TWO STEP SYNTHESIS AND BIO-PHYSICAL CHARACTERISATION OF SILVER NANOPARTICLES USING GREEN APPROACH

Mangrola M. H.*, Joshi V. G.1, Dudhagara P. R.2 and Parmar B. H.3

1. Department of Physics, Veer Narmad South Gujarat University, Surat, Gujarat (INDIA)
2. Department of Biotechnology, Veer Narmad South Gujarat University, Surat, Gujarat (INDIA)
3. Department of Physics, Government Science College, Valod, Gujarat (INDIA)

Received July 03, 2012
Accepted December 10, 2012

ABSTRACT

Various schemes are exist and are being used for the synthesis of the silver nanoparticles due to its multiple vital applications however synthesis of nanoparticles may not safe for environment and may generate the hazardous waste. This fact creates the prompt need of the green method for the synthesis of silver nanoparticles. In the present study the eco-friendly approach has been applied for synthesis of silver nanoparticles. Aqueous extract of the Parthenium leaf and 0.5 mM AgNO₃ were used for the synthesis. Synthesis reaction was started at 100 °C temperature using different volume of the leaf extract and 0.5 mM AgNO₃. Ratio of leaf extract: AgNO₃ were 10:1 (SA), 10:0.5(SB), 10:2 (SC). Maximum absorbance was reported at 440 nm in 10:1 (SA) ratio followed by 10:2 (SC) and 10:0.5(SB). Nanoparticles formation was also detected during the synthesis due to the colour changes in the mixture. An antibacterial property was evaluated using six different Gram negative and Gram positive pathogenic bacteria by cup method on bacteriological media. Significant zone of inhibition was found against Salmonella typhi, Escherichia coli, Pseudomona aerogens, Protease vulgaris and Bacillus subtilis indicating the antibacterial potential of the synthesised silver nanoparticles. So such scheme for the synthesis of nanoparticles has a great impending applications at large scale.

Key Words: Silver nanoparticles, Parthenium, Antibacterial, Pseudomonan aerogens, Synthesis reaction

INTRODUCTION

Now a days, people works on synthesis of nanomaterials by different way, size control of the nanomaterials and its application in different fields. These work are going on nanomaterials because nanostructures materials have highly specific morphologies and properties are of great interest to chemists and material scientists.¹,²

Nanoparticles have been extensively investigated because of their unique electronic and optical properties are different from bulk materials. A lot of have efforts in particular, devoted to the synthesis and characterization of stable dispersions of nanoparticles made of silver, gold and other noble metals.³⁻⁷

*Author for correspondence

Silver nanocrystallites exhibit an enhancement of some potential properties including catalysis⁸, magnetic and optical polarizability,⁹ electrical conductivity¹⁰ and antimicrobial activity in Surface-Enhanced Raman Scattering (SERS).¹¹ Currently, many techniques have been devoted to synthesizing nanosize silver particles on different way with different techniques.¹²⁻¹⁵

Some well-known examples of biosynthesis of metal nanoparticles are gold nano-triangles using Lemmon grass¹⁶ and tamarind leaf extract.¹⁷ Synthesis of silver nanoparticles using geranium leaf.¹⁸ Recently synthesis of silver nanoparticles at room temperature from the extract of Parthenium hysterophorus leaves has been reported.¹⁹

1021
However, we report the synthesis of silver nanoparticles using *Parthenium* leaf extract in the aqueous solution by introducing solution of silver nitrate. The optical absorption properties are measured using UV-visible spectrophotometer and observed the absorption peaks at near 440 nm, which are close to the characteristics Surface Plasmon Resonance (SPR) wavelength of metallic silver. In addition, the effect of the reaction time with different concentration has been studied. We studied the antibacterial activity of silver nanoparticles on five-six type of different bacteria.

**MATERIAL AND METHODS**

**Collection of the plant leaf**

Plant leaf was collected from the bank side of the river Midhoda, Bardoli, Gujarat, India.

**Preparation of leaf solution**

Fresh leaves of *Parthenium* were bringing in laboratory followed by repeatedly washing with sterile distilled water and cut in to small pieces. 25 gm of leaves pieces were boiled in the 250 ml sterile distilled water for 15 min. followed by the filtration using Whatman filter No.1 to remove the cell and tissue debris. Filtrate was further used for the synthesis of nanoparticles.

**Synthesis of silver nanoparticles**

The solution 0.5mM AgNO₃ was prepared in a 500 ml beaker. In which, different volume of leaf extract was added to standardized the amount required for the nanoparticles formation followed by the incubation at the temperature of 100 °C until the changes of the colour of the system. Ratio of leaf extract was taken 10:1 (SA), 10:0.5(SB) and 10:2(SC).

**Characterization study**

Synthesized nanoparticles from all the three system were analysed for the absorbance maxima in UV-visible spectrum. Separate absorbance was SA (10:1) was also performed to find out the maximum absorbance.

**Antimicrobial study**

Antibacterial property was performed *in vitro* using six different strains of pathogenic bacteria. Out of six strains, two strains- *Staphylococcus aureus* and *Bacillus subtilis* were Gram positive and rest of four were Gram negative *Salmonella typhi, Escherichia coli, Pseudomona aerogens* and *Protease vulgaris*.

All the bacterial strains were activated in nutrient media. Antibacterial study was performed using agar cup method on solid nutrient agar plates. Two aliquots (50 µl and 100 µl) were used from all the three system (SA), (SB) and (SC). Plates were incubated at 37 °C for 24 hours. Zone of inhibition was observed on next day.

**RESULTS AND DISCUSSION**

Synthesis of nanoparticles using the *Parthenium* leaf is one of the least studied approaches, present study impart the importance of such plant species for the nanoparticles synthesis. Different proportion of the leaf extract was found to affect the synthesis of nanoparticles. As the time for colour changes from green to yellow and eventually red colour was different in all the three system which indicated the reaction status and synthesis of the particles (Fig. 1). However the 10:1 (SA) was found

![Fig. 1 : Green colour solution at the initial stage and yellow colour solution after heating 100°C, and eventually red colour indicates the silver nanoparticles colloidal solution](image_url)
best system for the synthesis of nanoparticles. Absorbance maxima suggest that the maximum absorbance was reported at 440nm by system 10:1 (SA) indicates the formation of the silver nanoparticles. UV–visible absorption spectrum is sensitive to the formation of silver nanoparticles because silver particles can show an intense absorption peak around 400 nm originating from the surface plasmon absorption of nanosized silver particles.\textsuperscript{13,20,21} Fig. 2 shows the onset of absorption is located at 440 nm for SA, 433 nm for SB and 423 nm for SC. Moreover, Fig. 3 shows the UV-Visible spectra of the Silver nanoparticles of SA (10:1) solution at 435 nm after one month. This result indicated the good stability of the silver nanoparticles. This is very useful properties and offers the impending application of such nanoparticles. Antibacterial properties indicated by all the three system against six strains of bacteria were remarkable. That was observed by measuring the zone of inhibition on the solid agar media (Fig. 4). Inhibition of both gram positives and negatives bacteria reveals the broad spectrum capacity of the nanoparticles and it may acts at the molecular level. This is very useful in the formulation of the antibacterial drugs. Candidates of the Anti-Bacterial activity and green synthesis is one
of the environment friendly method to produce the silver nano particles.

CONCLUSION

We reported on the green synthesis of silver nanoparticle and its anti-bacterial activity. We have prepared three samples with different concentration. The UV-visible optical absorption properties are measured. The absorption peak observed at near about 440 nm wavelength. This green chemistry approach towards the synthesis of silver nanoparticles has many advantages. Both samples are shows a good anti-bacterial activity. Plant extract is being eco-friendly and very cost effective, the presented method can be economic and effective alternative for the large scale synthesis of silver nanoparticles in nanotechnology processing industries. This method is a completely environment friendly to produce a silver nano particles.

REFERENCES


