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SYNTHESIS AND CHARACTERIZATION OF SILVER NANO PARTICLES FROM *WRIGHTIA TINCTORIA*

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ABSTRACT: In our present study the conventional (physical and chemical) method of nano particles synthesis was replaced with biological synthesis of silver nanoparticles by using the leaf extract of *Wrightia tinctoria.* New drug delivery system has been enhanced with noval techniques like nano particle synthesis and its role in drug delivery system, by exploiting the nanotechnology in particle synthesis. The aqueous extract of *Wrightia tinctoria* leaves was prepared and mixed with 1mM $AgNO_3$ solution. After 48 hours the reduction of silver nitrate to silver nanoparticles (AgNPs) was confirmed by UV-visible spectrophotometer. The size of Silver nanoparticles were characterized by XRD and FTIR and the size were of 19 – 68nm. The biosynthesis of AgNPs using *Wrightia tinctoria* leaf extract is very simple and economic. This green chemistry approach is amenable to large scale commercial production. The use of environmentally benign and renewable plant material offers enormous benefits of eco-friendliness.

Key words: *Wrightia tinctoria*, silver nano particle synthesis, FTIR, XRD,

INTRODUCTION

Nanotechnology *is* the study of manipulating matter on an atomic and molecular scale. Generally nanotechnology deals with structures that are ranged from 1 to 100 nano meter which has vast range of applications, such as in medicine, electronics, biomaterials and energy production. With the development of several chemical synthetic techniques, the concern for environmental contaminations is also heightened as the chemical synthesis protocols need some chemicals for synthesis which are not biodegradable. (Song *et al.,* 2008). Most of the physical methods deal with enormous consumption of energy to maintain high pressure and temperature were employed in the synthesis procedures. With the increasing interest in minimization of waste and implementation of sustainable processes through the adoption of all the fundamental principles of green chemistry (Anastas *et al.,* 1998), the development of ecofriendly and simple approaches for the preparation of advanced materials is desirable.

Consequently, researchers in the field of nanoparticle preparation turned their attention towards biological systems. The biosynthesis of nanoparticles as an emerging highlight of the intersection of nanotechnology and biotechnology has received increasing attention due to a growing need to develop environmentally benign technologies in material synthesis. Biological methods of nanoparticles synthesis using microorganisms, enzymes and plant or plant extracts have been suggested as possible ecofriendly alternatives to chemical and physical methods (Kasthuri *et al 2009).* Use of plants in synthesis of nanoparticles in quite novel leading to truly green chemistry which provide advancement over chemical and physical method as it is cost effective and nanoparticles synthesis can be advantageous over other biological processes because it eliminates the elaborate process of maintaining cell cultures and can also be suitably scaled up for large-scale synthesis of nanoparticles. (Zhang *et al.,* 2007; Kattumuri *et al.,* 2007).

One nanometer (nm) is one billionth, or 10−9, of a meter. By comparison, typical carbon-carbon bond length, or the spacing between these atoms in a molecule, are in the range 0.12–0.15 nm, and a DNA double-helix has a diameter around 2 nm. On the other hand, the smallest cellular life-forms, the bacteria of the genus. Mycoplasma, are around 200 nm in length. Biologically synthesized silver (Ag) nanoparticles have wide range of applications because of their remarkable physical and chemical properties. Gold, silver and platinum nanoparticles are widely applied to human contact areas such as shampoos, soaps, detergents, shoes, cosmetic products and toothpaste as well as medical and pharmaceutical applications. Ag nanoparticles are excellent nanomaterials providing a powerful platform in biomedical applications of biomolecular recognition, biosensing, drug delivery and molecular imaging. (Sperling *et al.* 2008).

Metal nanoparticles have a high specific surface area and a high fraction of surface atoms have been studied extensively because of their unique physicochemical characteristics including catalytic activity (Hayat *et al.,*1990), optical properties (Schultz *et al.,* 2000), electronic and magnetic properties, antibacterial properties (Kowshik *et al.,*2003). Silver nanoparticles are currently being utilized in several technological applications and are gaining popularity as a form of counter measures against several illnesses that cannot be treated through conventional means.

In recent trends silver nano particles of plant extract found have antimicrobial property. (Krishnaraj et al 2009) Silver in its pure form was known, even to the by ancient Greeks, as a great material to keep microbes at bay. If silver is transformed into a nanoparticle, this anti-microbial property is intensified, making it useful in effectively eliminating fungus, bacteria, and viruses. As a natural material, silver is known to be safe to man and produce little to no allergic reactions when tested for curing various diseases. Wrightia tinctoria is a small to medium-size deciduous tree and belongs to the family Apocynaceae and native to India and Burma,. The plant contains wrightial, a triterpenoid chemical, along with cycloartenone, cycloeucalenol, β-amyrin, and β-sitosterol isolated from the methanolic extract of the immature seed pods.

MATERIALS AND METHODS

Sample collection

Fresh *Wrightia tinctoria* leaves were collected from TRC (Tuberculosis research center) road, Chetpet, Chennai, Tamilnadu, India.

Extraction of plant material

A known amount of healthy leaves of Wrightia tinctoria were collected, dried at room temperature and powdered. The hot aqueous extract of the plant was prepared with distilled water (60mg of leaf powder in 600 of DW; 1:10 W/V). The extract was then filtered to obtain aqueous extract of definite concentrations.

Synthesis of silver nanoparticles

For synthesis of silver nanoparticles, a known concentration (10 ml) of *Wrightia tinctoria* leaf broth was interacted with 90 ml of 1mM AgNo3 solution in 1:9 ratio in a conical flask. The flask was incubated at room temperature for 48 hours. It was then analyzed in UV-Visible double beam spectrophotometer in the range of 400–500 nm. (Spectrochem Pvt.Ltd, Mumbai.).

Separation of silver nanoparticles

The mixture was centrifuged at 10000 rpm for 10 minutes in a refrigerated centrifuge (Eltek refrigerated centrifuge RC 4100 D), followed by re dispersion of the pellet in acetone. The dispersed pellets were dried in a incubator (Apex lab incubator) at 37 °C for 1 week. The size of the purified Ag nanoparticles was analyzed by X-ray powder diffraction crystallography (Seifert, JSO-Debyeflex 2002).

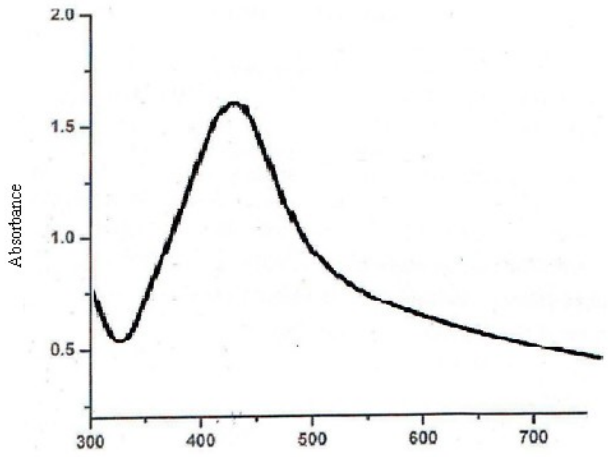
Sample Preparation for FTIR

The functional group of silver nanoparticles was identified by FTIR (Fourier transform infrared spectroscopy- Spectrum RXI). One drop of sample was placed between the plates of sodium chloride. The drop forms a thin film between the plates. sodium chloride is transparent to infrared light.

RESULT AND DISCUSSION

In our present study, AgNPs was synthesized by the addition of the aqueous extract of *Wrightia tinctoria* leaves to AgNO3 solution, boiled the mixture till the colour of the reaction medium changed rapidly from colourless to brown. The appearance of brown colour was due to the excitation of surface plasmon vibrations, typical of silver nanoparticles**.** The localized surface plasmon resonance (SPR) are collective oscillations of the conduction electrons confined to metallic nanoparticles. Excitation of the localized surface plasmons causes strong light scattering by an electric field at a wavelength where resonance occurs; this phenomenon results in the appearance of strong SPR bands. A. Tripathy *et al.,* 2009, in his study reported that the appearance of brown colour was due to the excitation of surface plasmon vibrations, typical of silver nanoparticles. The results of present study are inconsistent with his report. The optical absorption spectrum of metal nanoparticles is dominated by the SPR, which exhibits a shift towards the red end or blue end depending upon the particle size, shape, state of aggregation and the surrounding dielectric medium (Mock *et al.,* 2002; Mulvaney *et al.,* 1996). In the present study, the formation of silver nanoparticles was initially confirmed using SPR phenomenon. Silver nanoparticles have kmax values in the visible range of 400–500 nm (Sastry *et al.,* 1997).

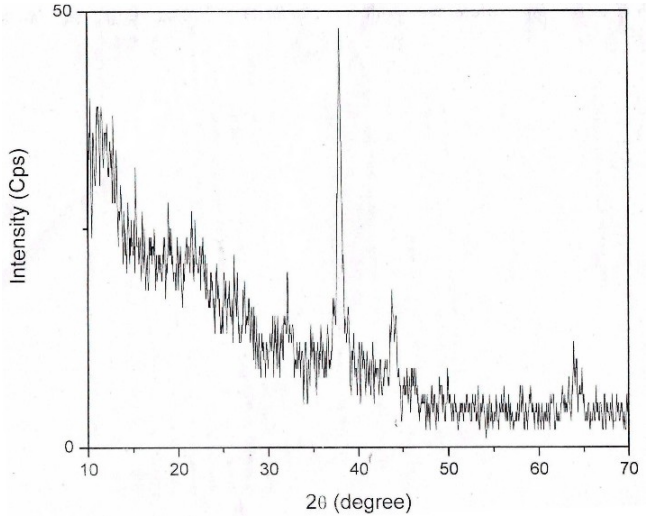
Graph 1 : UV-Vis absorption spectra of Silver nanoparticles synthesized by *Wrightia tinctoria* with 1mM Silver nitrate.



Graph 1 shows the UV–visible spectra of the nanoparticles obtained on *Wrightia tinctoria* broth. The particles synthesized gave a plasmon resonance band (absorbance value 1.650) at 420 nm. The long-term interaction study was carried out varying time intervals from 1 to 10 days to investigate the ageing effect on biosynthesized nanoparticles and to study their stability. The red shift (from 420 to 485 nm) and broadening of the SPR was observed with increasing interaction time. The peak at 440–460 nm was primarily due to excitation of longitudinal plasmon vibrations (Shankar *et al.,* 2003).

To study the crystalline nature of the silver nanoparticles, the XRD analysis was undertaken, Graph 2 revealing four peaks at degree (2θ) 10.24, 32.08, 37.93, 43.80 corresponding to four diffraction facets of silver. The broadening of X-ray peaks observed is primarily due to the small particle size. The spectra were recorded in Seifert -Jso-Debyeflex 2002 X-ray diffractometer. The mean size of silver nanoparticles was calculated using the Debye-Scherrer's equation. Kannan Badri Narayanan *et al.,* 2010 in his study he also used XRD analysis and Debye-Scherrer's equation to calculate the size of AgNPs. The average mean size of AgNPs was 39.5 nm.

Graph 2 : XRD patterns of Ag nanoparticles synthesized by using *Wrightia tinctoria*



Debye-Scherrer's equation

$D = K\lambda / \beta . \cos\theta$

Where,

$\beta = \pi / 180 * FWHM$

(FWHM= Full Width Half Maximum)

K= 0.9

λ= 1.540598 A°

$K\lambda$= 0.9 * 1.540598 A°

= 1.3865

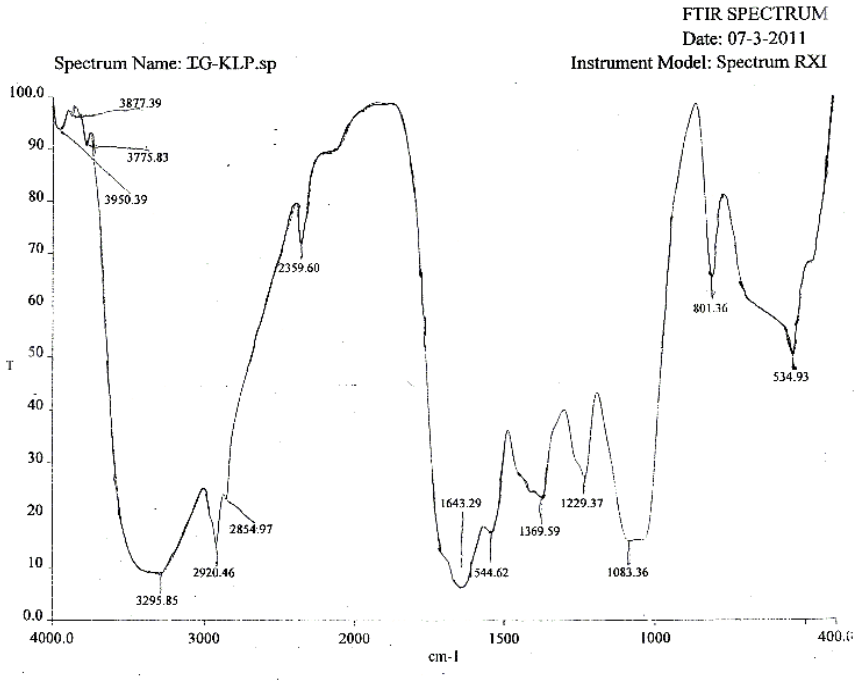
TABLE 1 : Measurement of the size of AgNPs by using Debye-Scherrer's equation

S.NO	2θ	FWHM	β= π / 180 * FWHM	Cosθ	D = Kλ / β. Cosθ
1	10.24	0.0400	0.00069	5.12	19.9 nm
2	32.08	0.1200	0.00209	16.04	68.3 nm
3	37.93	0.2400	0.00419	18.96	34.6 nm
4	43.80	0.2400	0.00419	21.90	35.1 nm

Average = 19.9 nm + 68.3 nm + 34.6 nm +35.1 nm / 4 = 39.5 nm

Graph 3 shows the FTIR spectra of the AgNPs. Representative spectra of obtained nanoparticles manifests absorption peaks located at about 3295.85 cm^{-1}, 2920.46 cm^{-1}, 2359.60 cm^{-1}, 1643.29 cm^{-1}, 1544.62 cm^{-1}, 1369.59 cm^{-1}, 1229.37 cm^{-1}, 1083.36 cm^{-1}, 801.36 cm^{-1}, 534.93cm^{-1} in the region of 4000 cm^{-1} to 400 cm^{-1}. The FTIR spectra revealed the presence of different functional groups like secondary amides (N-H stretching), alkanes (-CH_2-), charged amines (NH stretching), alkenes (c=c stretching), tertiary nitro compounds (NO_2 stretching), sulfonyl chlorides (S=O stretching), sulfites (S=O stretching), aliphatic ethers (R-O-R stretching), benzene ring with three adjacent H atoms (C-H stretching), bromides (C-Br stretching). AgNPs was synthesized from from *Wrightia tinctoria.* The nanoparticles were confirmed by UV-Vis spectrophotometer. The size of the AgNPs was measured by XRD and the functional groups of AgNPs were identified by FTIR.

Graph 3 FTIR Spectra of Ag nanoparticles synthesized using *Wrightia tinctoria*



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