WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 7.523
Volume 6, Issue 6, 1410-1417. Research Article ISSN 2277–7105

GREEN SYNTHESIS OF SILVER NANOPARTICLES FROM FLOWER EXTRACT OF NERIUM OLEANDER AND ITS CHARACTERIZATION

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Article Received on
23 April 2017,

Revised on 12 May 2017,
Accepted on 01 June 2017

DOI: 10.20959/wjpr20176-8456

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ABSTRACT

There is an increasing commercial demand for nanoparticles due to their wide applicability in various areas such as electronics, catalysis, chemistry, energy, and medicine. This work deals with the synthesis and characterization of silver nanoparticles using *Nerium oleander* flower. The synthesized nanoparticles were characterized by using UV–Vis absorption spectroscopy, FT-IR and SEM analysis. The reaction mixture turned to brownish gray colour after 5 hrs of incubation and exhibits an absorbance peak around 450 nm characteristic of Ag nanoparticles. Scanning Electron Microscopy (SEM) analysis showed silver nanoparticles was pure and polydispersed and the size were ranging from 10-40 nm. The approach of green synthesis seems to be cost efficient, eco-friendly and easy alternative to conventional methods of silver nanoparticles synthesis.

KEYWORDS: electronics, catalysis, chemistry, energy, and medicine.

INTRODUCTION

Nanotechnology is mainly concerned with the synthesis of nanoparticles of variable sizes, shapes, chemical compositions and controlled dispersity. Their potential uses, in human welfare has been reported in several disciplines (Kasthuri et al., 2009). Although chemical and physical methods may successfully produce pure, well-defined nanoparticles, these methods are quite expensive and potentially dangerous to the environment. Use of biological organisms such as microorganisms, plant extract or plant biomass could be an alternative to chemical and physical methods for the production of nanoparticles in an eco-friendly manner.

Family : **Apocynaceae**
Genus : ***Nerium L.***
Species : ***N. oleander***
Tamil name : **Arali**

Oleander has been used in the treatment of cardiac illness, asthma, diabetes mellitus, corns, scabies, cancer, and epilepsy. It has been used to treat ulcers, hemorrhoids, leprosy and ringworm. It cures asthma, epilepsy and paralysis**.** It cures for skin disease such as eczema**.** It reduces the blood sugar levels. It enhances the immune-system. It Promotes normal menstrual cycles Garima et al.,(2011).

MATERIALS AND METHOD

Nerium oleander flowers were collected from Lalgudi Taluk, Tiruchirappalli district, Tamilnadu., authenticated and deposited in RAPINET HERBARIUM, St. Joseph College, Trichirappalli, Tamilnadu. Homogenate was prepared by weighing 20grams of fresh flower of *Nerium oleander. n* Washed thoroughly (thrice) in distilled water and homogenized using a mortar and pestle. The homogenate was then filtered using a sterile gauze cloth. This homogenate extract prepared was then transferred to a sterile container and used for the study.

Qualitative Phytochemical Analysis

Qualitative Phytochemical Analysis for sugar, alkaloid, saponins, tannins, terpenoids, flavonoids, steroids, quinone, coumarin and phenol were carried out for the extract as per the standard protocols (Harborne, 1984).

Preparation of Silver Nanoparticles

To 750ml of each millimolar concentration of silver nitrate, 7.5ml of the plant homogenate was added, respectively into a clean conical flask. The conical flasks were then exposed to the sunlight (while being continuously shaken) for the synthesis of the nanoparticles to begin. The colours of the mixture turns from green to brown when exposed to sunlight and once it turns to colourless the particles were settled at the bottom of the flasks.

Charecterization of Nanoparticles

UV -VIS Spectral Analysis

The bioreduction of Ag+ions in solutions was monitored by measuring the UV-VIS spectrum of the reaction medium. The UV-VIS spectral analysis of the sample was done by using U-3200 Hitachi spectrophotometer at room temperature operated at a resolution of 1 nm between 200 and 800 nm ranges.

FT-IR Analysis

For FT-IR measurements, the Ag nanoparticles solution was centrifuged at 10,000 rpm for 30min.The pellet was washed three times with 20ml of de-ionized water to get rid of the free proteins/ enzymes that are not capping the silver nanoparticles. The samples were dried and grinded with KBr pellets and analyzed on a Shimadzu IR-IR Affinity1 model in the diffuse reflectance mode operating at a resolution of 4 cm−1.

Scanning Electron Microscopy

The supernatant from the maximum time-point of production (of silver nanoparticles) was air-dried. The synthesized silver nanoparticles were fabricated on a glass substrates were done for the determination of the formation of silver nanoparticles. The morphology and size of silver nanoparticles was investigated using Scanning Electron Microscope (VEGA 3 TESCAN).The micrograph were recorded by focusing on clusters of particles.

RESULTS AND DISCUSSION

In the present investigation, Silver Nanoparticles (SNPs) were synthesized from the flower extract of *Nerium oleander* and the formation of SNPs were also confirmed by UV-VIS, FT-IR and SEM analysis. The crude extract was analyzed for the presence of different secondary metabolites.

The Qualitative phytochemical analysis of *Nerium oleander* extract showed the presence of alkaloids, tannins, terpenoids, steroids, coumarin, flavonoids and phenolic compounds (Table: 1). Sugar, Saponin and Quinone were absent in the extract of *Nerium oleander.*

Various herbs and spices have been reported to exhibit antioxidant activity and antimicrobial properties. A majority of the antioxidant antimicrobial properties is attributed to the flavones, isoflavones, flavonoids, anthocyanin, coumarin, lignans, catechins and isocatechins. Antioxidant based drug formulations are used for the prevention and treatment of complex

diseases like atherosclerosis, stroke, diabetes, Alzheimer's disease and cancer Huang et al.,(2007)**.**

In the present study SNPs were synthesized by using extract of *Nerium oleander* rapidly within 20 min of incubation period and brown colour was developed by addition of Silver Nitrate. The time duration of change in colour and thickness of the colour varies from plant to plant. The reason could be that the quantitative variation in the formation of SNPs (or) availability of H+ ions to reduce the silver. It is well known that SNPs exhibit yellowish brown colour in aqueous solution due to excitation of surface plasmon vibrations in silver nanoparticles. Silver nitrate is used as reducing agent as silver has distinctive properties such as good conductivity, catalytic and chemical stability. The aqueous silver ions when exposed to herbal extracts were reduced in solution, there by leading to the formation of silver hydrosol. (Table:2).

Detection and Characterization of Phyto Silver Nanoparticles

Visual Observation: After treatment of *Nerium oleander* extract with AgNO3, the colour change of the reaction mixture was visually observed. The time taken for the reaction mixture to change colour was noted. The reduction of silver ions into silver particles during exposure to the plant extract is followed by colour change from colourless or pale yellow to yellowish brown. It is well known that silver nanoparticles exhibit yellowish brown colour in aqueous solution due to excitation of surface plasmon vibrations in silver nano particles Renugadevik et al.,(2010)

UV- Vis- Spectroscopy

The reduction of silver metal ions to silver nanoparticles was preliminarily analysed using UV-Vis Spectrophotometer between 300-700nm. This analysis showed an absorbance peak at 420 nm which was specific for Ag nanoparticles (Fig:1).

UV–visible spectroscopy is an important technique to determine the formation and stability of metal nanoparticle in aqueous solution. The reaction mixture changes the colour by adding various concentrations of metal ions. These colour changes arise because of the excitation of surface plasmon vibrations in the silver Nanoparticle**.** It shows yellowish to dark brown in colour. The dark brown colour of silver colloid is accepted to surface plasmon resonance (SPR) arising due to the group of free conduction electrons induced by an interacting electromagnetic field.

The phytosynthesis of silver nanoparticles was confirmed primaryly by visual observation. The yellowish colour of the flower extract was turned in to brown after addition of $AgNO_3$ 10^{-3} M solution due to excitation of surface plasmon vibrations indicating the formation of silver nanostructures (Saraniya et al., 2012).

FT-IR analysis

FT-IR measurement was carried out to identify the possible biomolecules responsible for capping and efficient stabilization of Ag nanoparticle synthesized using *Nerium oleander* extract. This spectrum showed lot of absorption bands indicated the presence of active functional groups in the synthesized silver Nanoparticles. The intensity peaks are slightly increased for the period of silver nanoparticle synthesis like 3432,2398, 2390, 1124 cm^{-1} as well as some intensity peaks decreased like 1045, 2080, and 2359 cm-1. Fig: 2 shows the band at 3429 correspond to N-H, O-H Stretching vibrations of Silver, amide, alcohol and H–bonded to phenols. The peak at 1637 indicate to C=C, C=O stretching vibrations to alkenes and amide. The peak at 1382 represents to C-H in plane bend to alkenes. The peak at 595 corresponds to C- Cl, C-Br stretching vibrations to alkyl halides. The band at 2080 corresponds to C-N stretching vibration. The weak band at 1045 indicates C-O, C-N stretching vibrations and it corresponds to the presence of alcohols, carboxylic, acids, ethers, esters and aliphatic amines in the seed extract. The presence of active functional groups in seed extract results in the swift reduction of silver ions to silver Nanoparticle. To obtain good signal to noise ratio of silver nanoparticle were taken in the range 500–3400 cm^{-1}.

The ionic silver strongly interacts with thiol group of vital enzymes and inactivate the enzyme activity. Experimental evidence indicates that DNA loses its replication ability once the bacteria have been treated with silver ions (Mercy et al., 2013).

SEM

The SEM image showing the high intensity of silver nanoparticles synthesized by *Nerium oleander* extract further confirmed the development of silver nanostructures.SEM provided further insight into the morphology and size details of the silver nanoparticles. SEM analysis showed the particle size of about 10 μm as well the crystal structure of the nanoparticles.(Fig:3).

The silver nanoparticles synthesized via green route are highly toxic to multidrug resistant bacteria hence has a great potential in Biomedical applications. The present study showed a

simple, rapid, economical route to synthesized silver nanoparticles. Application of such eco-friendly nanoparticles in bactericidal, wound healing and other medical and electronic applications makes this method potentially exciting for the large scale synthesis of other inorganic materials (nano-materials).

Table 1: Preliminary phytochemical investigation in the flower extract of *Nerium oleander.*

Phytochemical compound	Result of qualitative tests
Sugars	-
Terpenoids	+
Alkaolids	+
Phenolic compounds	+
Tannins	+
Flavonoids	+
Saponin	_
Quinones	-
Steroids	+
Coumarins	+

Table 2: Indication of Colour Change in Synthesis of Silver Nano Particle (SNPs)

S.No	Plant flower extract+AgNo3	Colour change		pH change		Colour intensity	Time	Result
	Scientific name	Before	After	Before	After			
1	*Nerium oleander*	Light Yellow	Brown	4.0	4.60	+++	20min	Positive

Colour intensity: +++ = very dark colour..

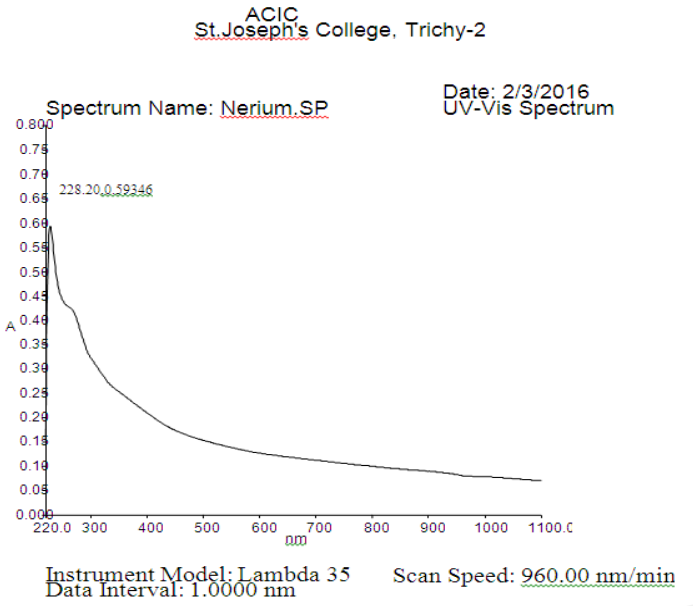

Fig 1: UV-VIS Spectral analysis of *Nerium oleander* flower extract.

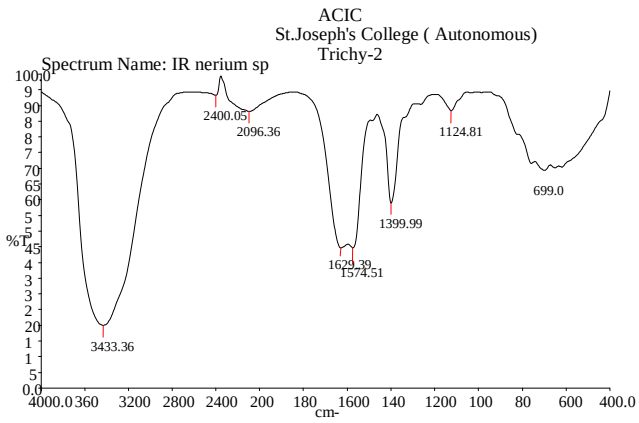

Fig 2: FT- IR Spectral analysis of *Nerium oleander* flower extract.

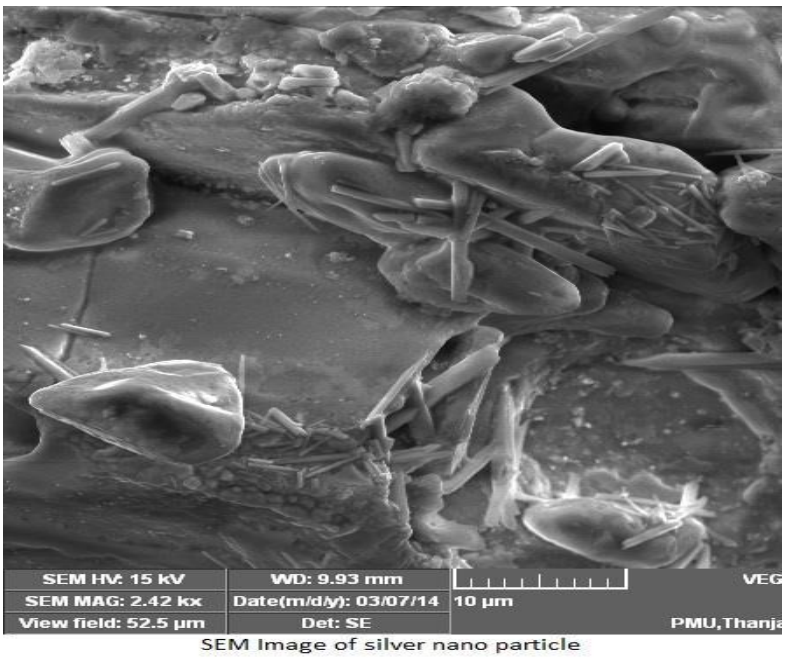

Fig 3: SEM Analysis of SNPs formed from *Nerium oleander* flower extract.

SUMMARY AND CONCLUSION

The Phytochemical analysis confirm the presence of Alkaloids, terpenoids, Tannins, Flavonoids and Phenolic compounds. The phytosynthesis of silver nanoparticles was demonstrated by visual inspection and by performing some spectral techniques (UV-VIS absorption, FT-IR spectroscopy and SEM analysis). FT-IR results proved that bioactive compounds responsible for silver bioreduction could be proteins and flavonoids presumed to act as reducing and capping agents for the silver nanoparticles preventing the agglomeration of the particles and thereby stabilizing the nanoparticles. These environmentally benign SNPs

were further confirmed by using UV-Vis spectroscopy finally the size and shape of the SNPs was characterized by SEM analysis.

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