LIPS International Journal of Interdisciplinary Research Volume 1, Issue 2, October 2024 - SPECIAL ISSUE
Proceedings ISBN 978-93-94174-47-4 "International Conference on interdisciplinary research, education and job scope"

# ANTIBACTERIAL ACTIVITIES OF *SYZYGIUM AROMATICUM* LEAVES ASSISTED GOLD NANOPARTICLES

M. Amalin Sobi[1], S. Sajeena Beevi[2], M.R. Bindhu[3]*

[1]Department of Physics and Research Centre, Women's Christian College, Nagercoil, Affiliated to Manonmaniam Sundaranar University, Abishekapatti, Tirunelveli, Tamilnadu, India.
[2]Department of Physics and Research Centre, St.Jude's College, Thoothoor, Affiliated to Manonmaniam Sundaranar University, Abishekapatti, Tirunelveli, Tamilnadu, India.
[3]Department of Physics, Sree Devi Kumari Women's College, Kuzhithurai-629163, Tamilnadu, India.
*Email: bindhufm@gmail.com; Tele:04651260344

## Abstract

Nowadays, nanoparticles such as gold nanoparticles (AuNPs) with specific biophysical characteristics have attracted remarkable attention as innovative options for the diagnosis and treatment of different diseases. In the present research, AuNPs were green synthesized using the *Syzygium aromaticum* leaves (SAL) extract as an inexpensive and eco-friendly synthesis method. Then the physicochemical properties were characterized by X-ray diffraction (XRD), UV-vis absorption spectroscopy (UV–vis) and Transmission Electron Microscope (TEM).

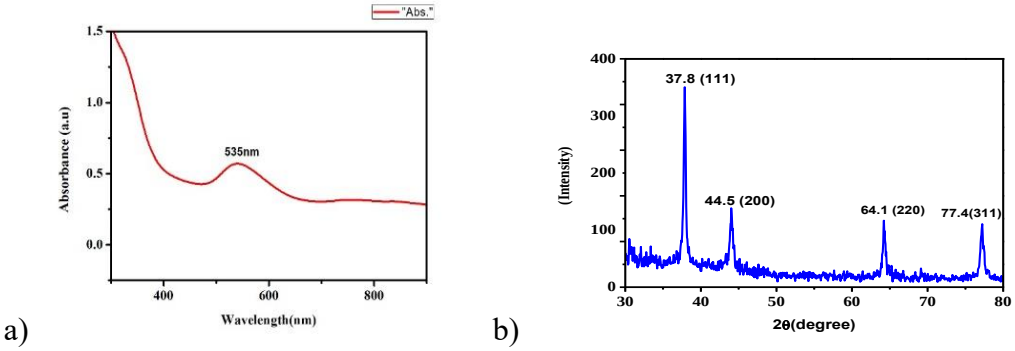
## 1.Introduction

Nanotechnology has attracted a great interest in recent years due to its expected impact on many areas such as energy, medicine, and electronics [1]. Currently there is a growing need to develop environmentally benign colloidal nanoparticles synthesis process that does not involves any toxic chemicals in the synthesis protocol which raises great concern for environmental reasons [2]. Among the nanoparticles, gold nanoparticles (AuNPs) have received major attention due to their unique and tunable Surface Plasmon Resonance (SPR) [3]. It has many effective applicationsin biomedical sciences including drug delivery, photothermal therapy, and immunochromatographic identification of pathogens in clinical specimens [4]. Biosynthesis of AuNPs using microorganisms like bacteria [5], fungi [6] and yeast [7] are already exploited. However, biosynthesis of nanoparticles by plant extracts is currently under exploitation. *Syzygium aromaticum* (clove) is a traditional spice that has been used for food preservation and possesses various pharmacological activities. *Syzygium aromaticum* is rich in many phytochemicals as follows: sesquiterpenes, monoterpenes, hydrocarbon, and phenolic compounds. It is a medicinal plant having various therapeutic applications including antimicrobial, anticancer and anti-inflammatory activities [8].

## 2. Materials and Methods

For the synthesis of AuNPs, 5 ml of SAL extract was added to aqueous solution of $HAuCl_4$ (1 mM) and stirred continuously for 15 min and it was turned to pink color after 6 h which gives SAL-AuNPs. Then the dried samples in an Muffle furnace at 100°C for two hours. The obtained powder was stored for further characterizations such as XRD, UV–vis, and TEM.

## 3. Results and Discussion



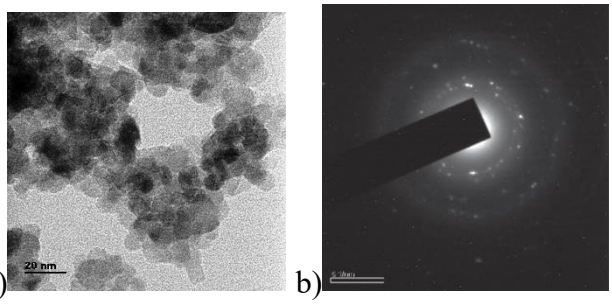

a) b)

Fig. 1. a) UV-vis Spectrum, and b) XRD analysis of SAL-AuNPs.

The UV-vis absorption spectrum of SAL-AuNPs is shown in (Fig.1). SPR is a collective excitation of electrons in the conduction band around the nanoparticle surface. The color of the $HAuCl_4$ solution changed from transparent to light or ruby red, indicating the formation of SAL-AuNPs. The visible red color is due to the reduction of $Au^{3+}$ to $Au^0$ [9]. The characteristic absorption peak centered at 535 nm, indicating the formation of nanoparticles and are polydispersed (Fig. 1 (a)). This result is accordance with the results obtained from bio reduction of gold nanoparticles using SAL extract.

Fig. 1 (b) shows the XRD pattern, of AuNPs. The diffraction peaks at 2θ = 37.8°, 44.6°, 64.1° and 77.4° were indexed with the planes (111), (200), (220), and (311) for the resultant particles with FCC phase. The XRD diffractions of AuNPs with [JCPDS card no. 04-0784] extract match with previously reported results [10]. The average crystalline size of the SAL-AuNPs calculated using the Debye-Scherrer’s formula was found to be 22 nm. The SAL extract has completely bio reduced the gold with high purity. This result reveals that the green synthesis of AuNPs forms with a highly stable form of Au.

TEM images of AuNPs derived from higher concentration of SAL is shown in Fig. 2(a). TEM analysis explicates the size and morphology of the obtained particles. It reveals that the AuNPs are spherical shaped. The particles sizes in the range 15 nm. The SAED pattern of SAL-AuNPs shown in Fig. 2 (b) confirmed its crystalline nature.




a) b)

Fig. 2 TEM images of SAL-AuNPs

The antibacterial activity of synthesized AuNPs was evaluated by agar well diffusion method. The antibacterial activity of SAL against gram positive *(S. aureus*) and gram negative bacteria (*P. aeruginosa*) was shown in Fig. 3. The high zone of inhibition was observed in the range of 23 mm. Based on Fig. 4,it can be concluded that *P. aeruginosa* was more active and inhibits greatest bacterial effect. In our results, the gram positive bacteria showed lower zone of inhibition while gram negative bacteria showed better results. This characteristic enhances biological and chemical activity of the nanoparticles with high antibacterial efficacy.

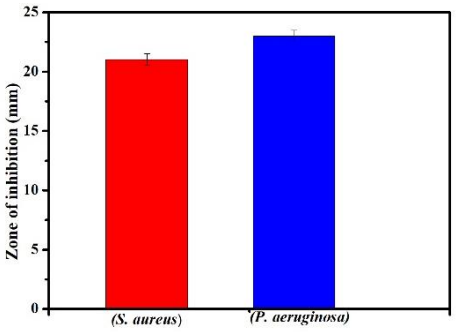



Fig.3. Zone of inhibition of synthesized SAL-AuNPs

## 4. Conclusion

The green synthesis method is eco-friendly and capable of producing AuNPs at room temperature. UV–vis absorption spectra show the (SPR) at 535 nm which is the characteristic peak of AgNPs. XRD patterndemonstrated the polycrystalline nature of AuNPs. The average crystallite size of AuNPs is 22 nm. HR-TEM image showed its size distribution in the range 15 nmand spherical morphology. The stronger antibacterial inhibition was observed in gram negative bacteria compared to gram positive bacteria.

## Reference

[1]. Cao, G. (2004). London: Imperial College Press.
[2]. Jensen, T. R., Malinsky, M. D., Haynes, C. L., Duyne, R. P., & Van. (2000). The Journal of Physical Chemistry B, 104, 10549–10556.
[3]. Tsuji, T., Kakita, T., & Tsuji, M. (2003). Applied Surface Science, 206, 314–320.
[4]. [Sivakumar, M., Venkatakrishnan, K., & Tan, B. (2009). Nanoscale Research Letters, 9, 1263 1266.
[5]. Ahmad T, Wani IA, Ahmed J, Al-Hartomy OA (2014). Appli Nanoscience 4:491–498.
[6]. Kahrilas, G. A., Haggren, W., Read, R. L., Wally, L. M., & Fredrick, S. J. (2014). ACS SustaChemi&Engi, 2(4), 590–598.
[7]. Iravani, S. (2011). Green Chemistry, 13, 2638–2650.
[8]. A. John B, J. V. M. L. Jeyan, J. NT, A. Kumar, Assessment of the Properties of Modified Pearl Millet Starch. Starch. 2023, 75, 2200160. https://doi.org/10.1002/star.202200160
[9]. N.D. Jasuja, J. Choudhary, P. Sharma, N. Sharma, S.C. Joshi, Jourl of Plant Sci 7(4) (2012) 113-137.
[10]. M. Bhardwaj, A. Alia, Commiphorawightii (Arn.) Bhandari. Journal of Drug aDeli and Thera9(4-s) (2019) 613-621.
[11]. M.A. Fazaludeen, C. Manickam, I.M.A. Ashankyty, M.Q. Ahmed, Q.Z. Beg, J. Microbiol. Biotechnol. Res. 2 (2012) 23–24.
[12]. John B, A., Jeyan, J. V., NT, J., & Kumar, A. (2023). Assessment of the Properties of Modified Pearl Millet Starch. Starch/Staerke, 75.
[13]. Jyothi, N. T., Ganesan, H., & Jeyan, J. V. (2024, April). Methodical assessment and truth flow analysis of wind tunnels. In AIP Conference Proceedings (Vol. 3037, No. 1). AIP Publishing.
[14]. Shukla, S., & Darney, P. E. The Effect of the Interfacial Resistance of the Superconducting-Stabilizer Film on the Typical Sector Diffusion Pace For 2g Hts Tapes.

[15]. Sumalatha, M. S., & Darney, P. E. (2023). The investigation of network security, including penetration attacks and potential security mechanisms.

[16]. lal Jeyan, J. M., Jyothi, N. T., Raja, B., & Rajarajan, G. THEORY STRATEGY OF SUBSONIC WIND TUNNEL FOR LOW VELOCITY. International Journal of Emerging Technologies and Innovative Research (www. jetir. org), ISSN, 2349-5162.

[17]. Venkatesh, M. Rajarajan G Jyothi NT JV Muruga Lal Jeyan" Systematic Survey of Wind Tunnel Test facility in India. International Journal of Emerging Technologies and Innovative Research (www. jetir. org), ISSN, 2349-5162.

[18]. lal Jeyan, J. M., Jyothi, N. T., Thampuratty, V. D., Nithin, B., & Rajarajan, C. D. DEVELOPMENT OF SUPERSONIC WIND TUNNEL. International Journal of Emerging Technologies and Innovative Research (www. jetir. org| UGC and issn Approved), ISSN, 2349-5162.

[19]. A. S. Kumar, J. V. M. L. Jeyan, J. N. T, S. Annamalai and N. V. Kousik, "Lossless Video Compression Using Reinforcement Learning in UAV Applications," 2023 International Conference on Data Science and Network Security (ICDSNS), Tiptur, India, 2023, pp. 1-6, doi: 10.1109/ICDSNS58469.2023.10245784. keywords: {Image coding;Neural networks;Data compression;Reinforcement learning;Video compression;Network security;Data science;Lossless Video;Compression;Reinforcement Learning;UAV},