



**International Journal of Biology, Pharmacy
and Allied Sciences (IJBPAS)**

'A Bridge Between Laboratory and Reader'

www.jibpas.com

SYNTHESIS AND CHARACTERIZATION OF SILVER AND GOLD NANOPARTICLES FROM *BRYONOPSIS LACINIOSA* FRUIT EXTRACT

RAMYA B^{1*}, SARUMATHI V², ANISHA M², MOWLINA S S², DHARUNIKA S² AND
DEEPIKA S²

1: Faculty of PG Department of Biochemistry, Holy Cross College (Autonomous)
Tiruchirappalli, Tamil Nadu, India

2: Students of PG Department of Biochemistry, Holy Cross College (Autonomous)
Tiruchirappalli, Tamil Nadu, India

*Corresponding Author: Dr. B.Ramya: E Mail: ramyagps06@hcctrichy.ac.in

Received 14th April 2023; Revised 15th May 2023; Accepted 8th Aug. 2023; Available online 1st April 2024

<https://doi.org/10.31032/IJBPAS/2024/13.4.7927>

ABSTRACT

Plant-based nanomaterial synthesis is becoming increasingly common due to its environmental friendliness and cost-effectiveness. The biological activities of silver and gold nanoparticles (AgNPs and AuNPs) synthesized from *Bryonopsis laciniosa* fruit extract were investigated in this research. The green synthetic method was used to make AgNPs and AuNPs which were then analyzed using UV-Visible spectroscopy, FTIR, SEM, and EDAX. Diphenyl-1-picryl hydrazyl radical scavenging assay was used to determine the antioxidant ability of *Bryonopsis laciniosa*. In the UV-Vis spectrum, the synthesized BL AgNPs and AuNPs displayed a characteristic absorption peak. The biomolecules contained in fruit extract were responsible for reducing and capping the material of silver and gold nanoparticles, according to FTIR spectra. The particles were found to be crystalline with a face-centered cubic (FCC) structure, according to an XRD study. The AgNPs and AuNPs were mostly spherical, with an average size ranging from 103.2-124.84 nm, according to SEM and EDAX data. Furthermore, the Diphenyl-1-picryl hydrazyl radical scavenging assay (DPPH) revealed that they could be used as a potential scavenger against

free radical-induced damage. The current study looked into whether *Bryonopsis laciniosa*, an efficient producer of AgNPs and AuNPs could be used as a safe and cost-effective antioxidant. These results support further research into *Bryonopsis laciniosa* AgNP and AuNPs for biological applications.

Keywords: Photosynthesis, *Bryonopsis laciniosa*, Silver, Gold nanoparticles, Antioxidant

1. INTRODUCTION

Due to global problems associated with environmental issues, 'green' environment-friendly processes in chemistry and chemical technologies are becoming increasingly common and are much needed [1]. Silver and Gold are most common commercialized nanomaterials, with annual production of 500 tons nanoparticles [2, 3]. The latest field of research in nanomedicine is the use of inert materials such as silver, gold, and platinum to synthesize nanoparticles and their best use in various biomedical applications. These nanoparticles' surface plasmo resonance (SPR), which can be easily detected using a UV-Vis spectrophotometer, has received much more attention than other nanoparticles [4]. The use of environmentally friendly materials such as plants, bacteria, and fungi to make AgNPs and AuNPs is a new branch of nanotechnology [5]. Green synthesized materials are used in pharmaceutical and biomedical applications due to their environmentally friendly and compatible existence [6, 7]. Due to the ineffectiveness of synthetic antibiotics against drug-resistant

bacteria, interest in silver, which has a long history as an antibacterial agent [8], has resurfaced. Antioxidants, as described by Halliwell and Gutteridge, are natural or synthetic substances that can protect or delay cell damage caused by oxidants (ROS, RNS, free radicals, and other unstable molecules) [9]. The use of nanoparticles as therapeutic agents has opened up a new avenue for medical care [10]. Plants have natural capping agents and are free of harmful chemicals, making them ideal for the production of silver nanoparticles [11].

The fruit extract of *Bryonopsis laciniosa* was used in this study for the rapid synthesis of AgNPs and AuNPs which was found to be easy, cost-effective, and viable. The Cucurbitaceae family includes *Bryonopsis laciniosa*. Shivlingi is used as an aphrodisiac in traditional medicine. It also helps men become more fertile [12] it boosts the body's masculinity and testosterone levels. It is thought to be a testosterone booster. It is used to treat impotence in men as a result of this. Shivlingi seeds have spermatogenic properties

as well. As a result, shivlingi seeds increase the overall count. [13, 14]. If the patient has excess Kapha Dosha or signs of increased or exacerbated Kapha, shivilingi seeds are recommended in cases of impotence and oligospermia, according to Ayurveda. Shivlingi clears excess Kapha and Ama from the body, reducing blockages in many channels. This mechanism also increases the supply of nutrients to the testes and blood flow to the male reproductive organs, which aids in the spermatogenesis process. Antimicrobial [15] anti-inflammatory [16] and analgesic [17, 18] properties are also found in fruit. As a result, the current research aims to synthesize silver and gold nanoparticles from *B. laciniosa* aqueous extract, characterize synthesized nanoparticles, and investigate potential antioxidant activities [19].

2. MATERIALS AND METHODS

Collection and Preparation of *Bryonopsis laciniosa* fruit extract

Bryonopsis laciniosa (Linn) fruit was collected from Ramanathapuram District. Each specimen was washed under running tap water, labeled, weighed and annotated with the date of collection. Each specimen dried at 37°C for 15 days, powdered and stored in air tight container. 2gm of dried finely powdered plant material was taken in a beaker. 30ml of distilled water and 70ml of methanol was

added. The mixture was shaken by continuous stirring at room temperature for 30 minutes and kept for 2 days [21]. Then the solvent was allowed to evaporate and the extract was used for the analysis [20]. The prepared extract was subjected to Qualitative and estimation of phytochemicals. Identification of bonds and functional groups by UV-Visible and FTIR spectroscopy [20], Morphology prediction by Scanning Electron Microscopy, Elemental signal of silver and gold nanoparticles by EDX analysis and In vitro Antioxidant activity [20].

3. RESULTS AND DISCUSSION

3.1 Visual color change

At room temperature, the color of the samples gradually changed from colorless to dark brown, indicating that Ag⁺ was being bio reduced in the fruit extract. The AuNPs exhibit brown colour in due to excitation of surface plasmon vibrations. Thus, the appearance of brown color in the reaction mixture indicated the formation of AgNPs and AuNPs (Figure 1) [21, 22, 25].

3.2 UV Visible Spectroscopic Analysis for Identification of Bonds in *Bryonopsis laciniosa* fruit Extract

UV-Visible spectroscopy was used to identify compounds with -bonds, -bonds, and lone pair of electrons, chromophores, and aromatic rings; the profile revealed peaks at 437 nm and

410nm for the fruit-AgNPs and AuNPs (**Figure 2**). The presence of peaks indicates that the absorption bands are caused by flavonoids, phenol, and their derivatives present in the extract. Thus, we establish that the fruit contains the highest concentrations of flavonoids, phenols, and their derivatives, all of which exhibit potent pharmacological activity [22,19].

3.3 FTIR Spectroscopic Analysis for Identification of Functional Groups in *Bryonopsis laciniosa* fruit Extract

The FT-IR spectrum of synthesized elucidates the functional group involved in the reduction of silver ions and gold metal (**Figure 3**). The FT-IR spectrum of silver and gold nanoparticles synthesized and these spectra strongly indicated the presence of flavonoids and phenols, which were primarily responsible for the formation of silver and gold nanoparticles via silver nitrate reduction. According to the FTIR spectral analysis, the hydroxyl and carboxyl groups present may act as reductants and stabilizers, while the phenolic group may act as a capping agent [20, 19].

3.4 Scanning electron microscopy

The silver nanoparticles' surface morphology, size, and shape were analyzed using a scanning electron microscope. Silver nanoparticles synthesized from *Bryonopsis*

laciniosa fruit extract are shown in **Figure 4**. SEM images of silver nanoparticles synthesized at 124.84 and 103.2 nm. SEM analysis reveals that the majority of synthesized silver nanoparticles are nearly spherical and cubic in shape. Due to the presence of biomolecules in the fruit extract, spherical silver nanoparticles and cubic silver nanoparticles were synthesized as secondary metabolites [21, 23, 26, 27].

3.5 EDX analysis for the elemental signal of silver nanoparticles

The elemental signal of silver nanoparticles was verified using an energy dispersive X-ray (EDX) spectrometer. The vertical Y-axis represents the number of X-ray counts, while the horizontal X-axis represents the energy in KeV. The silver nanoparticles' EDX spectrum is shown in **Figure 5** with additional oxygen peaks due to biomolecules attached to the silver nanoparticles' surface. Silver nanoparticles are reduced by sample's silver weight percentage of 60.34 percent, as determined by EDX spectra and shown in **Figure 5** [22].

3.7 ANTIOXIDANT ACTIVITY OF SYNTHESIZED SILVER NANOPARTICLES BY DPPH ASSAY:

Silver nanoparticles synthesized from *Bryonopsis laciniosa* fruit extract demonstrated the highest antioxidant activity

at high concentrations when compared to ascorbic acid. Silver nanoparticles synthesized in the laboratory demonstrated a 53.90 percent efficiency at a concentration of 100 g/ml, whereas ascorbic acid demonstrated an efficiency of 83.59 percent at the same

concentration (**Figure 6**). Previous research indicated that the alcoholic extract of *Bryonopsis laciniosa* possessed increased antioxidant activity, as measured by reducing power and the DPPH assay [27 & 28].

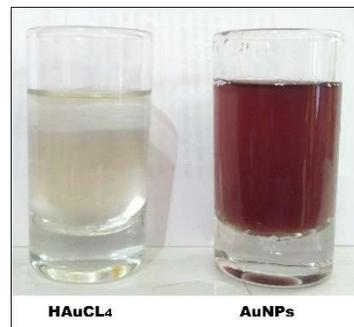


Figure: 1a - Visual color change of silver and b Visual color change of Gold

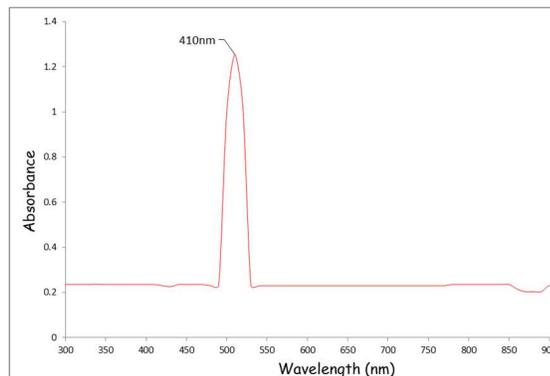
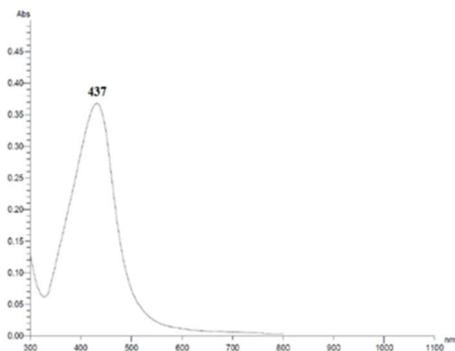


Figure 2: UV-Vis spectrum of synthesized silver and Gold nanoparticles of *Bryonopsis laciniosa*

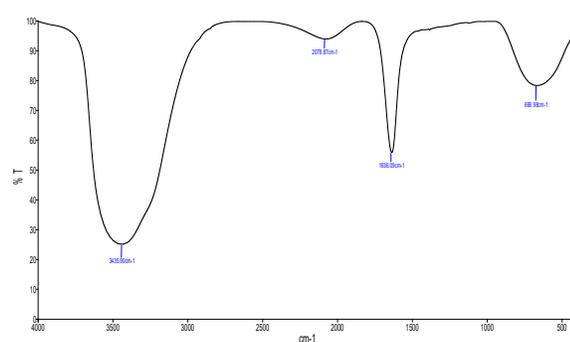
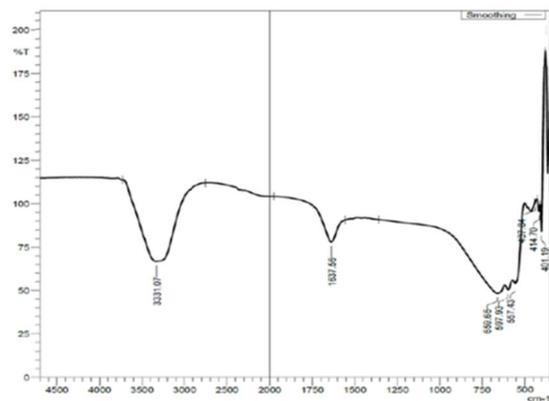


Figure 3: FT-IR spectra of synthesized silver and gold nanoparticles

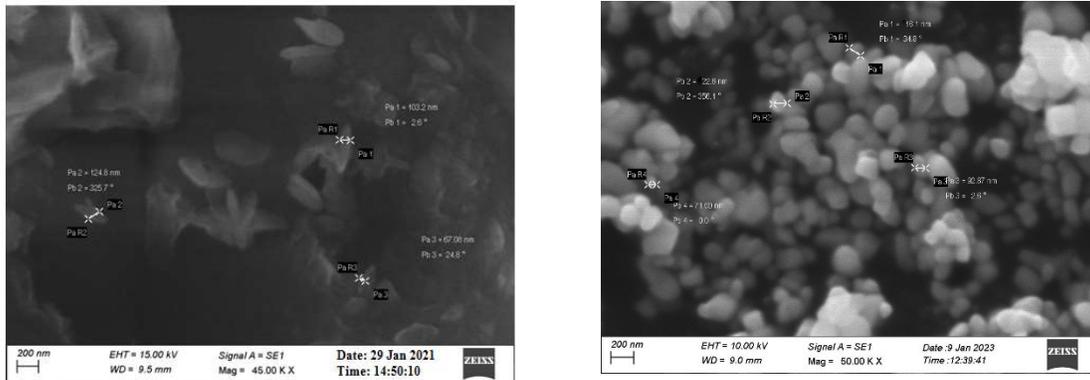


Figure 4: High resolution scanning electron microscopic (SEM) image of AgNPs &AuNPs

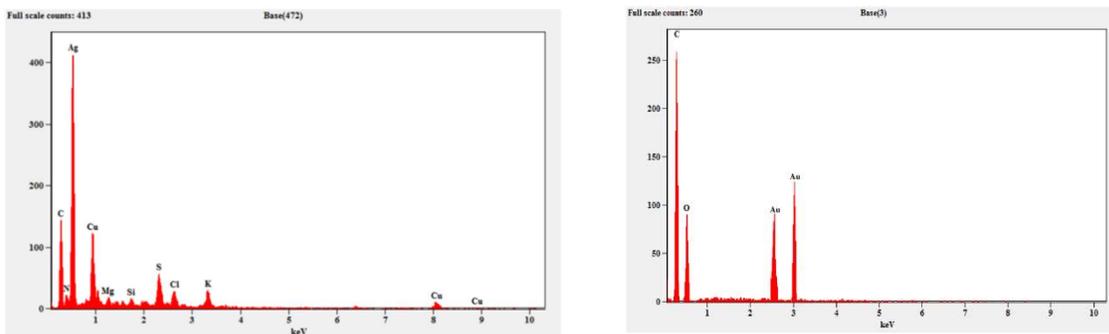


Figure 5: EDX spectrum of synthesized silver nanoparticles

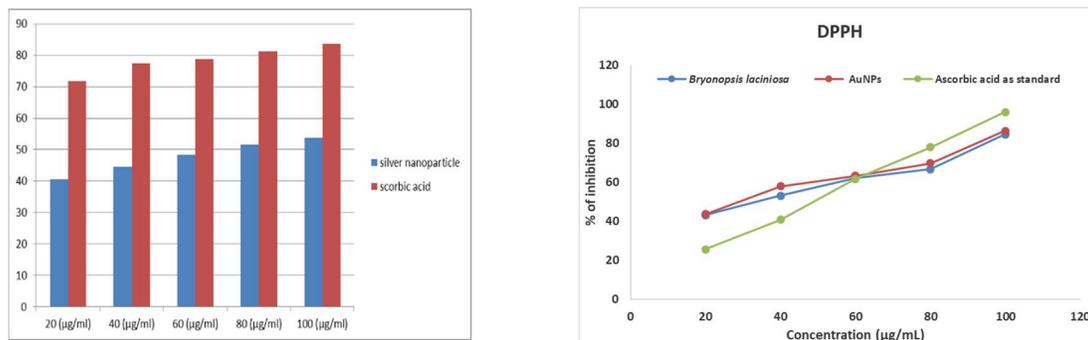


Figure 6: Antioxidant activity of synthesized silver nanoparticle using the fruit of *Bryonopsis laciniosa* by DPPH activity

CONCLUSION

The primary objective of the green synthesis of silver nanoparticles is to develop a method for mitigating the negative effects of physical and chemical methods. Silver nanoparticles were synthesized from the fruit of *Bryonopsis laciniosa* and the corresponding peak intensity at 437 nm was determined using UV-

visible spectroscopy. The FTIR analysis of the silver nanoparticles revealed the presence of functional groups. SEM analysis demonstrates that the silver nanoparticles synthesized are spherical. The XRD analysis revealed that the silver nanoparticles have a face-centered cubic crystal structure. Energy Dispersive X-ray analysis was used to confirm

the primary composition of silver nanoparticles. In conclusion, the results indicate that the silver nanoparticle synthesized from the fruit of *Bryonopsis laciniosa* possesses significant antioxidant activity.

Ethical Approval and Consent to participate:

The authors declare that article have no Ethical issues.

Funding

The authors declare that no funds generated from any source to complete this work

Acknowledgment:

The authors gratefully acknowledge the Holy Cross College (Autonomous) Tiruchirappalli, Tamilnadu, India for providing this opportunity for students to do this work at Under Graduate level.

Conflict of Interests:

The authors declare that there is no Conflict of Interest.

REFERENCE:

[1] Thuesombat, P., Hannongbua, S., Akasit, S., & Chadchawan, S. Effect of silver nanoparticles on rice (*Oryza sativa* L. cv. KDML 105) seed germination and seedling growth. *Ecotoxicol. Environ. Saf.* 2014;104: 302-309.

[2] Larue, C., Castillo-Michel, H., Sobanska, S., Ce'cillon, L., Bureau, S., Barthe's, V., *et al.* Foliar exposure of the crop *Lactuca sativa* to silver nanoparticles: evidence for internalization and changes in Ag speciation. *J. Hazard. Mater.* 2014: 264, 98-106.

[3] Ananda Lakshmi K, Venugobal J, Ramasamy V. Characterization of silver nanoparticles by green synthesis method using *pedalium murex* leaf extract and their antibacterial activity. *Appl Nanosci*; 2016: 6:399-408.

[4] Abbai R, Mathiyalagan R, Markus J, Kim Y, Wang C. Green synthesis of multifunctional silver and gold nanoparticles from the oriental herbal adaptogen siberian. *Int J Nanomed*: 2016;11:3131-43.

[5] Panel Shakeel Ahmed Saifullah Mudasir Ahmad Babu Lal Swami Saiqa Ikram. Green synthesis of silver nanoparticles using *Azadirachta indica* aqueous leaf extract. *J. Radiat. Res. Appl. Sci.* 2016;9:1:1- 7

[6] Suresh G, Gunasekar PH, Kokila D, Prabhu D, Dinesh D. Green synthesis of silver nanoparticles using *Delphinium denudatum* root extract exhibits antibacterial and mosquito

- larvicidal activities. Spectrochim Acta part A; 2014;127:61-6.
- [7] Saleih S, Shanidiz SAS, Ghanbar F, Darvish MR, Ardestani MS. Photosynthesis of silver nanoparticles using *Artemisia marschallian asprengel* aerial part extract and assessment of their antioxidant, anticancer, antibacterial properties. Int J Nanomed; 2016;11:1835-46
- [8] Wan G, Ruan I, Yin Y, Yang T, Ge M. Effects of silver nanoparticles in combination with antibiotics on the resistant bacteria *Acinetobacterbaumanni*. Int. J. Nanomed;2016: 11:3789-800.
- [9] Guru Nathan S., Park J.H., Han J.W., Kim J.H. Comparative assessment of the apoptotic potential of silver nanoparticles synthesized by *Bacillus tequilensis* and *Calocybe indica* in MDA-MB-231 human breast cancer cells: Targeting p53 for anticancer therapy. Int. J. Nanomed; 2015;10:4203–4222.
- [10] Xi-Feng Zhang, Zhi-Guo Liu, Wei Shen, and Sangiliyandi Guru Nathan. Silver Nanoparticles: Synthesis, Characterization, Properties, Applications, and Therapeutic Approaches. Int J Mol Sci.; 2016;17:9:1534.
- [11] S. Iravani, H. Korbekandi, S.V. Mirmohammadi, and B. Zolfaghari. Synthesis of silver nanoparticles: Chemical, physical and biological methods. Res Pharm Sci. 2014; 9(6): 385–406.
- [12] Chaudhary Vivek Murlidhar, Avlaskar Amit D. Role of Shivilingi in Infertility. J Homeop Ayurv Med 2013;2:141.
- [13] Ramya B., T. Malarvili and S. Velavan. Evaluation of Phytoconstituents of *Bryonopsis laciniosa* Fruit Extract. Int. J. Pharm. Sci. Res., 2015; 6:8:1000-1005.
- [14] Alpana S Moghe, Sudha G Gangal, Priya R Shilkar. In vitro cytotoxicity of *Bryonia laciniosa* (Linn.) Naud, on human cancer cell lines. Ind J Nat Products and Resources 2011; 2:3:322-329
- [15] Bonyadi Rad Ehsan, Awad Vital, Nirichan Kunchiraman Bipinraj. Antimicrobial activity of the ethanolic extract of *Bryonopsis laciniosa* leaf, stem, fruit, and seed. Afr J Biotechnol 2009;8:15: 3565-3567.

- [16] Gupta M, Mazaumdar UK, Siva Kumar T, Vamsi ML, Karki SS, *et al.* Evaluation of anti-inflammatory activity of chloroform extract of *Bryonia Laciniosa* in experimental Animal Models. *Biol Pharm Bull* 2003;26:1326-1344.
- [17] Siva Kumar T, Perumal P, Kumar RS, Vamsi ML, Gomathi P, *et al.* Evolution of analgesic, antipyretic activity and toxicity study of *Bryonia lasiniosa* in mice and rats. *Am J Chin Med* .2004;32: 531-539
- [18] Reddy Jayarama, Gnanasekaran D, Vijay D, Ranganathan TV. In vitro studies on anti-asthmatic, analgesic and anti convulsant activities of the medicinal plant *Bryonia laciniosa*. *Linn. Int J Drug Discovery* .2010;2:2:1-10
- [19] T. Malarvili, Ramya B, S. Velavan. In Vitro Antioxidant Activity of *Bryonopsis laciniosa* Fruit Extract. *Indian journal of applied research* 2015;5:6:262-266.
- [20] N. SrinivasaRao, Mandava V, V. Basaveswara Rao, Green synthesis, characterization and biological studies on silver nanoparticles in *Caesalpina bonduc* bark extract; *Der Pharma Chemica*, 2016: 8:18:14-19.
- [21] Kero Jemal, B. V. Sandeep, and Sudhakar Pola. Synthesis, Characterization, and Evaluation of the Antibacterial Activity of *Allophyl usserratus* Leaf and Leaf Derived Callus Extracts Mediated Silver Nanoparticles. *J. Nanomater.* 2017:1:1-11.
- [22] Chandra Sekhar Espenti, K.S.V. Krishna Rao, K. Madhusudana Rao. Bio-synthesis and characterization of silver nanoparticles using *H. enneaspermus* leaf extract and evaluation of its antibacterial potential, *Mater. Lett.* 2016:174:129-133
- [23] Rajkiran Reddy Banala, Veera Babu Nagati, Pratap Reddy Karnati Green synthesis and characterization of *Carica papaya* leaf extract coated silver nanoparticles through X-ray diffraction, electron microscopy, and evaluation of bactericidal properties. *Saudi J. Biol. Sci.* 2017:22, 637–644
- [24] S Anbalagan; M Sankareswaran; P Rajendran; M Karthikeyan. *World J. Pharm. Pharmaceut. Sci.* 2015: 4: 3: 1136-1144.
- [25] S. Rajeshkumar Synthesis of silver nanoparticles using the bark of *Pongamia pinnata* and their

- antibacterial activity; Resource-Efficient Technologies; 2016: 2:1:30-35.
- [26] S. Sreegayathri, Dr. (Mrs). Rachel Regi; Dr. Shebagarsdhai Daniel. Studies on green synthesis of silver nanoparticles and their characterization using leaf extracts of *H. enneaspermus*; Int. J. Res. Biol. Sci; 2015: 4: 2: 29-35.
- [27] Asha Rani, P. V., Low KahMun, G., Hande, M. P., and Valiyaveetil, S. Cytotoxicity and genotoxicity of silver nanoparticles in human cells. ACS Nano. 2009:3:279-290.
- [28] A. Bagyalakshmi; A. Haritha, Green synthesis of silver nanoparticles in *Pterocarpus marsupium* and their antidiabetic activity; Am. J. Adv. Drug Deliv.; 2017: 5: 3: 118-130.