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Archives of Applied Science Research, 2012, 4 (3):1289-1293
(http://scholarsresearchlibrary.com/archive.html)

ISSN 0975-508X
CODEN (USA) AASRC9

Synthesis of silver nanoparticles using *Tridax procumbens* and its antimicrobial activity

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ABSTRACT

Most of the researchers have been reported about the nontoxic biosynthesis of silver nanoparticles using several microorganisms and plant extracts. This ecofriendly silver nanoparticles exhibit completely new or improved properties based on specific characteristics such as size, distribution, morphology and many applications. In this research the synthesis of silver nanoparticles using plant Tridax procumbens has been investigated. We have synthesized silver nanoparticles by adding the 50ml of 1mM silver nitrate solution in to the plant extract and characterized by uv-vis absorption spectroscopy, and SEM techniques. This techniques showed that the size 55nm as well as revealed the structure. The antimicrobial efficacy also determined by Kirby-bour method with E.coli, Salmonella, Shigella and Vibrio cholera and it showed that high level of inhibition. The most outcome of this research will be suggested that biologically synthesized silver nanoparticle has more effective against various disease causing pathogens.

Key words: *Tridax procumbens*, silver nanoparticles synthesis and antimicrobial activity**.**

INTRODUCTION

Nanotechnology is one of the modern techniques of the material science. The small sized nanoparticles mean they exhibit enhanced or different properties when compared with the bulk material. The extremely small size of nanoparticles having a large surface area relative to their volume. Especially silver, have drawn the attention of scientists because of their extensive application in the development of new technologies in the areas of electronics, material sciences and medicine at the nanoscale[1-3]. New applications of nanoparticles and nanomaterials are emerging rapidly[4-6]. Nanocrystalline silver particles have found tremendous applications in the field of high sensitivity biomolecular detection and diagnostics[7], antimicrobials and therapeutics[8, 9], Catalysis[10] and micro-electronics[11]. However, there is still need for economic, commercially viable as well environmentally clean synthesis route to synthesize silver nanoparticles.

The development of green processes for the synthesis of nanoparticles is evolving into an important branch of nanotechnology[12,13]. Especially Silver nanoparticles have many applications; for example, they might be used as spectrally selective coatings for solar energy absorption and intercalation material for electrical batteries, as optical receptors, as catalysts in chemical reactions, for biolabelling, and as antimicrobials [1-3].

The antimicrobial properties of silver nanoparticles are well-established and several mechanisms for their bactericidal effects have been proposed. While various hypotheses have been proposed to explain the mechanism of antimicrobial activity of silver nanoparticles, it is widely believed that silver nanoparticles are incorporated in the cell membrane, which causes leakage of intracellular substances and eventually causes cell death [12, 14, 15]. Some of the silver nanoparticles also penetrate into the cells. It is reported that the bactericidal effect of silver nanoparticles decreases as the size increases and is also affected by the shape of the particles[16, 17].

Chemical synthesis methods lead to presence of some toxic chemical absorbed on the surface that may have adverse effect in the medical applications. Green synthesis provides advancement over chemical and physical method as it is cost effective, environment friendly, easily scaled up for large scale synthesis and in this method there is no need to use high pressure, energy, temperature and toxic chemicals[18, 19]. Therefore there is most need of silver nanoparticles synthesized by biological methods of plant extract instead of other toxic methods [18, 19, 20].

In the present scenario, there is an urgent and continuous need of exploration and development of cheaper, effective new plant based nanoparticles with better bioactive potential and least side effects. The entire plant of *T. procumbens* is used by indigenous people in Guatemala for the treatment of protozoal infections (malaria, leishmaniasis, vaginitis, dysentery) and gastrointestinal disorders (colic/stomach pains, gastritis/enterocolitis) [21-23]. The objective of this study was the synthesis of silver nanoparticles, reducing the silver ions present in the solution of silver nitrate by the extract of ***Tridax procumbens*** leaf. Further these biologically synthesized silver nanoparticles have high efficacy of antimicrobial activity.

MATERIALS AND METHODS

Plant material and synthesis of silver nanoparticles

Tridax procumbens leaves were collected from our college campus Nehru arts and science college. The leaves were air dried for 7 days by keeping at 60^0C for 24-48 hrs in hot air oven and powdered. Twelve grams of dried powder was mixed with 1 mM silver nitrate and make up to a final solution 200 ml. The mixture was centrifuged at 20,000 rpm for 25 min. The collected pellets were stored at -4^0C.The supernatant was heated at 60^0c to 95^0C.A change in the color of solution was observed during the heating process.

UV-VIS Spectra analysis

The reduction of pure Ag+ ions was monitored by measuring the UV-Vis spectrum of the reaction medium at 3 hours after diluting a 1ml of the sample into 4ml of distilled water. UVVis spectral analysis was done by using UV-VIS spectrophotometer UV-164 (ELICO). (At **430 nm)**

SEM analysis of silver nanoparticles

Scanning Electron Microscopic (SEM) analysis was done using instrument JSM-6390. Thin films of the sample were prepared on a carbon coated copper grid by just dropping a very small amount of the sample on the grid, extra solution was removed using a blotting paper and then the film on the SEM grid were allowed to dry by putting it under a mercury lamp for 5 min.

Antimicrobial Activity

The antimicrobial activity was done on human pathogenic *Escherichia coli* and *salmonella, shigella and vibrio* by the standard disc diffusion method. Briefly Luria Bertani (LB) broth/agar medium was used to cultivate bacteria. Fresh overnight cultures of inoculum (100 μl) of each culture were spread on to LB agar plates. Sterile paper discs of 2mm diameter (containing 50mg/liter silver nanoparticles) along with four standard antibiotic containing discs were placed in each plate.

RESULTS AND DISCUSSION

The synthesis of Silver nanoparticles exhibited as the yellowish color changed to brown color in the aqueous solution of the plant extract due to excitation of surface Plasmon vibrations in silver nanoparticles[24] (fig.1). This was confirmed by the UV-VIS spectrograph of the colloidal solution of silver nanoparticles has been recorded as a function of time. Fig.2 shows the result of the UV-Vis spectra recorded from the reaction medium after 3 hours. Absorption spectra of silver nanoparticles formed in the reaction media has absorbance peak at 460 nm, broadening of peak indicated that the particles are polydispersed. Many have reported absorbance peak were 450-500nm with using different plant leaves extract [25], *Argemone mexican, Papaya fruit extract*[19], *Trianthema decandra*[26], *Coriandrum sativum*[27], *Anthoceros*[28].

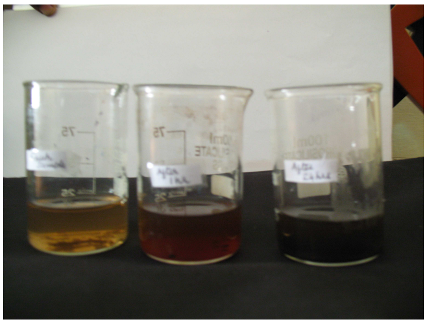

Fig.1: Color change of leaf extracts containing silver before and after synthesis of Silver nanoparticles

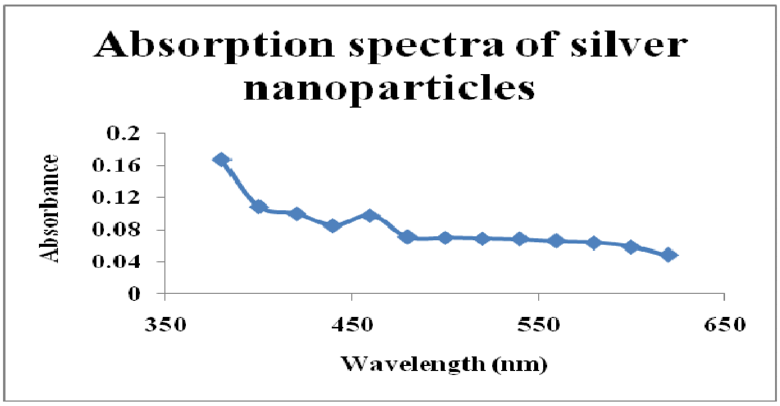

Fig 2: UV-Vis absorption spectrum of silver nanoparticles synthesized by treating 1mM aqueous AgNO3 solution with *Tridax procumbens* extract after 3 hrs.

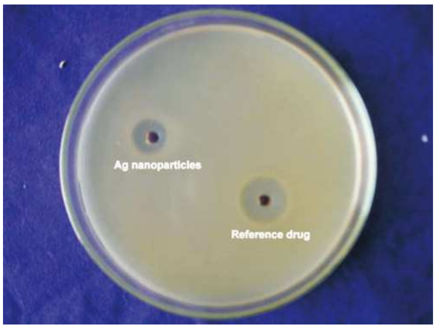

Fig.3. Shows that the antimicrobial activity of Ag nanoparticles from Tridax plant extract.

Fig.3 shows that the plant *Tridax procumbens* has been effectively involved in the antimicrobial activity and also which is used to synthesis the silver nanoparticles. Many reports has been given for the same pathogenic organisms[28].

Fig 4.shows that the size and structure of silver metal nanoparticles was further characterized using SEM analysis. The surface deposited silver nanoparticles are clearly seen at high magnification (x 5,000) in the micrograph. This was further confirmed by SEM analysis.

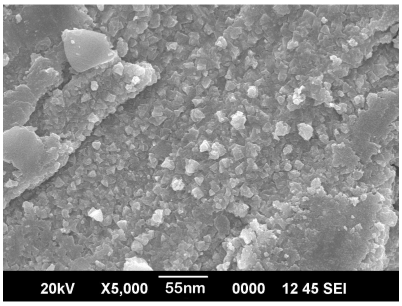

Fig 4.The SEM micrograph recorded from the silver nanoparticles

It is known that silver nanoparticles exhibit a high antibacterial effect due to their well-developed surface which provides the maximum contact with the environment. Furthermore, toxicity is presumed to be size and shape dependent[29] because small size nanoparticles (< 10 nm) may pass through cell membranes. Inside a bacterium, nanoparticles can interact with DNA, thus losing its ability to replicate which may lead to the cell death. Green synthesized nanoparticles also have the more effective antimicrobial activity that was measured by the zone inhibition of the pathogens Table.1 shows.

Table1. Effect of silver nanoparticles on human pathogens

Pathogens	Zone of Inhibition	
	Plant silver	**chloromphenicol**
E.*coli*	4mm	7mm
Salmonella sps	5mm	8mm
Shigella sps	5mm	7mm
Pseudomonas	6mm	10mm
Vibrio sps	9mm	10mm

Finally this report suggested that Silver nanoparticles synthesized from ever green plant sources. Some report shows that many microorganisms like algae, bacteria and fungi [30].

CONCLUSION

The presence study concluded that the plant *Tridax procumbens* can be used as an excellent source for synthesizing the silver nanoparticles. The primary confirmatory for the silver nanoparticles was color changes and Uv-Vis adsorption spectra of silver nanoparticles formed peak at 460nm. The SEM study revealed that the size of the silver nanoparticles is 55nm. The green synthesized nanoparticles have more effective antimicrobial activity to the pathogens. So green synthesis of nanoparticles can be ecofriendly involved in the many Applications of clinical, electronics and etc.

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