International Journal of Advanced Technology in Engineering and Science www.ijates.com
Volume No.03, Issue No. 05, May 2015 ISSN (online): 2348 - 7550

SYNTHESIS OF SILVER NANOPARTICLES USING THE VEGETABLE EXTRACT OF RAPHANUS SATIVUS (RADISH) AND ASSESSMENT OF THEIR ANTIBACTERIAL ACTIVITY

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ABSTRACT

The green synthesis of nanoparticles (AgNPs) has more advantages because they are safe to handle and of their easy availability. The present investigation reports the synthesis of silver nanoparticle using the vegetableradish andassessmentof their antibacterial activity.The presence of silver nanoparticles wasinitially confirmedby the colour developed and then by UV-Vis Spectrometer, XRD, SEM and EDAX. The antibacterial activity was evaluated against the pathogenic strains Klebsiella pneumoniae, Bacillus subtilis, Staphylococcus aureus and Escherichia coliand the maximum zone of inhibition wasobtainedfor Bacillus subtilis.

Keywords: Green Synthesis, Raphanussativus, Silver Nanoparticles, SEM , Antibacterial Activity

I. INTRODUCTION

Materials show unique properties when at nano scale. Nanomaterials or structures in typically range from sub nanometers to several hundred nanometers[1]. There are numerous methods to synthesize as silver nanoparticles[2].The chemical methods expended for the synthesis of nanoparticles are too expensive and also involve the use of toxic, hazardous chemicals that are responsible for various biological risks. So the synthesis of nanoparticles using plants or vegetables and their extracts can be advantageous over other synthesis. The vegetable itself act as a reducing and capping agent in the synthesis process [3].

The green synthesis of silver nanoparticles by plants like Radish leaves[4], Carica papaya fruit[5], Banana[6], LanthanaC camera fruit[7], Ocimumbasillicum[8], Tansi fruit[9] were reported in journal. In the present investigation the vegetable *RaphanusSativus. L* (Radish) was used to synthesize the silver nanoparticle.The radishis an edible root vegetable of the Brassicaceae family. It is originally from Europe and Asia. The radish hasdurable biological and immunological activities[10]. It also has various chemical constituents. They are a very good source of electrolytes, minerals, vitamins and dietary fibers, is othiocyanate anti-oxidant compound called sulforaphane, phytochemicals like indoles which are detoxifying agents andzea-xanthin, lutein and beta carotene which are flavonoid antioxidants [11]. Eventhough AgNps have been synthesized from various biological sources, the synthesis of AgNP from Radish is not report in literature. So this investigation is designed to synthesis the AgNPs from Radish and to evaluate the antibacterial activity.

2.MATERIALS AND METHODS

To obtain silver nanoparticlesthe deionized water was used as a reaction medium, the reducing agent used was vegetable extract, i.e radish extract and the reagent used for the synthesis was silver nitrate which does not evolve any toxic hazard on the atmosphere.

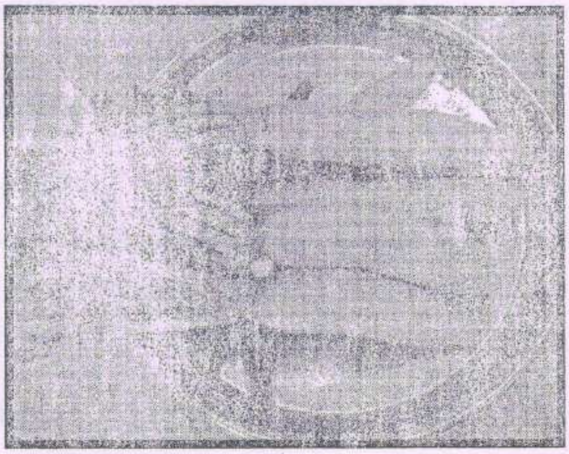


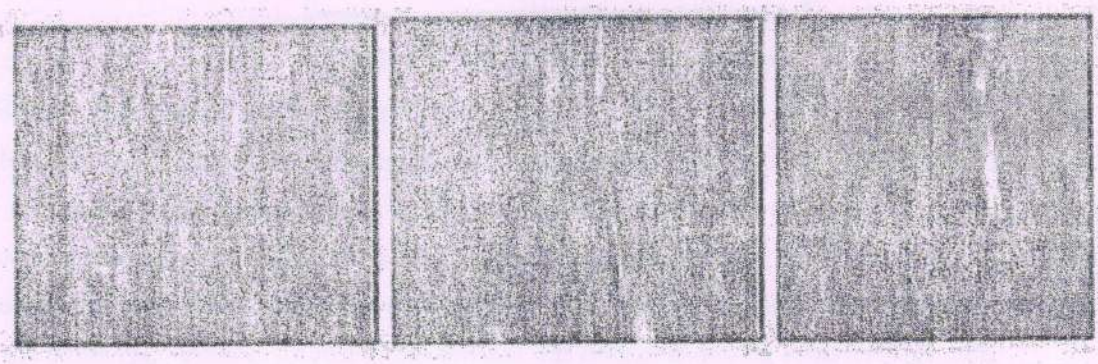
Fig.1: RaphanusSativus

Preparation of Fresh Radish Extract

Radishes were procured from the local market (Nov, 2014) .Aqueous extract of *RaphanusSativus* was prepared using 25 gm. It was washed thoroughly in deionised water, dried, cut into small pieces and were boiled in 150 ml of deionized water for 5-10 minutes. The extract was filtered through Whatmann No.1 filter paper and used for further research.

II. SYNTHESIS OF SILVER NANOPARTICLE

1mM aqueous solution of Silver nitrate ($AgNO_3$) was prepared and used for the synthesis of silver nanoparticles. 10 ml of the vegetable extract was added into 90 ml of aqueous solution of 1 mM Silver nitrate and incubated 15 minutes at room temperature. After 15 minutes, the colour of the solution changed from colourless to dark brown indicating the formation of silver nanoparticles.



A B C

Fig.2: Synthesis of Silvernanoparticle

A-Silver Nitrate Solution; B-Vegetable extract; C-Colour change after adding A&B

III. CHARACTERIZATION OF SILVER NANOPARTICLES

The extract was centrifuged twice to isolate the AgNPs and to eliminate the unwanted surplus. It was dried in a hot air oven for 30 minutes at a temperature of 100°C. Synthesized silver nanoparticles were confirmed by UV–Vis spectroscopy and it was carried out using UV-Vis spectrophotometer in the 200–1100nm range. Detailed analysis of the morphology, size and distribution of the nanoparticles was documented by Scanning Electron Microscopy (SEM) machine and the presence of elemental silver signal was confirmed in the sample by using EDAX. The possible functional groups in the synthesis and stabilization of nanoparticles was identified by performing FTIR analysis.

3.1 Assessment of antibacterial activity

Antibacterial activity of synthesized silver nanoparticles against Gram negative (Escherichia coli and Klebsiella pneumoniae) and Gram positive (Bacillus subtilis, Staphylococcus aureus) bacteria was evaluated using the disc diffusion method and zone of inhibition was measured.

IV. RESULTS AND DISCUSSION

4.1 UV-Vis Spectroscopy

The confirmation of formation and stability of silver nanoparticles was studied by using UV-Visible spectrum. A uv-vis spectrum was recorded using aqueous solution of Ag nanoparticles. The silver nanoparticle showed the sharp peak around 411 nm (Fig.3) with high absorbance which is very specific of silver nanoparticles.

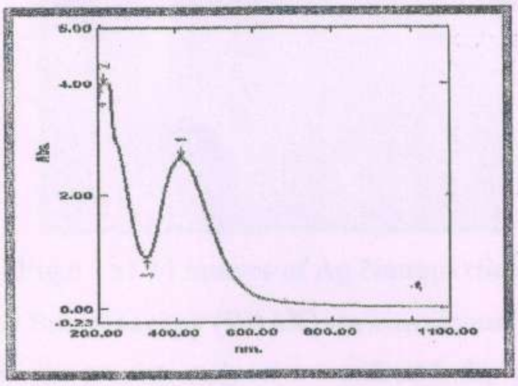


Fig.3: UV-Vis Spectra of the Sample

4.2 XRD Analysis of Silver Nanoparticles

Fig.4 showsthe XRD pattern for different intensity peaks in the whole spectrum of 2θ values ranging from 10 to 80 for radish. The silver nanoparticles produced in our experiments were in the form of nanoparticles as evidenced by the peaks at 2 theta values was matched with the JCPDF # 89-3722(which confirms the silver). We confirm that this pattern shows the cubic system and face centered lattice parameter. The average particle size of the silver nanoparticles formed in this process was determined using Scherrer's formula,

$d = 0.9\times\lambda / \beta * \cos\theta$. For this the calculated particle size was 35nm. TheXRD pattern thus clearly illustrates that the silver nanoparticles were formed .

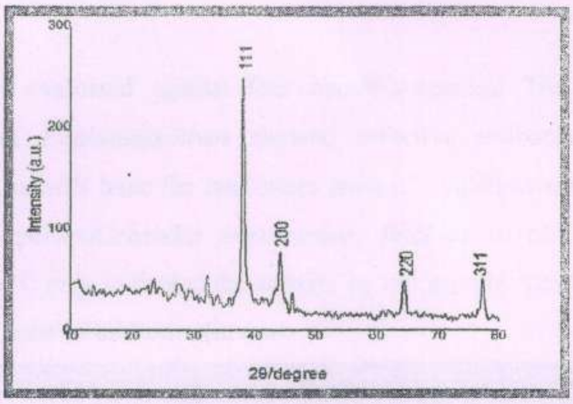


Fig.4 :XRD pattern of Ag Nanoparticles

4.3 Scanning Electron Microscopy

SEM was used to view the morphologhy and size of the silver nanoparticles. SEM images show the nanoparticle synthesized by fresh Radish extract were relatively polygonal in shape. This confirmed the development of silver nanostructures. Fig.5shows the nanoparticles in the range of 30 -60 nm. This size of particle confirms the presence of nanoparticles.

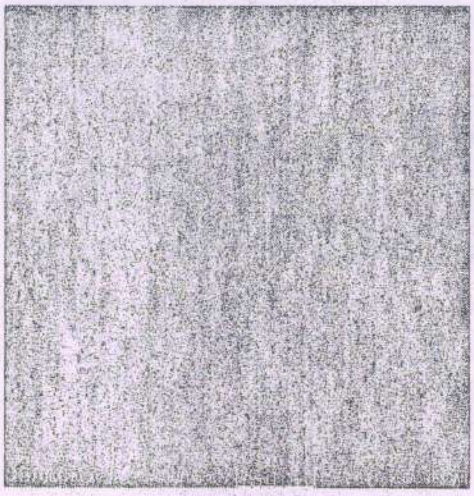


Fig.5 : SEM images of Ag Nanoparticle

4.4 Energy Dispersive X-Ray Spectroscopy (EDAX) measurement

The EDAX analysis found in the present study also confirmed the presence of silver nanoparticles synthesized from radish extract. Metallic silver nanoparticles generally show typical optical absorption peak approximately at 3 keV.Fig.6 clearly shows the presence of silver nanoparticles.

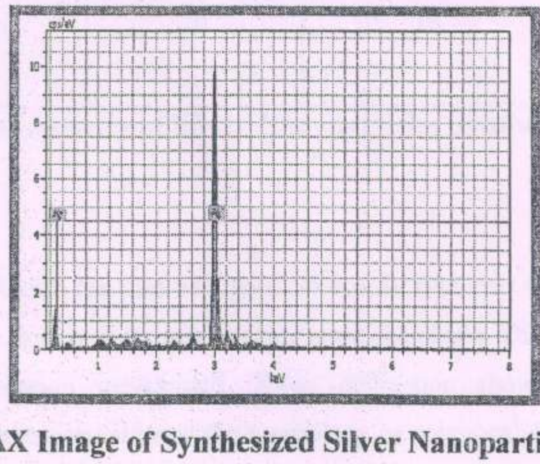


Fig.6: EDAX Image of Synthesized Silver Nanoparticles

4.5 Antibacterial Activity

The antibacterial activity was evaluated against four bacteria species. The results indicated that silver nanoparticles synthesized from *Raphanussativus* showed effective antibacterial activity compared with ampicilin. Amid them,*Bacillus subtills* have the maximum zone of inhibition which is 14mm.Fig.7showed the bacterial activity of bacteria species*Klebsiella pneumoniae, Bacillus subtilis, Staphylococcus aureus and Escherichia coli*. In each image, C only indicated the activity by our sample.Ampicilin was taken as the positive control for the measurement of zone of inhibition(in mm).

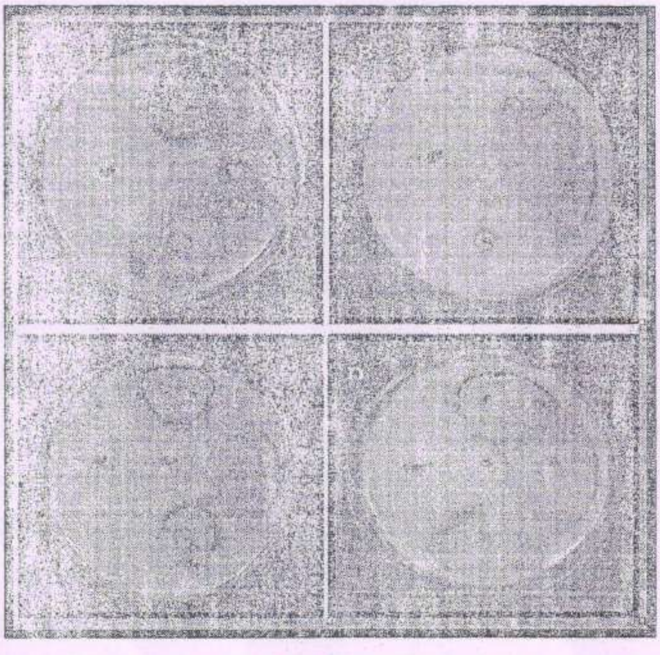


Fig.7: Bacterial activities of Synthesized Ag Nanoparticles Against Four Bacteria Species

Sample Code	*Klebsiella pneumoniae*	*Bacillus subtilis*	*Staphylococcus aureus*	*Escherichia coli*
C	10	14	11.5	10
CONTROL	R	R	R	R
STANDARD DISC (AMIKACIN)	16mm	20	16	16

Table 1: The Antibacterial Activity of Silver Nanoparticles Synthesized Using Radish

V. CONCLUSION

In the present study we found that Radish can also be a good source for synthesis of silver nanoparticlesandalso it is environmental friendly and free from organic solvents and toxic chemicals. The characterizations of UV Vis analysis showed 411nm as absorption wavelength, X-ray diffraction showed the presence of silver nanoparticles, ScanningElectron Microscope showed the morbology as polygonal shape and Energy dispersive

X-ray analysis showed the 3Kev energy peak which also confirms the presence of silver nanoparticles.Further research will include the anti-inflammatory effect and anti-cancerous activity by silver nanoparticles synthesized from radish.

VI. ACKNOWLEDGEMENTS

The authors are really thankful to the Department of Chemistry, JAC, Periyakulam for providing the chemical laboratory facilities to carry out this part of research work.

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