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Role of Plant Mediated Silver Nanoparticles and Their Efficacy in Control Against *Aedes aegypti* Vector

Rajeswari Anburaj*
***Assistant Professor, Department of Microbiology, M.I.E.T Arts and Science College, Trichy.**

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***Corresponding Author Email:** raji.anburaj@gmail.com

Abstract
Nanotechnology an emerging field of nanoscience received special attention due to their application in medicinal field. Mosquitoes transmit severe human disease leading to mortality. Usage of synthetic insecticides leads to physiological resistance and adverse environmental problems. An attempt has been made to evaluate the potential mosquitocidal and microbicidal activity of aqueous leaves extract synthesized AgNPs from *Eclipta prostrata*. Nanoparticle confirmation was done by surface plasmon band in Uv-vis, functional groups detecting the presence of capping agents in FTIR, crystallinity indicated in XRD. Broad spectrum of antimicrobial screening of synthesized Agnp was observed in 400 µl against *Bacillus* (21.1 mm) and *E. coli* (20.8 mm). Mosquitocidal assay suggest that the LD50 was found to be higher in Ist instar and pupae. These results recommend that the synthesized AgNPs can as an eco-friendly approach for the control of *Aedes aegyptii* vectors.

Keywords
Green synthesis, silver ion, LD50, Aedes sp, biolarvicide

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INTRODUCTION
In modern era, nanotechnology is the manufacturing of functional systems at the atomic scale and the use of matter with at least one dimension ranging from 1 to 100nm in size[1]. Metal nanoparticles are utilized not only in research but in many fields of applications, especially in the pharmaceutical and biomedical fields, owing to their improved physical and chemical properties upon size reduction. These particles have a broad range of applications, such as catalysis, biosensing, optoelectronics, chemical sensing, and medical diagnosis[2]. The green methods of nanoparticle synthesis using biological entities like bacteria[3], yeast[4], fungi[5]and plants are stated to be clean, nonhazardous, in-expensive and environmentally tolerable when compared to chemical methods.

Aedes aegypti is the major vector for dengue fever responsible for a number of morbidity and mortality around the world especially in tropical and subtropical countries[6, 7]. The efficient way to control this disease is the usage of mosquito repellents. Synthetic repellants are not safe for use; repellants synthesized from natural or herbal product are effective against vectors. The repellents prepared from herbal products are safe to human,

environment and reported to have repellency against mosquitoes[8-14].

Eclipta prostrata (Asteraceae) is an available herb distributed in many regions of the world. It is a common weed in moist regions throughout India. There is a potential for medicinal use of this plant as an antiseptic, astringent, depurative, emetic, febrifuge, ophthalmic, purgative, styptic, and tonic, for use against hepatitis, jaundice, liver cirrhosis, aching and weakness of the knees and loins, hematuria and diarrhea with bloody stools, and abnormal uterine bleeding[15]. Also, previous phytochemical studies on *E. prostrata* revealed the presence of thiophene derivatives, steroids, triterpenes[16,17], flavonoids, polyacetylenes, polypeptides, alkaloids, and so on, which are responsible for all its significant medicinal properties[18-20]. The relevance of nanotechnology initiates the development of nano herbal products possessing high bioavailability and less toxicity, leads to the novel era of herbal drug discovery[21].

In this study conditions were optimized to obtain mono-dispersed AgNPs and were characterized using ultraviolet (UV), Fourier transform infrared (FTIR) spectroscopy, X-ray diffraction (XRD) and scanning electron microscopy (SEM) imaging, antimicrobial and mosquitocidal activities of biosynthesized AgNPs were evaluated.

MATERIALS AND METHODS

Collection of Plant material

Leaves of *Eclipta prostrata* were collected from Madurai region, Tamilnadu, India. The plant materials were shade dried at room temperature and homogenized to a fine powder using an electrical blender. The samples were stored in an airtight container and used for further studies.

Preparation of inoculum

The bacterial cultures were inoculated into nutrient broth and incubated for 24h at 37°C. The growth was compared with 0.5 McFarland; the turbidity of the medium indicates the growth of organisms, while the fungal cultures were inoculated into potato dextrose broth and allowed to incubate at 25°C for 48 h[22].

Antimicrobial assay of Silver Nanoparticles

The Silver nanoparticles synthesized from *Eclipta prostrata* were tested for antimicrobial activity by well-diffusion method against pathogenic microorganisms. The pure cultures of organisms were subcultured on nutrient broth at 35°C on a rotary shaker at 200 rpm. Using gel puncture, wells were made on nutrient agar plates. By means of sterile cotton swabs, each strain was swabbed uniformly onto the individual plates of the sample of water as control, liquid culture filtrate, silver nitrate and silver nanoparticle were loaded onto the well using a micropipette. After incubation at 37°C for 48 h, the different levels of zone of inhibition were measured[23].

Characterization of silver nanoparticles

Synthesized silver nanoparticles were confirmed by UV–Vis spectra, at the wavelength of 200–700 nm in UV-3600 Shimadzu spectrophotometer at 1-nm resolution. The samples were centrifuged at 15,000 rpm for 20 min, and the resulting pellet was dissolved in deionized water and filtered through Millipore filter (0.45 µm). An aliquot of this filtrate containing silver nanoparticles was used for scanning electron microscopy (SEM) and Fourier transform infrared (FTIR) studies.

UV-Vis spectroscopy:

Leaves extract were challenged to 100 ppm$AgNO_3$ solution. The mixture were observed visually for any colour change and one ml of reaction mixture were withdrawn periodically for analysis of surface Plasmon resonance of silver nanoparticles using a UV-Vis spectrophotometer (Shimadzu 1601 model, Japan) at the resolution of 1 nm in range of 200 to 800 nm.

FT-IR analysis

The surface groups of the nanoparticles were qualitatively confirmed by using FTIR spectroscopy[24], with spectra recorded by a Perkin-Elmer Spectrum 2000 FTIR spectrophotometer. FT-IR analysis was performed using Shimadzu FT-IR model number 8400. Approximately three mg of lyophilized leaves extract under study was mixed with 300 mg of dried KBr, crushed well in mortar and pestle to prepare thin pellet for analysis. Same procedure was performed for synthesized AgNPs using leaves extract. 16 scans per sample were taken in range of 400-4000 cm^{-1}.

Scanning electron microscopy (SEM)

The structure and composition of freeze-dried purified silver particles were analyzed by using a 10-kV ultra-high-resolution scanning electron microscope. A drop of aqueous solution containing purified silver nanomaterials obtained after repetitive centrifugation was sputter coated on carbon coated copper grids and the images of nanoparticles were studied using FEI QUANTA-200 SEM.

Larvicidal bioassay:

The mosquitocidal activity of green synthesised silver nanoparticle using *E. prostrata* leaf extract was assisted by the procedure of WHO as per the modification of Rehuman *et al*[25]. The plant extract and the silver nanoparticle solution were prepared.

For this bioassay test, larvae were taken in 3 batches of 25 in 99 ml dechlorinated tap water. 1ml of *E. prostrata* leaf extract was added in different concentration (250 ppm, 500 ppm, 750 ppm, 950 ppm, 1200 ppm) to the water prior to introduction of larvae. For larvicidal bioassay of silver nanoparticle synthesis by *E. prostrata.* 5 different concentration (250 - 1200 ppm) of silver nanoparticle solution is added to each cups. Sonication is done for the Agnp solution to avoid settling of silver nanoparticle in higher concentration prior to introduction of larvae. Control was set up with dechlorinated tap water. The numbers of dead larvae were counted after 24 and 48 hours of exposure. And the percentage of mortality was reported from the average of replicates. The mortality is calculated by Abbot's formula

Abbot's formula

$$\text{Corrected mortality} = \frac{\text{Observed mortality in treatment - Observed mortality in control}}{\text{100 - control mortality}} \times 100$$

$$\text{Percentage mortality} = \frac{\text{Number of dead larvae}}{\text{Number of larvae introduced}} \times 100$$

Statistical analysis:

All the data were subjected to statistical analysis by Probit analysis[26].

RESULTS AND DISCUSSION

Table: 1 Antimicrobial assay of plant samples

Microorganism	Plant Samples used in the study Zone of inhibition in mm				
	Eclipta prostrata				
	A	**C**	**E**	**M**	**PE**
Bacillus sp.	17.1±0.2	11.1±0	15±0	17±0.2	11.8±0.6
Escherichia coli	12.2±0.28	12±0	13.8±0.28	16.1±0.28	11±0
Lactobacillus	14±0	14.5±0.28	14±0.2	15.3±0.2	10±0.2
Klebsiella	16±0	13.3±0.23	11.8±0.23	16±0	9.5±0
Pseudomonas aeruoginosa	20.5±0	12.3±0.23	12±0.8	20±0.2	9±0.5
Shigella	16.5±0.5	15.5±0	15±0.8	16.5±0	10.5±0.2
Staphylococcus epidermis	19.5 ±0	13.5±0.2	13±0.7	19±0.2	11.5±0

Microbicidal activity of plant samples were represented in Table:1 Among the extracts assayed in *E. prostrata* acetone and methanol extract possess maximum inhibition against *P. aeuroginosa*(20.5 mm, 20 mm) and *S. epidermis*(19.5 mm, 19 mm), followed by *B*acillus sp. (17.1 mm, 17 mm)and *Shigella* (16.5 mm). Moderate zone of inhibition was observed in chloroform and ethanol extract against *Shigella* (15.5 mm, 15 mm), *Lactobacillus* (14.5 mm, 14 mm), *S. epidermis* (13.5 mm, 13 mm), *P. aeuroginosa*(12.3 mm, 12 mm). Minimum inhibition was observed in petroleum ether extract against *Shigella sp*. (10.5 mm), *Lactobacillus* (10 mm), *K. pneumoniae* (9.5 mm) and *P. aeuroginosa*(9 mm).

Antimicrobial assay of synthesized Agnps were represented in Table: 2. 400µl of synthesised silver nanoparticle using *E. prostrata* exhibited maximum zone of inhibition against *Bacillus* (21.1 mm), *E.coli*(20.8 mm) *P. aeuroginosa*(19.5 mm), and *S. epidermis*(17.5 mm). The zone of inhibition was found to be resistant at 300 µl against *Bacillus sp*.(19 mm), *E. coli* (18.6 mm), *P. aeruoginosa*(18.5 mm), and *S. epidermis*(16.6 mm). Moderate level of inhibition was observed in 200 µl of synthesised silver nanoparticle against *Bacillus* (18.5 mm), *E. coli* (17.6 mm), *P. aeuroginosa* (17 mm). Minimum inhibition was observed in 100 µl against *Bacillus* (16.5 mm), *E.coli*(15 mm), *P. aeuroginosa* (14 mm), *S. epidermis*(13.1 mm). The AgNPs were found to show potential antimicrobial activity against multidrug resistant Gram-positive (*Escherichia coli* and *Pseudomonas aeruginosa*) and Gram-negative (*Klebsiella pneumonia* and *Staphylococcus aureus*) clinically isolated human pathogens[27]. Therefore, Agnp synthesised using *E. prostrata* remained

resistant towards *Bacillus* and *E. coli* possessing maximum zone of inhibition.

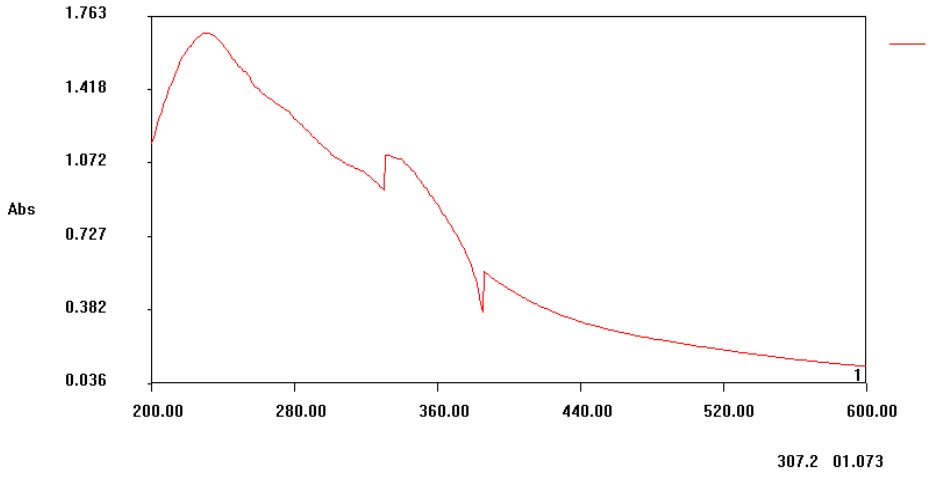
Table: 2 Antimicrobial screening of synthesised silver nanoparticles

Microorganism	Plant samples used in the study Zone of inhibition in mm			
	Eclipta prostrata			
	100	200	300	400
Bacillus sp.	16.5±0	18.5±0	19±0	21.1±0.28
Escherichia coli	15±0.5	17.6±0	18.6±0.28	20.8±0
Lactobacillus	10.6±0.76	13.5±0	15.6±0.76	16.6±0.28
Klebsiella	13.5±0.5	13.3±0.28	16.1±0.28	17±0
Pseudomonas aeruginosa	14±0	17±0	18.5±0	19.5±0
Shigella	11.5±0	11.8±0.20	12.3±0.28	14.6±0.76
Staphylococcus epidermis	13.1±0.28	14.1±0.28	16.6±0.76	17.5±0.28

Synthesis of Silver nanoparticle

After the addition of plant extract the colour changed to light brown. The bioreduction of silver ions in solution was monitored periodically by measuring the Uv-visible spectroscopy of the solution. *E. prostrata* act as reducing as well as capping agents, which mediates the Agnp synthesis. The source of plant extract plays a vital factor in affecting the morphology of synthesized nanoparticles[28]. The reaction is completed within few minutes and as a result of biochemical reduction, the metals are converted from their mono or divalent oxidation states to zerovalent states. This marks the formation of nanoparticles, which is physically indicated through the color change observed in the culture medium vessel[29].

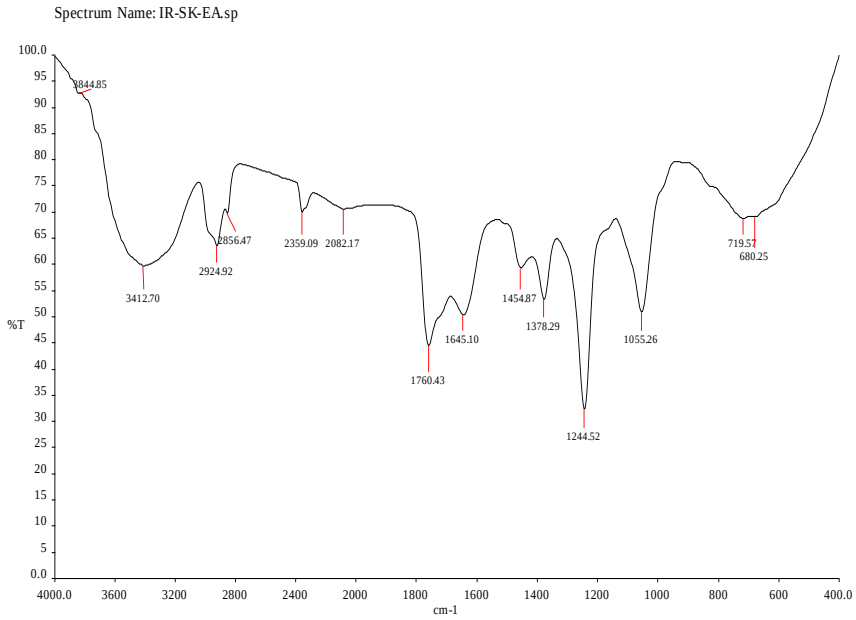
Figure: 1 Uv- Visible analysis of synthesised silver nanoparticle using *E. prostrata*



Uv- Visible analysis

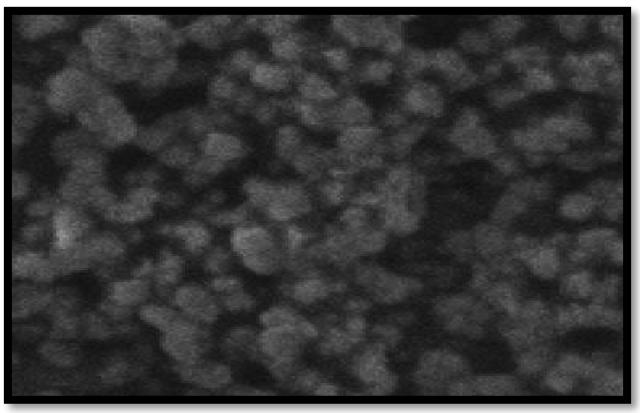
Figure: 1 reveals the absorbance spectra of Agnp synthesised from *E. prostrata*. The formation of AgNPs was preliminarily confirmed by UV-Vis spectral analysis. A well-defined absorption peak was observed in 240 nm, indicating the presence of colour change from yellow to brown. AgNPs exhibits extreme brown colour in extract is due to surface plasmons and the dipole oscillation arising when an electromagnetic field in the visible range is coupled to the collective oscillations of conduction electrons. It is an established fact that metal nanoparticles ranging from 2 to 100 nm in size demonstrate strong and broad surface plasmon peak[30]. Earlier studies have demonstrated the involvement of proteins, polyphenols, carbohydrates in AgNPs synthesis[31, 32, and 33].

Figure: 2 FTIR analysis of synthesised silver nanoparticles using *E.prostrata*



FTIR spectrum of synthesised Agnp using *E. prostrata* were revealed in Figure: 2. These biologically active compounds distinctively act as reducing and stabilizing agents for the AgNPs[34]. Demonstrative spectra obtained from AgNPs manifests the presence of different functional groups like secondary alcohol (O-H stretch, H-bonded), Alkanes (-C-H- stretching), Alkene (C=C- stretching), Aromatic (C=C-C- stretching), Alkane (-C-H bending), Ether (C-O stretching) and Alkene (=C-H bending) which are responsible for reduction of silver ions.The peak at 2924^{cm-1}, 2856 $^{cm-1}$ of C-H stretch represents aldehyde group. The peak at 1760^{cm-1} of C=C-C- stretching, 1454^{cm-1} of C=C stretching, 1244^{cm-1} in plane C-H bending indicates the presence of aromatic group. The wavenumber at 1645^{cm-1} of C=O stretching corresponds to secondary amide. The 1055^{cm-1} of aliphatic C-N stretching corresponds to amine group. The peak at 719^{cm-1} of N-H wagging corresponds to amine group. The functional assignments at 680^{cm-1}=C-H stretch denotes the presence of alkenes. The band proved the presence of functional groups strongly suggest the presence of proteins in *Eclipta prostrata* that act as reducing or capping agents and may be responsible for the synthesis of Agnps.

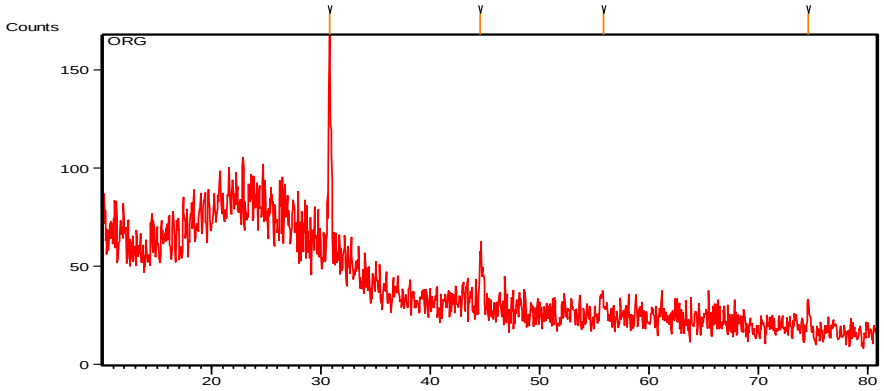
Figure: 3 Scanning electron microscope images of silver nanoparticle synthesised using *E. prostrata*



SEM analysis

SEM microscope images (Figure:3) indicates that the particles were found to be sphere shape and found to be evenly dipersed. This analysis was agreed to understand the topology and the range of the Ag-NPs, which showed the synthesis of higher density polydispersed spherical Ag-NPs of various sizes.

Figure: 4 XRD analysis of Agnps using *E. prostrata*



XRD analysis of Agnp synthesised using *E. prostrata*

The crystalline nature of silver nanoparticles was confirmed by X-ray diffraction and patterns of particles were specified in Figure: 4. This suggests a monoclinic configuration and the diffraction data were in good coordination with the Joint Committee on Powder Diffraction Standards card (no. 89-5899). The diffraction patterns exhibited concentric rings corresponding to 31.65 (111), 45.42 (200), 56.14 (220) and 75.14 (311) reflections. These distances are characteristic of the face-centered cubic (FCC) structure of silver metal.

Table: 3 Larvicidal activity of *Aedes sp*. using *Eclipta prostrata*

Mosquito	Instars of larvae	Period of bioassay	Conc.	LD50	LCL-UCL	Slope	Chi-square	P-level
Aedes	1st	24 hr	250	846.7674	432.2264-109,430.5763	2.0614	0.0318	0.9859
			500				0.0088	
			750				0.0910	
			950				0.0005	
			1200				0.059	
	1st	48 hr	250			7.4052	0.0007	0.9877
			500				0.0010	
			750				0.0189	
			950				0.0385	
			1200				0.0019	
	2nd	24 hr	250	645.3649	137.2005-4,186.4087	2.1917	0.0296	0.8893
			500				0.0101	
			750				0.0864	
			950				0.0002	
			1200				0.0598	
	2nd	48 hr	250			7.7679	0.0154	0.9681
			500				0.0079	
			750				0.0949	
			950				0.0003	
			1200				0.0909	
	3rd	24 hr	250	478.8827	187.0095-1,226.8888	3.3417	0.0071	0.9582
			500				0.0159	
			750				0.1912	
			950				0.0043	
			1200				0.0885	
		48 hr	250			6.6368	0.0048	0.9531
			500				0.012	
			750				0.1418	
			950				0.0043	

			1200				0.1374	
	4th	24 hr	250	371.0013	167.0574-	2.2866	0.0043	0.9681
			500		825.7611		0.0179	
			750				0.0724	
			950				0.0523	
			1200				0.0944	
		48 hr	250			7.2031	0.004	0.9374
			500				0.018	
			750				0.1053	
			950				0.0901	
			1200				0.1919	

Larvicidal activity of *Aedes sp*. using *Eclipta prostrata*

Larvicidal activity of *Aedes sp*. was assessed using *E. prostrata* extract- Table: 3. The LD 50 of 1st instar (846.7674) was higher whereas lower in 4th instar (371.0013), Similarly LCL(432.2264) and UCL (109,430.5763) was maximum in 1st instar, whereas lower in 2nd instar (145.2003 - 4,192.50980). 137.2005 - 4,186.4087. The slope was found to be higher in 2nd instar (7.7679) compared to 4th instar (7.2031). 3rd instar larvae when exposed to 750 ppm conc. of *E. prostrata* extract the chi-square value was found to be 0.2418 and 0.1919 at 1200 ppm concentration whereas lower at 250 ppm conc. (0.004). 3rd instar after 48 hr possess maximum chi-square value at 750 ppm conc. (0.1912), whereas lower at 950 ppm conc. (0.0043) when exposed to 24 hr. 1st instar at 48 hr acquires maximum chi-square value at 950 ppm conc. (0.0385); whereas minimum at 24 hr(0.0005). The p- level was found to be higher at 48 hr (0.9877) of 1st instar, followed by 24 hr (0.9859) of 1st instar, whereas low in 48 hr of 3rd instar (0.9531), followed by 4th instar (0.9374).

Table: 4 Larvicidal activity of synthesised silver nanoparticle using *Eclipta prostrata* against *Aedes sp.*

Mosquito	Instars of larvae	Period of bioassay	Conc.	LD50	LCL-UCL	Slope	Chi-square	P-level
Aedes	1st	24 hr	250	873.2012	5261.421-	1.4042	0.1368	0.9369
			500		3,189.7951		0.2392	
			750				0.0192	
			950				0.0017	
			1200				0.0528	
	1st	48 hr	250			8.7856	0.0425	0.9646
			500				0.119	
			750				0.0248	
			950				0.003	
			1200				0.0728	
	2nd	24 hr	250	648.4152	301.243-	1.7443	0.1634	0.8790
			500		1,350.1257		0.4062	
			750				0.0020	
			950				0.0289	
			1200				0.0162	
	2nd	48 hr	250			8.1363	0.0732	0.9126
			500				0.3250	
			750				0.0028	
			950				0.0374	
			1200				0.0274	
	3rd	24 hr	250	539.2399	50.8716-	2.2516	0.0733	0.9537
			500		1,103.0104		0.1030	
			750				0.0642	
			950				0.0002	
			1200				0.0707	

		48 hr	250			7.4873	0.0314	0.9867
			500				0.0811	
			750				0.0332	
			950				0.0164	
			1200				0.0271	
	4th	24 hr	250	461.6146	43.8010-724.6011	1.4240	0.1605	0.8791
			500				0.2043	
			750				0.0613	
			950				0.0033	
			1200				0.1345	
		48 hr	250			8.5314	0.0914	0.8577
			500				0.2216	
			750				0.0915	
			950				0.0067	
			1200				0.3076	

Larvicidal activity of synthesised AgNp using *Eclipta prostrata* against *Aedes sp*

Larvicidal activity of synthesised Agnp using *E. prostrata* against *Aedes sp* were represented in Table: 4. The LD 50 value was maximum towards 1st instar (873.2012). Similarly, LCL (5261.421) and UCL (3,189.7951) values were also higher in 1st instar. The LD 50 conc. was low (461.6146) in 4th instar, while LCL (43.8010) and UCL (724.6011) -was lower in 4th instar. At 48 hr the slope was found to be elevated at 1st (8.7856), 4th (8.5314), 2nd (8.1363), 3rd (7.4873); whereas in 24 hr the slope was found to be minimum in 2nd (1.7443) and 1st (1.4042) instar. After 24 hr the 2nd instar larvae when exposed to 500 ppm (0.4062) possess maximum value compared to 750 ppm (0.0020). 4th instar at 48 hr when induced to 1200 ppm (0.3076) acquires higher value compared to 950 ppm (0.0067). Chi-square value was found to be increased in 24 hr of 1st instar when exposed to 500 ppm (0.2392); while compared to 950ppm(0.002) at 48 hr. Chi-square value was found to be least in 3rd instar at 500 ppm (0.1047), whereas lower at 950ppm(0.0003). P-level was found to be maximum in 3rd instar (0.9867) at 48 hr.; followed by 1st instar(0.9646) at 48 hr; 3rd instar (0.9537) at 24 hr; 2nd instar(0.9126) at 48 hr; whereas p-value was found to be lower in 4th instar at 24 hr(0.8791) and 48 hr(0.8577).

Table: 5 Pupicidal and Adulticidal activity of *Eclipta prostrata* against *Aedes sp*.

Mosquito	Stages	Period	Conc.	LD50	LCL-UCL	slope	Chi-square	P-level
Aedes	Pupae	24 hr	250	1,177.4151	408.1744-2,164.8330	2.1835	0.0040	0.9992
			500				0.0193	
			750				0.0000	
			950				0.0007	
			1200				0.0009	
		48 hr	250			7.7531	0.0014	0.9985
			500				0.0086	
			750				0.0000	
			950				0.0007	
			1200				0.0009	
	Adult	24 hr	250	630.8674	273.6201-1,240.373	1.7032	0.0058	0.9940
			500				0.0022	
			750				0.0019	
			950				0.0348	
			1200				0.0106	
		48 hr	250			7.5614	0.0045	0.982
			500				0.020	
			750				0.0052	
			950				0.0511	
			1200				0.0041	

Pupicidal and Adulticidal activity of *Eclipta prostrata* against *Aedes sp*.

Pupicidal and Adulticidal activity of *Eclipta prostrata* against *Aedes sp*. were represented in Table: 5. The results suggest that LD50(1,177.4151), LCL(408.1744) and UCL(2,164.8330) value was maximum in pupae compared to LD50(630.8674), LCL(273.6201) and UCL(1,240.373) value of adult. The slope obtained at 48 hr was higher in pupae (7.7531); adult (7.5614); whereas the slope value at 24 hr was found to be minimum in pupae (2.1835); adult (1.7032). The chi-square value at 48 hr (950 ppm-0.0511) of adult was maximum compared to 750 ppm (0.0000) at 24 and 48 hr. The p-level obtained in pupae at 24 hr (0.9992) was found to be maximum compared to 48 hr (0.9985), whereas the adult possesses moderate value at 24 (0.9971) and 48h (0.993) compared to pupae.

Table: 6 Pupicidal and Adulticidal activity of synthesised silver nanoparticle using *Eclipta prostrata* against *Aedes sp*

Mosquito	Stages	Period	Conc.	LD50	LCL-UCL	Slope	Chi-square	P-level
Aedes	Pupae	24 hr	250	574.2416	141.0834-1,256.1043	2.2565	0.0002	0.9973
			500				0.0004	
			750				0.0076	
			950				0.0367	
			1200				0.0076	
		48 hr	250			7.6326	0.0000	0.9964
			500				0.0004	
			750				0.0089	
			950				0.0460	
			1200				0.0123	
	Adult	24 hr	250	499.7726	159.8014-784.2850	1.4210	0.0032	0.9996
			500				0.0204	
			750				0.0062	
			950				0.0005	
			1200				0.0004	
		48 hr	250			8.7612	0.0027	0.988
			500				0.0337	
			750				0.0006	
			950				0.0693	
			1200				0.0230	

Pupicidal and Adulticidal activity of synthesised silver nanoparticle using *Eclipta prostrata* against *Aedes sp*

Pupicidal and Adulticidal activity of synthesised Agnp using *Eclipta prostrata* against *Aedes sp* were represented in Table: 6. LD50 was found to be maximum in pupae (574.2416); whereas LCL (159.8014) and UCL (784.2850) was found to be maximum in adult. The obtained slope was found to be maximum in adult (8.7612) at 48hr compared to pupae at 7.6326. The slope value was lower at 24 hr in pupae (2.2565) and adult (1.421). The chi-square value was found to be maximum in adult at 48 hr (950 ppm-0.0693); compared to 24 hr (1200 ppm-0.0004); followed by pupae (950 ppm-0.0460); whereas found to be minimum in 250 ppm-0.0000. Adult at 24hr (0.9996); pupae at 24hr (0.9973); 48 hr (0.9964) acquired maximum p-level.

CONCLUSION

Nanotechnology utilizes physical, chemical and biological approaches to yield nanosized particles with specific functions. In the present study results recorded from UV-Vis spectrum, FT-IR, SEM and XRD supports the biosynthesis of silver nanoparticles. It is therefore, recommended that leaves extract of *E. prostrata* can be used in application for synthesis of AgNPs. Plant synthesized AgNPs may have significant impact on dengue incidence and potential to be considered as an integrated vector control agent. These AgNPs, being readily available and their application methods are simple and affordable for eradicating mosquitoes.

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