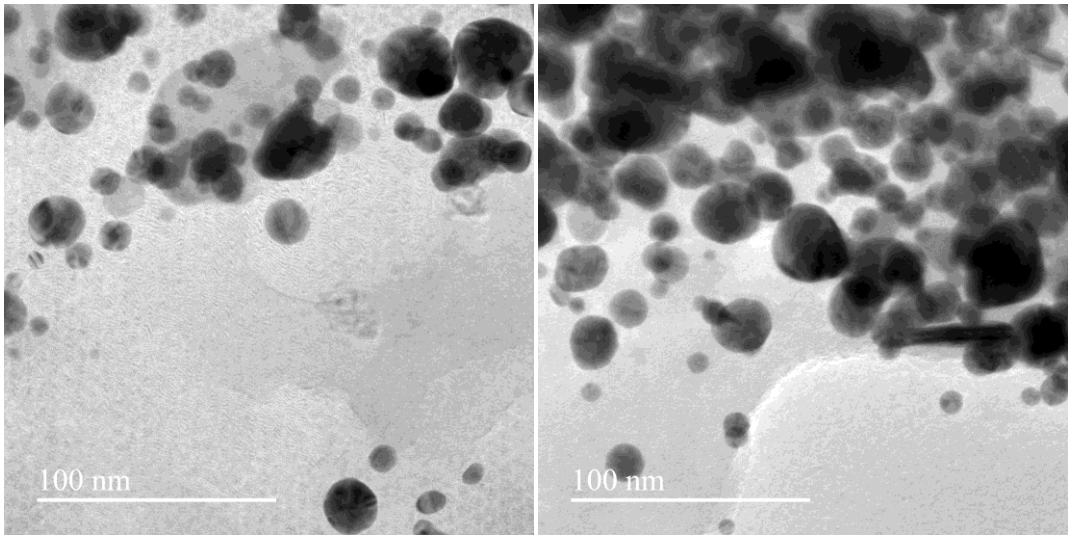

Plate 03: Transmission Electron Microscopy

Synthesized gold nanoparticles showed inhibition zone against *Streptococcus .sp* in different concentrations i.e. 100 mg/ml, 200 mg/ml (Table: 1). The zone of inhibition in the 20, 40 and 60 mg/ml concentrations is less significant compare to 100 mg/ml, 200 mg/ml concentration (Plate: 04).

Table 01: Anti-microbial activity in different concentration

Test organism	Zone of inhibition for different concentration of gold nano particles extract in millimeter (mm)				
	100 mg/ml	200 mg/ml	Standard	Positive control	Negative control
Streptococcus.sp	0.5	0.9	0.4	1.4	0.1

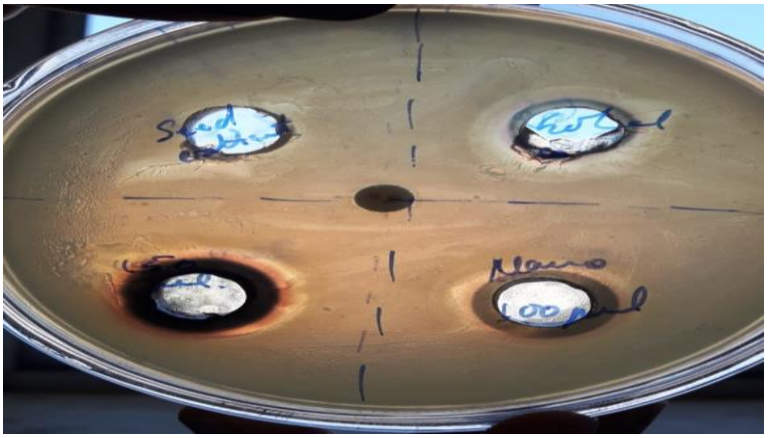

Plate 04: Antimicrobial activity against *Streptococcus .sp*

7. Discussion

In the current study, color change demonstrates the presence of gold nanoparticles. The presence of gold nanoparticles was additionally affirmed by depiction techniques. In present study 528.4 nm was the maximum absorption in UV-Vis spectral analysis. Similar type of researches were carried by Shameli K *et al.,* 2016, Chen M N *et al.,* 2019, Sett A *et al.,* 2016, Sundarapandian S M *et al.,* 2018, Leon E R *et al.,* 2019 in which maximum absorption reported at 540-550 nm, 533 nm, 530-535 nm, 533 nm, 280 nm respectively. In the present study 5-23 nm gold nanoparticle size was recorded via Transmission Electron Microscopy technique. Same type of research carried by Shameli K *et al.,* 2016, Yulizar Y *et al.,* 2017, Ismail E H *et al.,* 2018, Geetha R *et al.,* 2013 whereas synthesized gold nanoparticles were in the size of 32.96 nm, 5-20 nm, 16-95 nm, 7- 48 nm respectively. In current study synthesized gold nanoparticles shows poor significance in 20, 40 and 60 mg/ml concentrations against *Streptococcus .sp* and the concentration like 100 mg/ml and 200 mg/ml shows higher significant against above test organism. Similar work by Haliza Katas *et al.,* 2018 and Folorunso A *et al.,* 2019 , synthesized gold nanoparticles was showed inhibition against *Pseudomonas sp*, *Staphylococcus sp*, *Bacillus sp* and *Staphylococcus sp*, *Klebsiella sp*, *Clostridium sp* respectively.

8. Conclusion

In the present study gold nanoparticles was synthesized from aqueous extract of *Litchi chinensis* seeds, initially color change in the solution was observed as soon as aqueous extract was mixed with aurichloride solution. The color changed from yellow to purple was reported. The maximum absorption of UV- Vislible radiation was at 528.4 nm. Alcohol, carboxylic acid, ester, ether are the functional group was recorded via FTIR analysis. The synthesized gold nanoparticles size 5-23 nm was recorded by TEM analysis technique. Antimicrobial efficiency of synthesized nanoparticles was examined against *Streptococcus .sp* where as higher significance was recorded in 100 and 200 mg/ml, lower significance in 20, 40, 60 mg/ml concentrations.

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