Journal of Advanced Zoology

ISSN: 0253-7214

*Volume **44** Issue-**3** **Year 2023** Page **1607:1614***

COMPARATIVE PERFORMANCE ANALYSIS OF GREEN SYNTHESIS USING CROTON SPARSIFLORUS MORONG LEAF WITH CYNODON DACTYLON LEAF

[1]BHASKARA RAO GORLE, [2]Dr.N.JAYA MADHURI

[1]Research Scholar, Department Of Physics, Jawaharlal Nehru Technological University, Ananthapuram, Andhra Pradesh, India

[2]Assistant Professor, NBKR Institute Of Science And Technology, Vidyanagar, Nellore District, Andhra Pradesh, India

Article History

Received: 06 Sept 2022
Revised: 05 Oct 2023
Accepted:11Nov 2023

ABSTRACT: There is an increasing commercial demand for nanoparticles (NPs) due to their wide applicability in various areas. The development of reliable and eco-friendly processes for synthesis of metallic nanoparticles is an important step in the field of nanotechnology. Plant extracts are eco-friendly and thus can be an economic and efficient alternative for the large-scale synthesis of nanoparticles. This process of plant extracts based synthesis is called as Green Synthesis. We evaluated the silver nanoparticles produced by green synthesis of two different plants leafs. This paper presents Comparative Performance Analysis of Green Synthesis using Croton Sparsiflorus Morong leaf with Cynodon Dactylon leaf. Green synthesis of Exopolysaccharides coated silver nanoparticles uses Croton sparsiflorus morong leaf and silver nanoparticles uses Cynodon Dactylon leaf. Comparative performance analysis uses EDX analysis, UV- Vis Spectral Analysis, FTIR analysis and Antimicrobial Activity. Compare to green synthesis of silver nanoparticles using Cynodon Dactylon leaf, Green synthesis of Exopolysaccharides coated silver nanoparticles uses Croton sparsiflorus morong leaf is high efficient in terms of different performance analysis.

KEYWORDS: nanoparticles (NPs), Green Synthesis, Sparsiflorus Morong leaf, Cynodon Dactylon leaf

I. INTRODUCTION

Nanoscience and nanotechnology has seen major development in the bio-fabrication process of metal nanoparticles (MNPs) [1]. The metal nanoparticles may act both as reducing agents by plant extracts and stabilizing agents in the synthesis of nanoparticles due to their specific electrical, optical, magnetic, chemical and mechanical properties are currently used in many high technology areas, such as the medical sector for diagnosis, antimicrobial, drug delivery [2], etc. The nanoparticles synthesis is usually carried out by various physical and chemical methods, such as laser ablation, pyrolysis, chemical or physical vapor deposition, sol gel, lithography electro-deposition most of them being expensive, and/or requiring the use of toxic solvents.

There is growing need to develop eco-friendly and body benign nanoparticle synthesis processes without use of toxic chemicals in the synthesis protocols to avoid adverse effects in biomedical applications. Obviously, researchers in this field paid their attention towards the use of biological systems for the synthesis of biocompatible metal and semiconductor nanostructures [3]. It is most beneficial as considered with traditional synthesis techniques in form of biosynthesis, biocompatible, minimum production costs and biological reductive chemical environment [4]. The synthetic routes utilize non-toxic solvents, chemical precursors and extra minimizing catalyst. Amino acids, photochemical, polysaccharides, polyphenols and vitamins have also been used in green synthesis of NPs [5]. There is a requirement to enhance improved methods/performances using green nanotechnology to enhance capacity of available drugs and antiviral/antimicrobial materials [6].

Green synthesis provides advancement over chemical and physical method as it is cost effective, environment friendly, easily scaled up for scale synthesis and in this method there is no need to use high pressure, energy, temperature and toxic chemicals [7]. The researchers show much interest in synthesizing nanoparticles and study their size with various applications because of their unique physicochemical characteristics. Biological methods of synthesis have paved way for the greener synthesis of nanoparticles and these have proven to be better methods due to slower kinetics, they offer better manipulation and control over crystal growth and their stabilization. The green chemistry utilizes nontoxic chemicals and environmentally friendly solvent water for synthesizing nanoparticles [8]. It shows a different path in eliminating wastes before it is generated. The modern nanotechnology has facilitated the production of smaller silver nanoparticles with low toxicity to human and greater efficacy against bacteria. Nanoparticles are attractive alternative to antibiotics by showing improved activity against multi drug resistant bacteria. The size and shape of nanoparticles plays a key role on their efficacy for improving their biocompatibility and further modification enhances the applications towards various fields.

The development of biofilm resistance to conventional antibiotics increases the need to develop new strategies to treat infections caused by biofilm and resistant bacteria. In recent years, one of the main approaches in the development of new antibacterials is the use of nanobiocomposites. These refer to those nanocomposites that include a naturally occurring polymer (biopolymer) combined with an organic moiety. It has been shown that nanobiocomposites show potential applications in the biomedical and pharmaceutical fields. Nowadays, hybrid nanobiocomposites of biomaterials combined with metal nanoparticles are being developed from a variety of metals and different types of conjugated biopolymers and linkers.

Silver nanoparticles (AgNPs) have applications in various fields due to their unique optical, physical, electrical and medicinal properties. Silver nanoparticles can be incorporated into biosensor materials, antimicrobial applications, cosmetic products and electronic components. Commonly, AgNPs can be synthesized by physical, chemical and biological methods. Although physical and chemical methods may produce well-defined AgNPs, but these conventional methods have several disadvantages. These methods usually involve expensive equipment, high energy consumption and operation conditions such as temperature and pressure. Besides, utilizing hazardous chemicals as reducing agent in synthesizing AgNPs such as sodium borohydride, NaBH4 gives an adverse effect to health due to the absorption of harmful chemicals on its surface. This concern has enhanced the researchers to develop safe consumption nanoparticles and environmentally friendly processes through other biological approaches.

Biocompatible polymers coating on nanoparticles are increase the stabilizing activity in a polymeric matrix which is suggested by some authors [9]. Multiple strategies are involved for achieving hybrid polymer-nanoparticle materials, such as polymeric solutions adding to nanoparticles, silver ions reduction and at the same time polymerizing monomers [10]. Biomolecules with silver nanoparticles are having great capacity; therefore it is used in gene transfer, drug delivery systems, antibacterials and cellular engineering.
Different structures and conformations are having the several monosugar units which are involved in ExoPolySaccharides (EPS) based biopolymers. These biopolymers are collected basically from fungi, plants, bacteria and microalgae. EPS biological function is closely matches to its configuration and bacterial growth is inhibited ability is found in one of the biological functions of ExoPolySaccharides (EPS).

II. COMPARATIVE PERFORMANCE

Comparative Performance Analysis of Green Synthesis using Croton Sparsiflorus Morong leaf with Cynodon Dactylon leaf is explained in this paper. Green synthesis of Exopolysaccharides coated silver nanoparticles uses Croton sparsiflorus morong leaf and silver nanoparticles uses Cynodon Dactylon leaf. Comparative performance analysis uses EDX analysis, UV- Vis Spectral Analysis, FTIR analysis and Antimicrobial Activities. These comparisons are represented in below Table 1.
Cynodon dactylon, commonly known as Bermuda grass, is a grass found worldwide. The grass creeps along the ground with its stolons, and roots wherever a node touches the ground, forming a dense mat. Cynodon dactylon reproduces through seeds, stolons, and rhizomes. The optimization studies indicated that sunlight exposure method and homogenized extract solution were best for the production of silver nanoparticles.
Many natural products are uses the Croton sparsiflorus morong plants which are having high medical uses. These plants are used in treatment of high blood pressure controlling, skin diseases treatment, curation of cuts and wounds because of rutin named active principle component presence. The screening of Croton sparsiflorus morong with phytochemically called secondary metabolites according to antimicrobial properties. Without any additional chemicals, little amounts of leaf extracts are used to prepare the Silver nanoparticles.

Table 1: COMPARATIVE PERFORMANCE ANALYSIS

Parameters	Green systhesis of Exopolysaccharides coated Silver Nanoparticles using Croton sparsiflorus morong leaf	Green systhesis of Silver Nanoparticles using Cynodon dactylon Plant
EDX	At 3 keV silver strong elemental signal existence is confirmed by EDX spectrum which is fundamental for metallic silver nanocrystallites absorption because	EDAX analysis confirms the presence elemental silver. Strong signals from atoms in the silver nanoparticles and weaker signals from carbon, nitrogen and oxygen atoms.

		of surface Plasmon resonance. The highest existence of lipids, proteins and chlorine related compounds are identified with EDX apart from silver peaks.	
UV- Vis Spectral Analysis		According to Ag NPs surface Plasmon resonance, kmax with single broad peak is observed at 474 nm.	The UV -Vis spectrum of silver nanoparticle in aqueous solution shows an absorbance peak around 420 nm due to Surface plasmon resonance.
FTIR		Sample is a polysaccharide indicative by the peak at 1019 cm^{-1}. The absorption peaks found in the 1200-1000 cm1 region are distinctive of glycosidic bands, which indicate that the EPS were incorporated into the nanoparticles.	The peak near 3292 cm-1 was assigned to hydroxyl group due to the presence of alcohols and phenols.
Bacterial properties (MIC) (nM)	E. coli	678.8	784
	P. aeruginosa	678.8	796
	S. aureus	1357.5	1247
	Bacilus cereus	1456	1231
	Citrobacter koseri	1410	1472

1. EDX analysis:

Exopolysaccharides coated Silver Nanoparticles using Croton sparsiflorus morong leaf:

Ag NPs elemental compositions information is analyzed by using EDX analysis and is depicted in Fig. 1. At 3 keV silver strong elemental signal existence is confirmed by EDX spectrum which is fundamental for metallic silver nanocrystallites absorption because of surface Plasmon resonance. The highest existence of lipids, proteins and chlorine related compounds are identified with EDX apart from silver peaks.

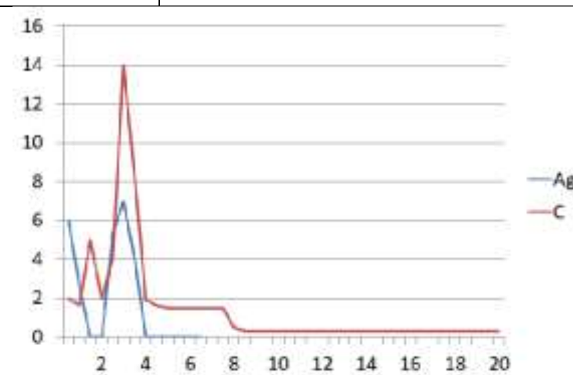

Fig. 1: EDX SPECTRUM OF EPS-SNPs

Green systhesis of Silver Nanoparticles using Cynodon dactylon Plant:

EDAX analysis confirms the presence elemental silver in Fig. 2. Different X-ray

emission peaks showed strong signals from atoms in the siver nanoparticies and weaker signals from carbon, nitrogen and oxygen atoms.

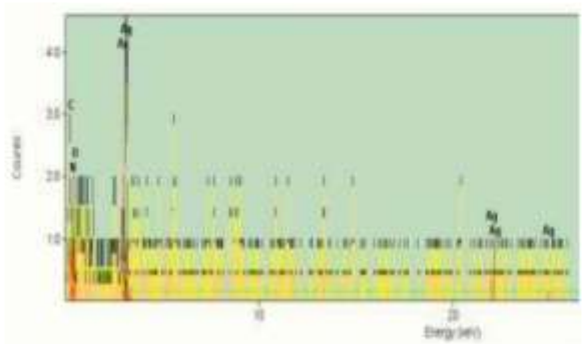

Fig. 2: EDAX SPECTRUM OF SILVER NANOPARTICLES

2. UV–Visible spectrum analysis:

Exopolysaccharides coated Silver Nanoparticles using Croton sparsiflorus morong leaf:

Total EPS-SNPs UV–Visible spectrum recorded at 24 h in this study. The explored results are indicating that, Ag+ ions reduction is possible with extracellular as shown in Fig. 3. Therefore these results conforms the Croton sparsiflorus morong leaf extract based Ag NPs. Earlier kmax values of typical EPS-SNPs for visible range of 450–480 nm.

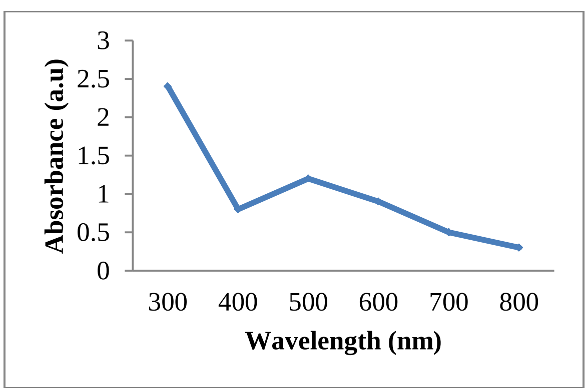

Fig. 3: EPS-SNPs UV–VIS SPECTRUM

Green systhesis of Silver Nanoparticles using Cynodon dactylon Plant:

Reduction of silver into silver nanoparticles are marked by color change. Silver nanoparticles exhibit dark yellowish brown colour due to surface plasmon resonance. The strong surface plasmon resonance band appears at the range of 440-480nm. Sunlight irradiated reaction mixture showed a strong characteristic absorbance peak at around 450 nm.

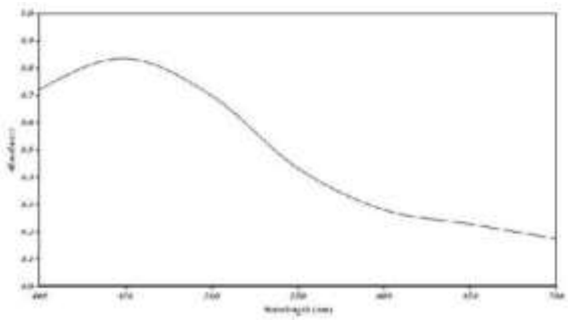

Fig. 4: UV-VISIBLE ABSORPTION SPECTRA OF SILVER NANOPARTICLES SYNTHESIZED USING CYNODON DACTYLON LEAF EXTRACT

3. FT-IR spectra analysis:

Exopolysaccharides coated Silver Nanoparticles using Croton sparsiflorus morong leaf:

EPS and EPS-SNPs several functional groups are identified by performing FT-IR spectra analysis. The bands are revealed at 3328, 2920, 1645, 1365, and 1000-1200 cm^{-1} which are used to denote the hydroxyl groups stretching vibrations from a polysaccharide, Methylene (*CH2*) , enol and amide groups, C-C stretching, carboxyl groups, C-O-H, C-O, C-O-C and polysaccharides deformation vibrations. The sample is a polysaccharide indicative by the peak at1019 cm^{-1}. Presence of a polysaccharide is indicated by observed absorption peaks at the range of 1200-1000 cm^{-1}. Functional groups with negative charges as hydroxyl, carboxyl and amide are existed in exopolysaccharides and these are reacted with metallic cations. At the peaks of the C-O, COOH and O-H groups, reduced intensity is observed in the comparison of FT-IR spectrums of both EPS and EPS-SNPs. distinctive of glycosidic bands are existed in absorption peaks found in the 1200-1000 cm^{-1} which indicates that EPS were integrated into the nanoparticles.

/

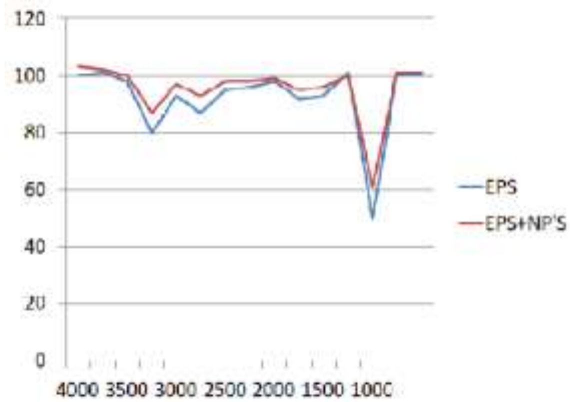

Fig. 5: EPS AND EPS-SNPs FOURIER

Green systhesis of Silver Nanoparticles using Cynodon dactylon Plant:

FTIR measurement was carried out to identify possible biomolecules of Cynodon Dactylon leaf extact responsible for the formation and stabilization of nanoparticles. Prominent IR bands are observed at 3273, 3232, 2956, 2917, 2848, 1648, 1542, 1457,1383,1238,1074 and 1036 cm-1.The peak at 2956 and 2917 indicates C-H stretching due to alkanes. The peak at 3273 indicates C-H stretching due to alkynes. The peak at 3273, 3232, 2956 and 2917 correspond to the OH stretching vibrations of alkanes, phenols and hydrogen bonded carboxylic acid. Peak at 1648 indicate C=C stretching vibrations to alkanes, NO2 asymmetric stretching vibrations to nitro compounds and NH bending vibrations due to amines. Peak at 1542 indicates NO2 asymmetric stretching vibrations to nitro compounds. Peak at 1457 indicates CH scissoring and bending due to umbrella deformation of methyl group. Peak at 1383 indicates CH scissoring and bending due to umbrella deformation of methyl group and NO2 symmetric stretching vibrations to nitro compounds. Peak at 1238 indicates C-O stretching due to alcohols, ethers, carboxylic acids, ethers and esters, NO2 symmetric stretching vibrations to nitro compounds and C-N stretching due to amines. Peak at 1074 and 1036 indicates stretching due to alcohols, ethers, carboxylic acids, ethers and esters and C-N stretching due to amines.

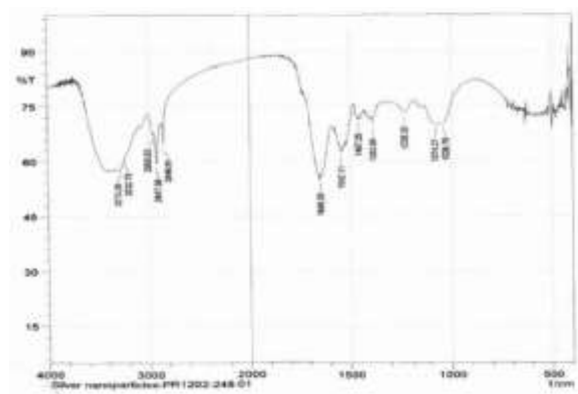

Fig. 6: FTIR SPECTRA OF SILVER NANOPARTICLES

4. Antimicrobial Activity:

Exopolysaccharides coated Silver Nanoparticles using Croton sparsiflorus morong leaf:

The ability to kill both Gram-positive and as well as Gram-negative bacteria of EPS-SNPs is determined by studying the antibacterial effects in which different treatments with exposing to bacteria. In these experiments, S. aureus was susceptible at concentrations between 169.7 and 2715 nM of EPS-SNPs. Higher bacterial reduction EPSSNPs from 339.4 to 2715 nM is shown by E. coli and P. aeruginosa. The test bacteria visible growth is null from results as observed lowest concentration of Minimum Inhibitory Concentration (MIC). EPS-SNPs has more sensitive for E. coli ATCC 11229 and P. aeruginosa ATCC 27853 strains than remaining.

Green systhesis of Silver Nanoparticles using Cynodon dactylon Plant:

The present study was conducted to investigate the antimicrobial activity of silver nano particles synthesized using extracts against bacterial strains such as Staphylococcus aureus (ATCC 25923), Citrobacter koseri (ATCC BAA-895), Bacilus cereus (ATCC 25922), Pseudomonas aeruginosa (ATCC 10145) and Escherichia coli (ATCC 25922). The table 1 summarizes the MIC of the silver nanoparticles synthesized using Cynodon dactylon extract. The Silver nano particle synthesized using Cynodon dactylon extract showed higher activity against Escherichia coli (ATCC 25922). Very low activity was found against Citrobacter koseri. The nano particle synthesized using Cynodon dactylon extract showed good antibacterial activity against the tested organisms.

5. Applications:

Finally, it was confirmed that the Exopolysaccharides coated Silver Nanoparticles using Croton sparsiflorus morong leaf might be applicable on the pharmacology, electronics, cosmetics, drug delivery systems, biosensors, interaction with biomolecules, Cancer therapeutics, Fungi and antifungal, respectively because of their good antibacterial activity against the tested organisms.

III. CONCLUSION

In this paper, Comparative Performance Analysis of Green Synthesis using Croton Sparsiflorus Morong leaf with Cynodon Dactylon leaf. Green synthesis of Exopolysaccharides coated silver nanoparticles uses Croton sparsiflorus morong leaf and silver nanoparticles uses Cynodon Dactylon leaf. Comparative performance analysis uses EDX analysis, UV- Vis Spectral Analysis, FTIR analysis and Antimicrobial Activities. From all these analysis, Green synthesis of Exopolysaccharides coated silver nanoparticles uses Croton sparsiflorus morong leaf is high efficient than green synthesis of silver nanoparticles using Cynodon Dactylon leaf. From this analysis, Exopolysaccharides coated Silver Nanoparticles using Croton sparsiflorus morong leaf might be applicable on the pharmacology, electronics, cosmetics, drug delivery systems, biosensors, interaction with biomolecules, Cancer therapeutics, Fungi and antifungal, respectively because of their good antibacterial activity against the tested organisms.

IV. REFERENCES

[1] P. Makvandi, Metal-based nanomaterials in biomedical applications: Antimicrobial activity and cytotoxicity aspects, Adv. Funct. Mater. (2020) 1910021

[2] Sharma, G.; Kumar, A.; Sharma, S.; Naushad, M.; Dwivedi, R.P.; Alothman, Z.A.; Mola, G.T. Novel development of nanoparticles to bimetallic nanoparticles and their composites: A review. J. King Saud. Univ. Sci. 2019

[3] Lakshmi KR, Pammi SVN, Pallela PNVK, Veerabhadra SP, Kolapalli, Venkata RM. Antibiotic potentiation and anti-cancer competence through bio-mediated ZNO nanoparticles. Mater Sci Engineering: C. 2019;103:109756. doi: 10.1016/j.msec.2019.109756.

[4] Alijani HQ, Pourseyedi S, Torkzadeh Mahani M, Green synthesis of zinc sulfide (zns) nanoparticles using stevia rebaudiana bertoni and evaluation of its cytotoxic properties. J Mol Struct. 2019;1175:214–218.

[5] Kirui, D.K.; Weber, G.; Talackine, J.; Millenbaugh, N.J. Targeted laser therapy synergistically enhances efficacy of antibiotics against multi-drug resistant Staphylococcus aureus and Pseudomonas aeruginosa biofilms. Nanomed. Nanotechnol. Biol. Med. 2019, 20, 102018

[6] Ismail, A.; Menazea, A.; Kabary, H.A.; El-Sherbiny, A.; Samy, A. The influence of calcination temperature on structural and antimicrobial characteristics of zinc oxide nanoparticles synthesized by Sol–Gel

method. J. Mol. Struct. 2019, 1196, 332–337.

[7] P. Devi, Vinita and S. S. Dhayal, "Study on Green Synthesis of Silver Nanoparticles for Dye Degradation and Sensing Applications by Plant Extracts," 2022 4th International Conference on Advances in Computing, Communication Control and Networking (ICAC3N), Greater Noida, India, 2022, pp. 1849-1855, doi: 10.1109/ICAC3N56670.2022.10074002.

[8] Y. Suresh, S. Annapurna, G. Bhikshamaiah and A. K. Singh, "Characterization of green synthesized copper nanoparticles: A novel approach," International Conference on Advanced Nanomaterials & Emerging Engineering Technologies, Chennai, India, 2013, pp. 63-67, doi: 10.1109/ICANMEET.2013.6609236.

[9] S. Shende, R. Bhagat, R. Raut, M. Rai and A. Gade, "Myco-Fabrication of Copper Nanoparticles and Its Effect on Crop Pathogenic Fungi," in *IEEE Transactions on NanoBioscience*, vol. 20, no. 2, pp. 146-153, April 2021, doi: 10.1109/TNB.2021.3056100.

[10] N. Agrawal, B. Zhang, C. Saha, C. Kumar, B. K. Kaushik and S. Kumar, "Development of Dopamine Sensor Using Silver Nanoparticles and PEG-Functionalized Tapered Optical Fiber Structure," in *IEEE Transactions on Biomedical Engineering*, vol. 67, no. 6, pp. 1542-1547, June 2020, doi: 10.1109/TBME.2019.2939560.