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Research Article

Preparation and Evaluation of Herbal Silver Nanoparticles containing hydro-alcoholic extract of Peristrophe bicalyculata (R.) Nees Leaves

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Abstract
The green synthesis method of nanomaterials is growing in the field of nanotechnology; it alters the route and duration of harmful substances. The current study revealed the green manufacture of silver nanoparticles utilising a plant extract from *Peristrophe bicalyculata* (R.) Nees Leaves. The plant, also known as kali aghedi, belongs to the Acanthaceae family and includes alkaloids, tannins, steroids, and flavonoids. The herbs demonstrated antibacterial properties (tuberculostatic), snake poison, bone fracture, sprain, fever, cold, cough, and ear and eye therapies. The formed silver nanoparticles were examined to determine their percentage yield, entrapment effectiveness, and surface charge.

Key-words: Leave Extract, Silver Nanoparticles, Evaluation

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Introduction

Nanoparticles have a high surface area to volume ratio. Nanoparticles such as silver, gold, cadmium sulphide, zinc sulphide, and zinc oxide are used in a variety of applications. The fabrication of silver nanoparticles has recently received a lot of attention due to their physical and chemical properties, as well as their application in biomedicine, including antiangiogenic activity against bovine retinal endothelial cells, anticancer activity against lung carcinoma cells, HIV infection control, bacterial pathogen detection, and good catalytic activity. Antimicrobial properties of silver nanoparticles are well documented [1]. *Peristrophe bicalyculata* is a subshrub that can reach 3-4 feet tall. It features ovate, hairy leaves and pink, hairy blooms with two lips. The plant grows in tropical Africa, India, Myanmar, Malaya, and Indochina. In India, it can be found in the Bellary district of Karnataka, Tamil Nadu, and the Kurnool district of Andhra Pradesh [2]. Plant sources have played a significant role in the synthesis of green materials-mediated nanoparticles throughout the last decade. Nanoparticles are synthesised from a variety of plants, including *Cinnamomum camphora*,

Azadirachta indica, *Nelumbo nucifera*, *Garcinia mangostana*, pomegranate, and grape fruit extract [3]. Keeping the foregoing in mind, the current study was

conducted to manufacture and assess silver nanoparticles from a selected plant extract.

Material and Methods

Collection and Authentication of Plant Material

Fresh leaves of the plant *Peristrophe bicalyculata* (R.) Nees were taken in August 2022 from the Malwa region of Madhya Pradesh, India, and validated by botanist Dr. S.N. Dwivedi, Visiting Professor, APS University, Rewa, Madhya Pradesh. The voucher specimen number J/Bot/PBL-39 was assigned. The leaves were then dried under shade and were powdered and stored in air tight container for further investigation.

Preparation of Extract

The shade dried coarsely powdered plant material of leaves *Peristrophe bicalyculata* (R.) Nees (about 250 gm) were extracted using ethanol:water (90:10) in soxhlet apparatus for 72 hours. After the extraction was completed, the filtrate was dried using water water till dryness and was placed in desiccators to remove excess moisture [4].

Preparation of Silver Nanoparticles using Extract

Silver Nanoparticles were prepared in six different batches using hydro-alcoholic extract of leaves of *Peristrophe bicalyculata* (R.) Nees (HAEPBL) and varying concentration of silver nitrate. The powder of $AgNO_3$ was dissolved in distilled water to make and prepare stock solution of 10mM $AgNO_3$ Solution. From the above solution 1 mM, 2mM and 3 mM solution were prepared. The $AgNO_3$ solution were then mixed by HAEPBL in the ratio of 1:1 and 1:2 v/v using VF of 50 ml. The VF was then wrapped with aluminum foil and was then heated using water bath at 60^0 C for about 5 hour. After that the mixture of solution was stored in the refrigerator [5].

Table 1: Composition of formulated Silver Nanoparticles of hydro-alcoholic extract of leaves of *Peristrophe bicalyculata* (R.) Nees

Formulation Code	Extract (mg)	$AgNO_3$ (mM)	Ratio
AgNPs-F1	250	1	1:1
AgNPs-F2	250	2	1:1
AgNPs-F3	250	3	1:1
AgNPs-F4	250	1	1:2
AgNPs-F5	250	2	1:2
AgNPs-F6	250	3	1:2

Evaluation of Silver Nanoparticles

Percentage Yield

The formulated silver nanoparticles containing hydro-alcoholic extract of leaves of *Peristrophe bicalyculata* (R.) Nees (HAEPBL) having size range in between 100-300 were collected randomly and weighted [6-7]. The percentage yield were calculated using the formula:

Percentage Yield= [Weight of the Silver nanoparticles/Weight of the extract and Silver nitrate]*100

Entrapment Efficiency

The entrapment effectiveness of silver nanoparticles containing a hydro-alcoholic extract of *Peristrophe bicalyculata* (R.) Nees (HAEPBL) was measured by adding 10 ml of pH 7.4 phosphate buffer and sonicating in a bath sonicator before filtering. 1 ml of filtrate was mixed with 10 ml of phosphate buffer and tested at 305 nm with a UV visible spectrophotometer, using pH 7.4 phosphate buffer as a blank [6-7]. The formula determined how much drug was entrapped.

Drug entrapment (%) = [(Amount of drug- Amount of free drug)/ Amount of total drug] 100

Particle Size

The average mean diameter and size distribution of silver nanoparticles containing hydro-alcoholic extract of leaves of *Peristrophe bicalyculata* (R.) Nees (HAEPBL) were determined using the Dynamic Light Scattering method at 25°C with a Malvern zetasizer. To achieve the desired light scattering intensity, dried silver nanoparticles containing a hydro-alcoholic extract of Peristrophe bicalyculata (R.) Nees leaves (HAEPBL) were disseminated in water [6-7].

Zeta Potential

The zeta potential is a measurement of surface charge. The surface charge (electrophoretic mobility) of nanoparticles can be evaluated using a Zeta sizer (Malvern Instrument) that includes zeta cells, polycarbonate cells with gold-plated electrodes, and water as a sample preparation medium. It is necessary for determining the stability of the silver nanoparticles. [6-7].

In-Vitro Drug Release Studies

The in vitro release investigation of silver nanoparticles containing hydro-alcoholic extract of leaves of *Peristrophe bicalyculata* (R.) Nees (HAEPBL) was accomplished using the dialysis bag approach. The samples were placed in dialysis bags and dialysed in 60 mL of phosphate buffer solution with a pH of 7.4. The medication release was expected to begin as soon as the dialysis fluid entered the reservoir compartment. The reservoir was kept constantly stirred. The sample was collected at regular intervals and replaced with the same amount of buffer. The obtained sample is filtered and diluted before being analysed with a UV-visible spectrophotometer [7].

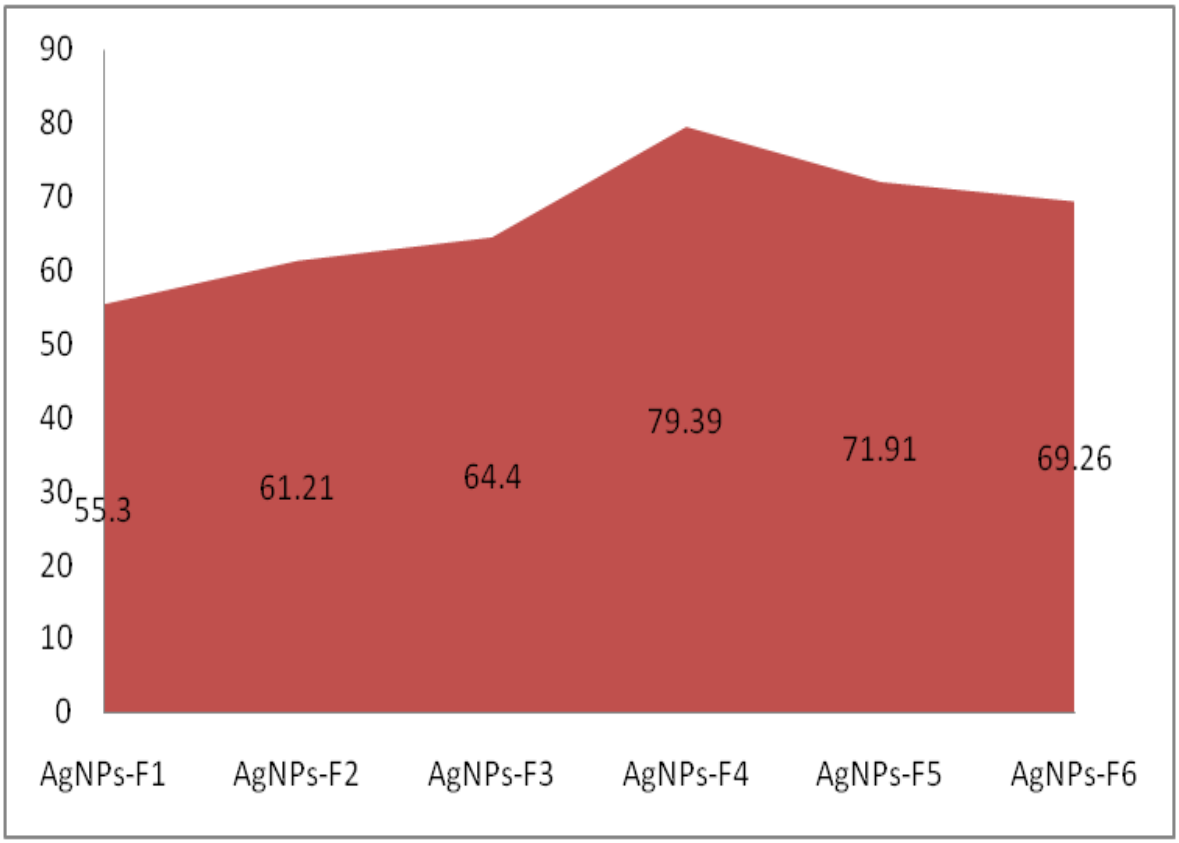
Results and Discussion

Silver Nanoparticles were prepared in six different batches using hydro-alcoholic extract of leaves of *Peristrophe bicalyculata* (R.) Nees (HAEPBL) and varying concentration of silver nitrate and was evaluated. HAEPBL-AgNPs of all the formulation batches were determined and reported. The results were given in table 2 and Graph 1.

Table 2: Percentage Yield of HAEPBL-AgNPs

S/No.	Formulation Code	Percentage Yield (%)
1.	AgNPs-F1	55.38±0.17
2.	AgNPs-F2	61.21±0.24
3.	AgNPs-F3	64.40±0.08
4.	AgNPs-F4	79.39 ±0.22
5.	AgNPs-F5	71.91±0.16
6.	AgNPs-F6	69.26±0.38

Note: Readings are expressed as Mean±SEM, n=3



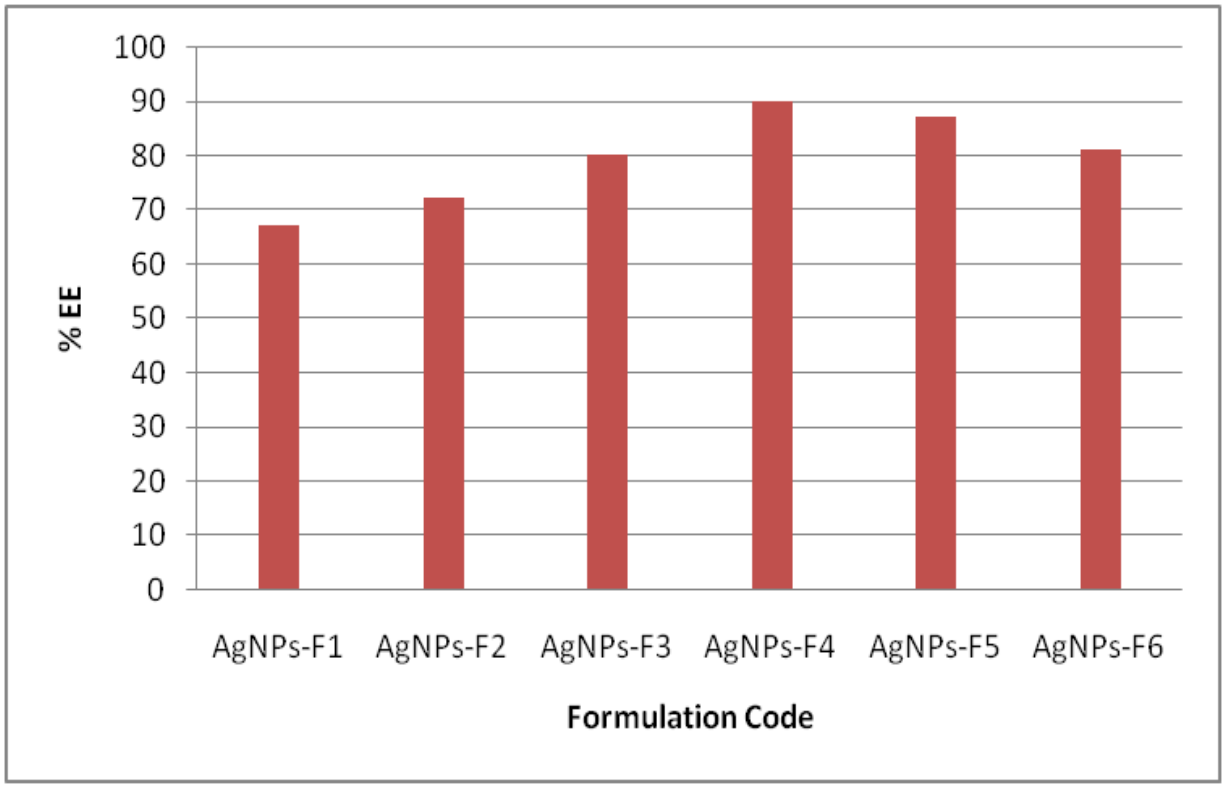
Graph 1: Percentage Yield of HAEPBL-AgNPs

The entraptment efficiency of the formulated batches of HAEPBL-AgNPs were calculated and the results were presented in table 3 and Graph 2. The results presented indicate that the % EE of formulation code AgNPS-F4 is maximum i.e., 90.17 %.

Table 3: Entrapment Efficiency of HAEPBL-AgNPs

S/No.	Formulation Code	Entrapment Efficiency (%)
1.	AgNPs-F1	67.46±0.11
2.	AgNPs-F2	72.39±0.28
3.	AgNPs-F3	80.46±0.14
4.	AgNPs-F4	90.17 ±0.09
5.	AgNPs-F5	87.20±0.12
6.	AgNPs-F6	81.31±0.13

Note: Readings are expressed as Mean±SEM, n=3



Graph 2: Entrapment Efficiency of HAEPBL-AgNPs

The particle size of the formulated batches of HAEPBL-AgNPs was determined and the results were presented in table 4. The particle size was found to be in range of 99.44 to 100.08 (Figure 1).

Table 4: Particle Size of HAEPBL-AgNPs

S/No.	Formulation Code	Particle Size (nm)
1.	AgNPs-F1	100.08
2.	AgNPs-F2	97.06
3.	AgNPs-F3	100.01
4.	AgNPs-F4	99.44
5.	AgNPs-F5	101.04
6.	AgNPs-F6	97.30

Results

		Size (d.nm):	% Intensity	Width (d.nm):
Z-Average (d.nm): 99.44	Peak 1:	139.1	96.8	83.98
PdI: 0.274	Peak 2:	19.87	2.1	3.364
Intercept: 0.876	Peak 3:	4477	1.1	889.4
Result quality : Good				

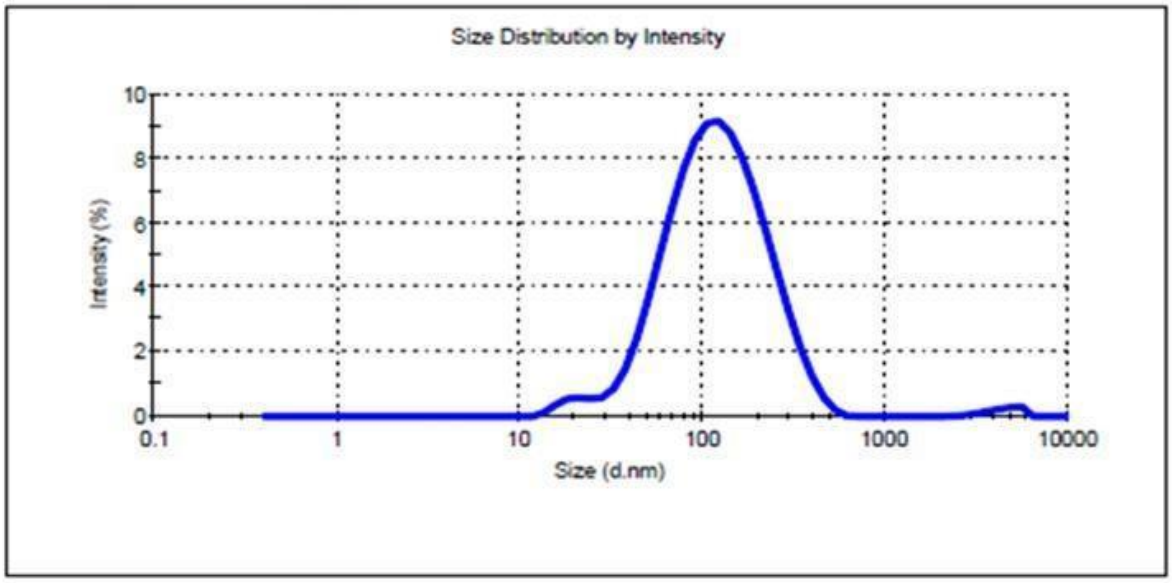


Fig. 1: Particle Size of Distribution of AgNPs-F4

The zeta potential of the formulated batches HAEPBL-AgNPs was determined and the particles having the charge of -20.32 mv to -30.5 mV. The results were given in table 5 and Figure 2. Poly Disparity Index (PDI) is 0.2 for (AgNPs-F4F4).

Table 5: Zeta Potential of HAEPBL-AgNPs

S/No.	Formulation Code	Zeta Potential (mV)
1.	AgNPs-F1	-30.20
2.	AgNPs-F2	-25.28
3.	AgNPs-F3	-27.11
4.	AgNPs-F4	-30.50
5.	AgNPs-F5	-29.19
6.	AgNPs-F6	-22.37

		Mean (mv)	Area (%)	St Dev (mV)
Zeta Potential (mV):	30.5	Peak 1: 30.5	100.0	5.64
Zeta Deviation (mV):	5.64	Peak 2: 0.00	0.0	0.00
Conductivity (mS/cm):	0.886	Peak 3: 0.00	0.0	0.00
Result quality :	Good			

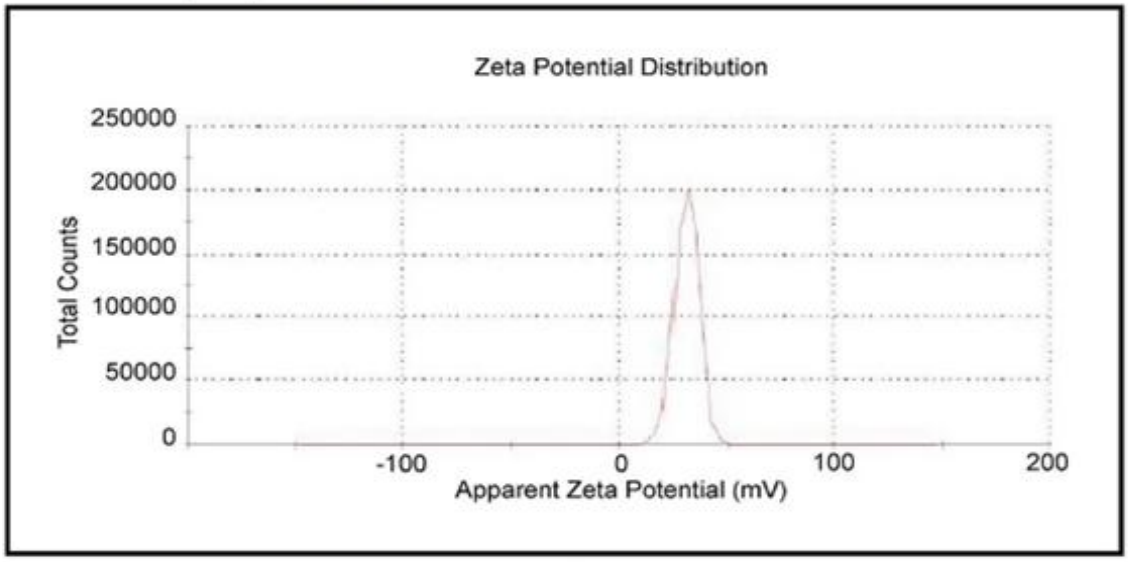


Fig. 2: Zeta Potential of AgNPs-F4

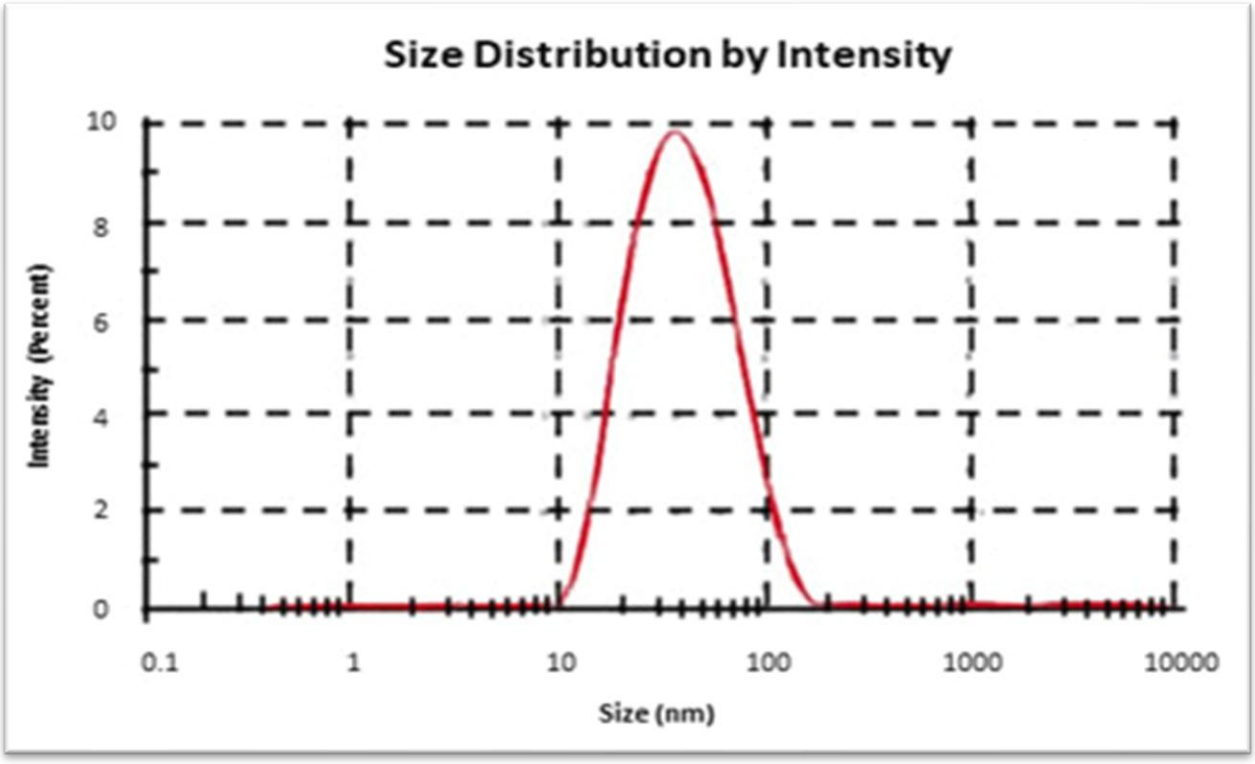


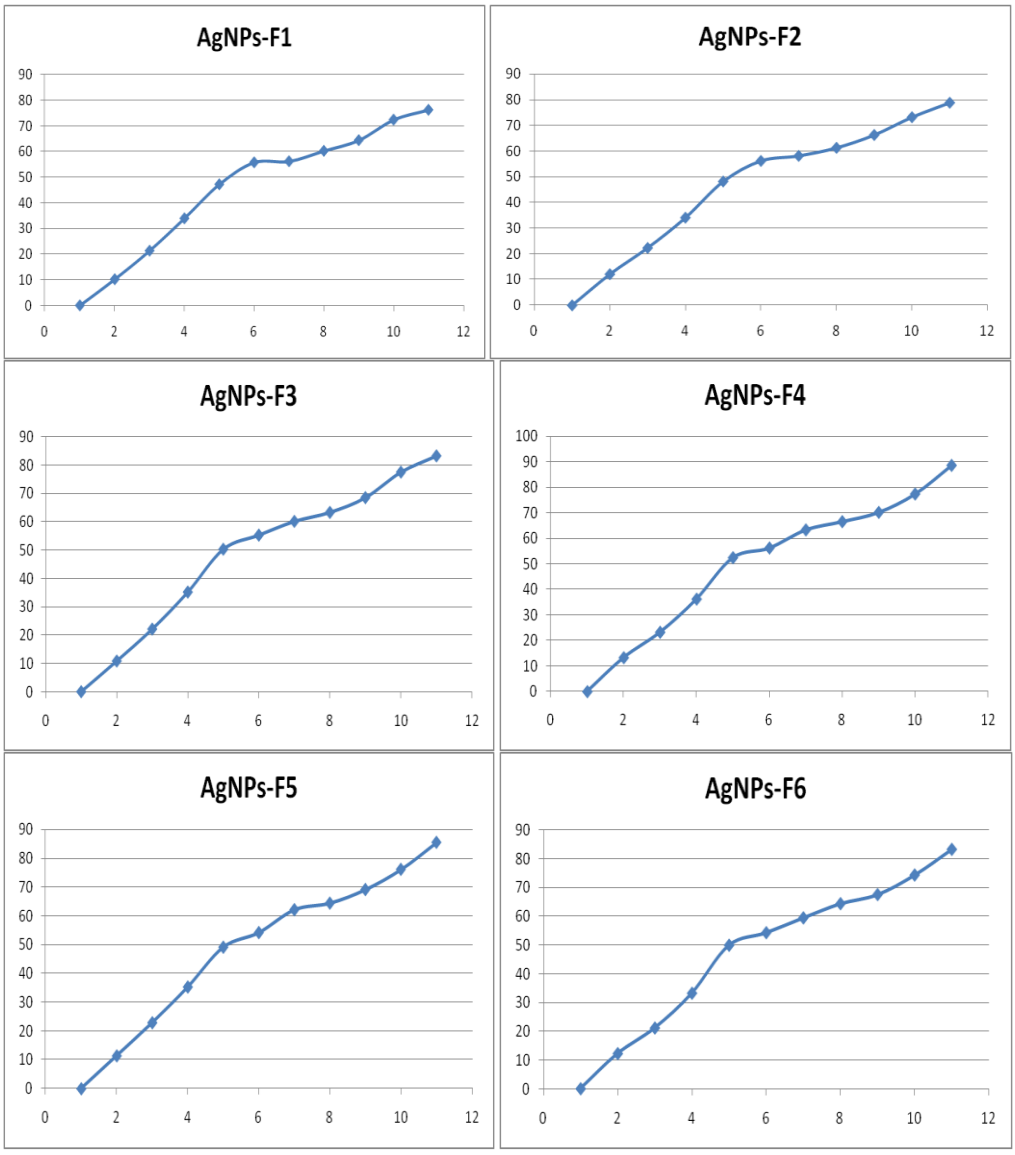
Fig. 3: PDI of AgNPs-F4 is 0.2

The drug release of the extract from the formulated silver nanoparticle was determined using phosphate buffer pH 7.4 using dialysis bag diffusion method. The amount of drug release till 24 hr time was noted down.

From the results as shown in table 6 and graph 3 it was observed that the drug release was found to be maximum for formulation code AgNPs-F4 i.e., 88.46%.

Table 6: In Vitro Drug Release of HAEPBL-AgNPs

Time (in Hr)	Cumulative % Drug Release					
	AgNPs-F1	AgNPs-F2	AgNPs-F3	AgNPs-F4	AgNPs-F5	AgNPs-F6
0	0	0	0	0	0	0
1	10.21	12.12	10.82	13.27	11.40	12.21
2	21.34	22.34	22.10	23.21	22.89	21.11
4	33.96	34.10	35.16	36.18	35.29	33.19
8	47.22	48.19	50.29	52.39	49.11	49.86
12	55.78	56.20	55.26	56.17	54.17	54.22
14	56.21	58.15	60.11	63.25	62.10	59.38
16	60.28	61.29	63.29	66.48	64.39	64.31
18	64.43	66.28	68.48	70.10	69.11	67.47
20	72.42	73.20	77.49	77.28	76.10	74.28
24	76.27	78.82	83.22	88.46	85.47	83.19



Graph 3: In Vitro Drug Release of HAEPBL-AgNPs

Conclusion

Herbal Silver Nanoparticles were prepared in six different batches using hydro-alcoholic extract of leaves of *Peristrophe bicalyculata* (R.) Nees (HAEPBL) and varying concentration of silver nitrate and was evaluated. Percentage yield of HAEPBL-AgNPs of all the formulation batches were determined and reported and found to be maximum of AgNPs-F4 i.e., 79.39 ±0.22. The % EE of formulation code AgNPS-F4 is maximum i.e., 90.17 %. The particle size was found to be in range of 99.44 to 100.08. The zeta potential of the formulated batches HAEPBL-AgNPs was determined and the particles having the charge of -20.32 mv to -30.5 mV. The Poly Disparity Index (PDI)

is 0.2 for (AgNPs-F4F4). It was observed that the drug release was found to be maximum for formulation code AgNPs-F4 i.e., 88.46%.

References

1. Magdy, G., Aboelkassim, E., Abd Elhaleem, S. M., & Belal, F. (2024). A comprehensive review on silver nanoparticles: synthesis approaches, characterization techniques, and recent pharmaceutical, environmental, and antimicrobial applications. *Microchemical Journal*, *196*, 109615.
2. Yong, P. H., Yi, W. X., Azzani, M., Mac Guad, R., & Ng, Z. X. (2024). Potential of Medicinal Plants to Inhibit Neurodegenerative Activities in Diabetes: A Systematic Review. *Journal of Young Pharmacists*, *16*(4), 620-632.
3. Shereen, M. A., Ahmad, A., Khan, H., Satti, S. M., Kazmi, A., Bashir, N. & Zouidi, F. (2024). Plant extract preparation and green synthesis of silver nanoparticles using Swertia chirata: Characterization and antimicrobial activity against selected human pathogens. *Heliyon*, *10*(6).
4. Karpitskiy, D. A., Bessonova, E. A., Shishov, A. Y., & Kartsova, L. A. (2024). Selective extraction of plant bioactive compounds with deep eutectic solvents: Iris sibirica L. as example. *Phytochemical Analysis*, *35*(1), 53-63.
5. Balamurugan, V., Ragavendran, C., Arulbalachandran, D., Alrefaei, A. F., & Rajendran, R. (2024). Green synthesis of silver nanoparticles using Pandanus tectorius aerial root extract: Characterization, antibacterial, cytotoxic, and photocatalytic properties, and ecotoxicological assessment. *Inorganic Chemistry Communications*, *168*, 112882.
6. Singh, A., & Maheshwari, S. (2024). Formulation, development and evaluation of Woodfordia fruticosa and β-sitosterol mediated silver nanoparticles gel for synergistic effect. *Intelligent Pharmacy*, *2*(1), 94-101.
7. Singh, R., Singh, R., Parihar, P., & Mani, J. V. (2024). Green synthesis of silver nanoparticles using Solanum sisymbriifolium leaf extract: Characterization and evaluation of antioxidant, antibacterial and photocatalytic degradation activities. *Process Biochemistry*.