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RESEARCH ARTICLE

ANALYSIS OF THE OPTICAL PROPERTIES OF SILVER NANOPARTICLES SYNTHESIZED USING AMARANTHUS EXTRACTS

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Abstract: Optical properties of metal nanomaterials hold both fundamental and practical significance. Nanosilver exhibits fascinating optical properties directly related to the Surface Plasmon Resonance(SPR) which corresponds to the shape and size distribution of the particles. UV-Visible spectral measurements are useful in predicting the size of nanosilver. Optical response of nanoparticles makes them potentially useful for nanoscopic sensors, biological labels and electronics. The present study deals with the biogenic synthesis of silver nanoparticles using Amaranthus leaf extract and studying its optical properties in a UV-Visible spectrophotometer. The results of the study clearly shows that the concentration of the capping molecule to be responsible for the shape and particle size distribution of silver nanoparticles.

Keywords: Nanosilver, UV-Visible spectroscopy, Surface Plasmon resonance

INTRODUCTION:

Nanoscience is an emerging field nowadays, which increases the need for nanotechnology in more important areas such as computing, sensors, and biomedical applications[1]. The high demands on cheaper devices and energy crisis have led to broad interest in nanomaterials and their properties. Nanoparticles possess unique properties depending upon their size, shape and method of synthesis different from that of parent materials. This area of research can be motivated in synthesizing nanomaterials with novel optical, magnetic and electronic properties[2].

The optical properties of noble-metal nanoparticles are desirable for the realization of a working biochemical nanosensor encompassing these ideal characteristics. Nanoparticles of noble metals have been found particularly useful as they exhibit surface plasmon resonance (SPR)[3]. Especially pronounced resonance extinction of light has been found in noble metallic nanoparticles. The unique optical properties of metal nanoparticles open up the possibility for numerous technological applications of such materials in optics, holographic systems, as nanophotonic devices and nanolenses[4].

SPR involves a collective oscillation of the conduction electrons in resonance with certain frequencies of incident light, where the plasmon resonance of the metallic substrate (colloids) provides the intense optical frequency fields responsible for the electromagnetic contribution to SERS method. Nanoparticles of noble metals have been found particularly useful as they exhibit surface plasmon resonance (SPR). Interest in the application of SERS as an effective analytical tool is increasing, with the potential of the development of highly selective and sensitive detection. Silver nanoparticles have attracted intensive research interest because of their important applications as antimicrobial, catalytic and Surface Enhanced Raman scattering effect[5].

Biosynthesis of silver nanoparticles has been adopted recently to implement the greener nanotechnology. Plant extracts[6,7], fungi[8] and bacteria[9] are used as reducing agent in the synthesis of metallic nanoparticles. This green synthesis of nanoparticles will reduce the toxicity evolved during chemical synthesis. Hence in the present work, synthesis of silver nanoparticles using the extracts of *Amaranthus dubius* and *Amaranthus polygonoides* was carried out. Optical properties of synthesized nanosilver were studied by UV-Visible spectroscopy.

1. Materials and methods

Fresh plant parts of *Amaranthus dubius* and *Amaranthus polygonoides* were collected from a retail shop in Coimbatore. Silver nitrate was purchased from SD fine chemicals. Millipore water was used throughout the study.

2.1 Preparation of extract

The fresh plant parts of *Amaranthus dubius* and *Amaranthus polygonoides* were cut into small pieces and heated with 100 ml water. The prepared extracts were filtered and refrigerated.

2.2 Synthesis of silver nanoparticles

Silver nanoparticles synthesized using the aqueous extract of *Amaranthus dubius* and *Amaranthus polygonoides* and silver ions under room temperature are reported in our earlier paper[10,11]. Different concentrations (6ml, 7ml, 8ml, 9ml and 10ml) of silver nitrate (3Mm) were treated with 1 ml aqueous extract of *A. dubius* at 30ºC. The formation of silver nanoparticles was initially confirmed through visible evaluation viz. formation of brown silver nanoparticles. Similar procedure was adopted with the extracts of *A.polygonoides*.

Concentration (AK + $AgNO_3$) mL	Absorption (nm)	Tansmittance (nm)
1+6	420.6	447.2, 477.6
1+7	420.6	447.2, 477.6
1+8	420.6	448.8, 478.4
1+9	420.6	448.0, 478.0
1+10	420.6	449.6, 478.4

Table.1 UV-Visible absorption and transmission measurements of nanosilver synthesized using *Amaranthus dubius*

2.3 Characterization of silver nanoparticles

The synthesized silver nanoparticles were characterized by UV-Visible spectroscopy (Double beam spectrophotometer – 2202 Systronics).

2. Results and discussion

The silver ions were treated with aqueous extract of *Amaranthus dubius* and *Amaranthus polygonoides* in the ratio 6:1 and kept at room temperature. The yellow colour solution was changed reddish brown after 30 min for *A. dubius* and 60 min for *A. polygonoides* respectively. The visual observation confirms the reduction of silver to silver ions was carried out by plant extracts. The UV-Visible spectroscopy was used to analyze the formation and completion of silver nanoparticles. Silver NPs have unique optical properties because they support surface plasmon's. At specific wavelengths of light the surface plasmons are driven into resonance and the AgNPs have a distinct color that is a function of their size, shape and environment.

The UV-Visible spectra of *A. dubius* assisted nanosilver (AKG) shows an absorption band at 420 nm whereas for silver nanoparticles synthesized using *A. polygonoides* (SKG) the band appears at 425 nm. The two absorption bands of synthesized silver nanoparticles correspond to the Surface Plasmon Resonance (SPR) bands of silver nanoparticles. As the concentration of the silver ions increases the intensity of SPR bands of AKG -nanosilver also increased without any shift in the peak wavelength (figure 1). In SKG-nanosilver, another band at 465 nm appears as the concentration of the silver ions increases with the steady increase in intensity of SPR band(figure 2).

The nonlinear refraction and absorption co-efficients values of AgNPs synthesized using *Coriandrum sativum* extract measured by Z-scan technique with ns-laser pulses showed superior optical non-linearity compared to those synthesized through other procedures [12].

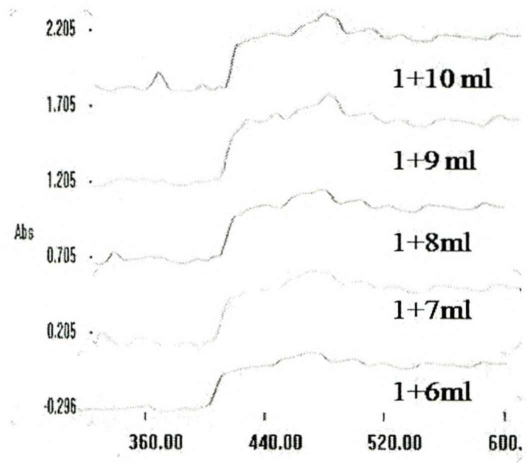

Figure 1. UV-Visible absorption spectra of nanosilver synthesized using *Amaranthus dubius*

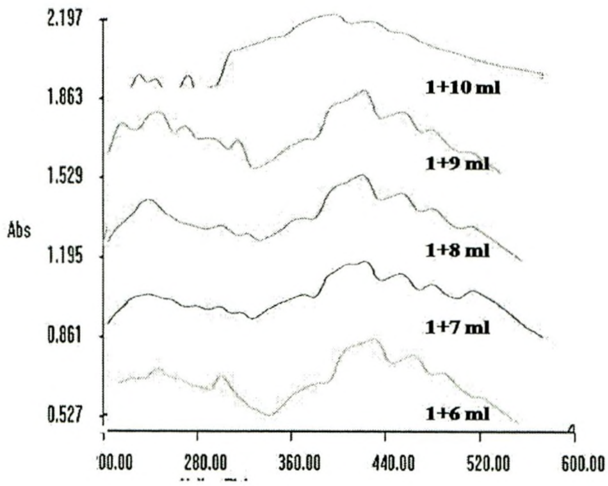

Figure 2. UV-Visible absorption spectra of nanosilver synthesized using *Amaranthus polygonoides*

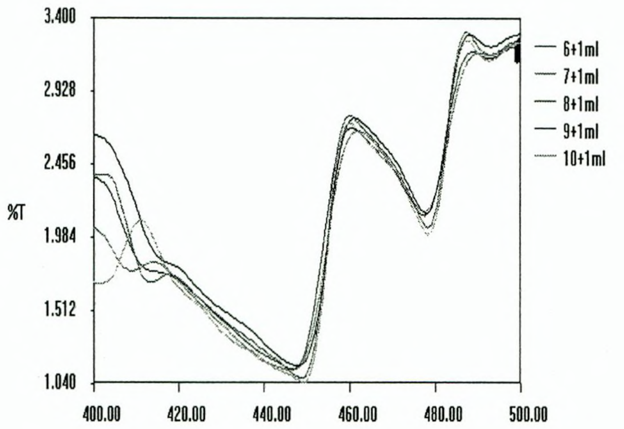

Figure 3. UV-Visible transmission spectra of nanosilver synthesized using *Amaranthus dubius*

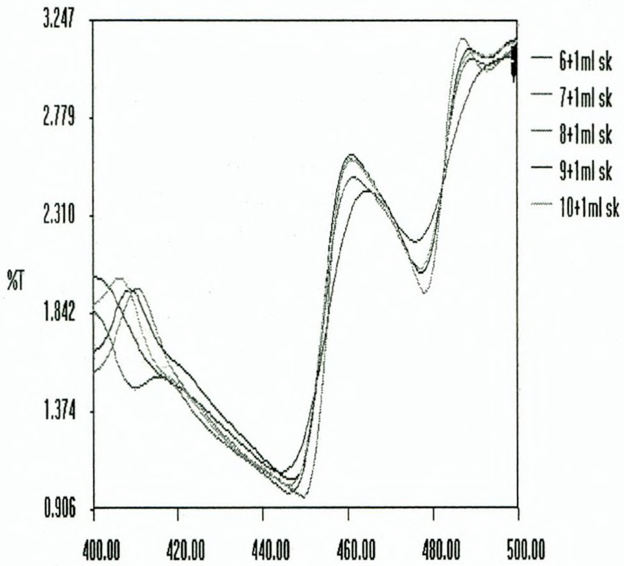

Figure 4. UV-Visible transmission spectra of nanosilver synthesized using *Amaranthus polygonoides*

Table. 2 UV-Visible absorption and transmission measurements of nanosilver synthesized using *Amaranthus polygonoides*

Concentration (SK + $AgNO_3$) mL	Absorption (nm)	Tansmittance (nm)
1+6	425.2	445.6, 476.8
1+7	425.2	449.6, 478.4
1+8	425.2	446.8, 477.2
1+9	425.2	447.2, 477.6
1+10	425.2, 465.4	446.8, 477.2

It is observed that the surface plasmon resonance bands steadily increases with intensity as a function of concentration in both synthesized nanosilver AKG and SKG. The transmittance spectra of silver nanoparticles synthesized using extracts of *A. dubius* and *A. polygonoides* is shown in (figure 3 & 4). From the figure 3 & 4, it was noted that the synthesized silver nanoparticles are not transparent. Hence modification in the method of synthesis has to be adopted to enhance its optical properties which find potential applications in various fields. The SPR bands are useful in predicting the optical properties of these synthesized silver nanoparticles. The properties of metal oxide nanoparticles are of great interest due to the many potential applications of these materials. Optical experiments provide a good way of examining the properties of semiconductors. Particularly measuring the absorption coefficient for various energies gives information about the band gaps of the material.

3. Conclusion

Green synthesis of silver nanoparticles was achieved using the extracts of *A. dubius* and *A. polygonoides* under room temperature. The absorption and transmission measurements were analyzed using UV-Visible spectroscopy. The value of SPR bands of synthesized silver nanoparticles confirms the formation of nanosilver. The phytoextracts serve as a good reducing agent. Thus the optical behavior of silver nanoparticles will be useful in implementing novel nanostructured materials with potential applications.

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References

1. Evanoff DD, Chumanov G. Synthesis and optical properties of silver nanoparticles and arrays. *ChemPhysChem*. 2005; 6: 1221–1231.
2. Cai W, Hofmeister H, Rainer T, Chen W. Optical properties of Ag and Au nanoparticles dispersed within the pores of monolithic mesoporous silica. J. Nanopart. Res. 2001; 3: 443–453.
3. Hao E, Schatz GC, Hupp JT. Synthesis and optical properties of anisotropic metal nanoparticles. J. Fluoresc. 2004; 14(4): 331-41.
4. Pinchuk A, Hilger A, Plessen G, Kreibig U. Substrate effect on the optical response of silver nanoparticles. *Nanotechnology*. 2004; 15: 1890-1896.

5. Power A, Cassidy J, Betts T. Non-aggregated colloidal silver nanoparticles for Surface Enhanced Resonance Raman Spectroscopy. *The Analyst*. 2011; 136: 2794-2801.
6. Parashar UK, Saxena PS, Srivastava A. Bioinspired synthesis of silver nanoparticles. Dig. J. Nanomater. Bios. 2009; 4: 159–166.
7. Dubey M, Bhadauria S, Kushwah BS. Green synthesis of nanosilver particles from extract of *Eucalyptus hybrida* (safeda) leaf. Dig. J. Nanomater. Bios. 2009; 4: 537-543.
8. Varshney R, Mishra AN, Bhadauria S, Gaur MS. A novel microbial route to synthesize silver nanoparticles using fungus *Hormoconis resinae*. Dig. J. Nanomater. Bios. 2009; 4: 349-355.
9. Lengke MF, Fleet ME, Southam G. Biosynthesis of silver nanoparticles by filamentous cyanobacteria from a silver (I) nitrate complex. Langmuir. 2007; 23: 2694-2699.
10. Firdhouse MJ, Lalitha P. Phyto-assisted synthesis and characterization of silver nanoparticles from *Amaranthus dubius*. IJABPT. 2012; 3: 96-100.
11. Firdhouse MJ, Lalitha P. Biomimetic synthesis of silver nanoparticles using aqueous extract of *Amaranthus polygonoides*. Int. J. Pharm. Bio. Sci. 2013; 4: 588–595.
12. Sathyavathi R, Krishna MB, Rao SV, Saritha R, Rao DN. Biosynthesis of silver nanoparticles using *Coriandrum Sativum* leaf extract and their application in nonlinear optics. Adv. Sci. Lett. 2010; 3: 1–6.