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Biosynthesis and Characterization of Silver nanoparticles from the marine seaweedSargassumplagiophyllum

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Abstract—Synthesis of Nanomaterials from biological source is a relatively new bloom in nanotechnology which is cheaper and has benefits over chemical and physical process of synthesis. The present work focussed on the synthesis of silver nano particles (Ag-NPs) from the marine seaweed *Sargasumplagiophylum* extract. Characterizations studies were analysed by UV-Visible Spectrometry, Scanning Electron Microscopy, Energy-dispersive X-ray spectroscopy, X-ray Diffraction and Fourier-Transform Infra-red Spectroscopy. The synthesis of Ag-NPs was confirmed through the presence of an intense absorption peak at 440nm by UV-Visible Spectrometer. The morphology was studied with SEM image. The elements concentration was identified using EDX. The structure of the nanoparticles were revealed using XRD results. The presence of functional groups was identified using FT-IR. The synthesized nanoparticles can be useful in various applications in medicine.

Keywords—Biosynthesis, Characterization, Silver Nanoparticles, Sargasumplagiophylum

1. Introduction

Nanotechnology is an escalating field of modern research with desired applications in electronic and medicine. Nanobiotechnology which combines biology principles with physical and chemical procedures to generate nano-sized particles with specifics functions. *(Kathiresan and Asmathunisha 2013).*Many of the proteins secreted by fungi are capable of hydrolyzing metal ions quickly. Spherical shaped silica nanoparticles was exracellularly synthesized using *F.oxysporum* through bioleaching process (Bansal et al., 2005).From the time immemorial the macroscopic marine algae have been closely associated with human life and are being exhaustively used in numerous ways as a source of food, feed, fertilizer, medicine and chiefly for economically important phycocolloids (Levering *et al*., 1969; Chapman, 1970).

The nanoparticles of silver were formed by the reduction of silver nitrate to aqueous silver metal ions during exposure to the extract of marine seaweed Sargassumwightii. *(Elechiguerra et al. 2005).*From the time immemorial the macroscopic marine algae have been closely associated with human life and are being exhaustively used in numerous ways as a source of food, feed, fertilizer, medicine and chiefly for economically important phycocolloids (Levering *et al*., 1969; Chapman, 1970).Nanoparticles of free metals have been extensively researched because of their unique physical properties, chemical reactivity and potential applications in catalysis, biological labeling, biosensing, drug delivery, antibacterial activity, antiviral activity, and detection of genetic disorders, gene therapy and DNA sequencing (A. Thirumurugan et al., 2010).

It is worth noting that nanoparticles can be made from a fully variety of bulk materials and that they can explicate their actions depending on both the chemical composition and on the size and shape of the particles (Brunner et al., 2006).Engineered nanoparticles have three different unique characteristics, size, structure and properties. These nanoparticles received a particular attention for their positive impact in improving many sectors of economy, including consumer products, pharmaceutics, cosmetics, transportation, energy and agriculture etc., and are being increasingly produced for a wide range of applications within industry (Novack and Bucheli, 2007; Roco, 2003).

Nanoparticles are classified primarily into two types, viz organic and inorganic nanoparticles. (Kathiresan and Asmathunisha 2013).The nanoparticles can be easily dispersed in aqueous media and other polar solvents due to coated by a layer of hydrophilic polyol ligands in situ. This approach provides a facile route to prepare magnetite nanoparticles (Maier et al. 1973).The magnetite nanoparticles are well – crystalline and the position and the relative intensity of the diffraction peaks match well with the standard XRD data for bulk magnetite. Among the metal nanoparticles, silver nanoparticles have gained remarkable consideration owing to their physicochemical properties (Elechiguerra et al. 2005).Silver nanoparticles (AgNPs) are currently one of the most widely commercially used nanomaterials (Chen and Schluesener, 2008)

2. Materials and Method

A. Sample Collection

Sargassumplagiophyllum was collected from Kovalam seashore, Chennai, Tamilnadu, South India. Sea weeds were brought to laboratory in polythene bags and cleaned with distilled water. After cleaning, the samples were shade dried for about 8 to 9 days. The dried samples were powdered and used further.

B. Preparation of Extract

200 mg of sample were weighed and dissolved in100ml distilled water. The sample was filtered and they were stored for further use.

C. Sythesis of Silver Nano particles

Five ml of aqueous sample extract was dissolved in 95 ml of 1mM AgNo3 solution and were kept in water bath at 60°C for 15 minsin dark condition. Colour change was monitored.

D. Characterization of Silver Nanoparticles

(a) UV – Visible spectral analysis:

I ml of prepared Sample was subjected for the UV spectral analysis at difference wavelength, UV – Visible spectral analysis has been done by using Spectrophotometer.

(b) Scanning electron microscope studies:

1 ml of nanoparticle solution was mounted over the stubs with double sized carbon conductivity take and thin layer of coat over the sample. Were created using an automated sputter coater for 3 minutes and scanned under scanning Electron Microscope, analysis was done using (Hitachi S-4500) and analyzed at Apex Lab, Chennai.

(c)Energy-dispersive X-ray spectroscopy analysis:

Energy-dispersive X-ray (EDX) analysis was also carried out for the detection of elemental silver nanoparticles in sample.

(d) X-Ray Diffraction Studies:

The powdered sample were coated on XRD grid and the spectra were recorded by using X-ray diffract meter (Philips PW 180 instrument) operated at a voltage of 40 kV available at Apex Labs, Chennai India was used.

(e) Fourier Transform Infrared Spectroscopic analysis:

FTIR technique is used for compound that is not the capping ligand of the synthesized nanoparticles. The powdered magnetite particles were subjected to FTIR spectroscopy measurement (Paragon 500, Perkin Elmer – RXI spectrophotometer) at IIT, Chennai.

3. Results and Discussion Preparation of Seaweed Extract

Sargassumplagiophyllum were collected, shade dried and powdered. The powdered sample was dissolved in100ml distilled water and the filtrates were used for synthesis of nanoparticles.

Figure1. Seaweed (*Sargassum plagiophyllum)*

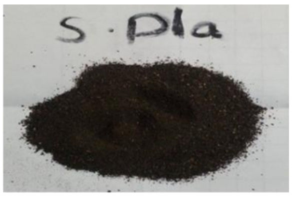

Figure 2. Seaweed (*Sargassum plagiophyllum)* powder.

Fig. 1: Biosynthesis of Silver Nanoparticles

A slight colour change was seen from colourless to yellow due to the reduction of silver nanoparticles. This shows the reduction of the silver nitrate to silver nanoparticles

Fig.2: Synthesized silver nanoparticle solution

4. UV Visible Spectral Analysis

The UV visible spectra of the synthesized silver nanoparticles were recorded. Absorption spectrum shows that the peak positioned at 440nm, this indicated the formation of silver nanoparticles.

5. Scanning Electron Microscope

The morphology of silver nanoparticles was characterized using Scanning Electron Microscope. SEM images observed from the drop coated samples of both

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silver nanoparticles were spherical in shape with different sizes 298, 398, 422, 425, 440, 499, and 600 nm, the average size is 440 nm.

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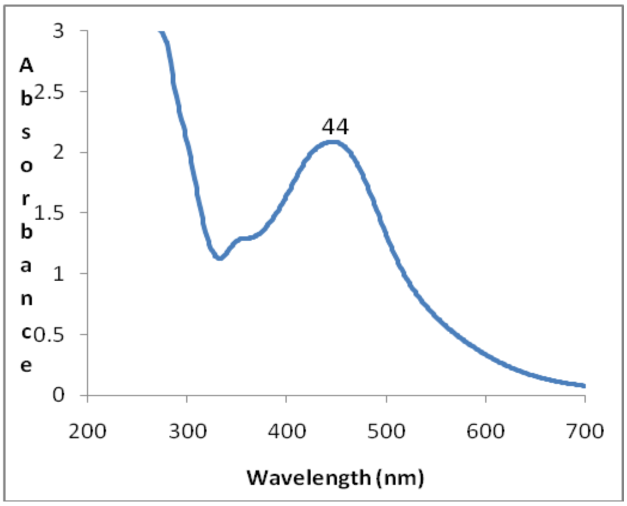

Fig. 3: UV-visible absorption spectrum of BiosynthesiedAgNps.

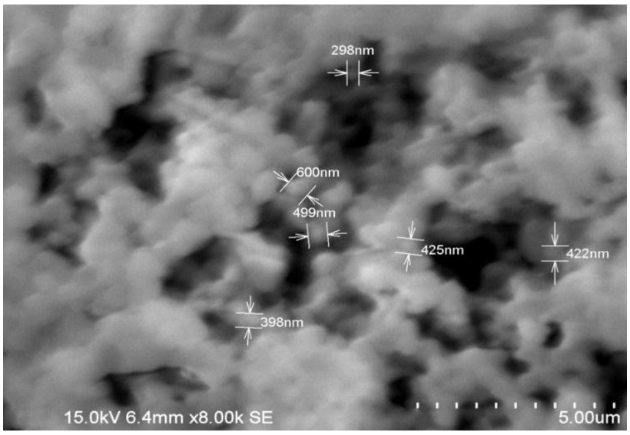

Fig.4: SEM images ofBiosynthesiedAgNps.

6. Energy Dispersive X-Ray Spectroscopy Analysis

EDX analysis shows a small peak of silver that confirmed the presence of silver nanoparticle in the suspension. The amount (percentage) of elements present in the suspension is shown in the Table.

Table 1: The percentage of elements present in sample.

Elements	Weight %	Atomic%
	100	100
Total	100	100

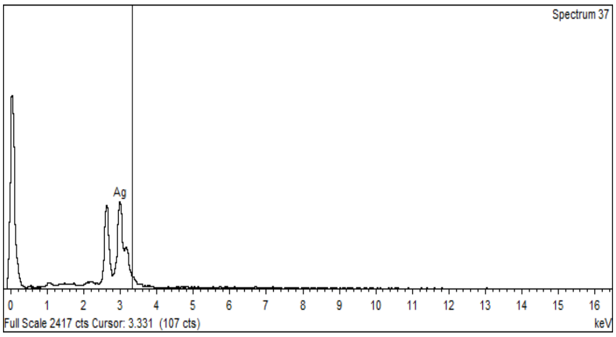

Fig. 5: Showing EDX Spectra for BiosynthesiedAgNps.

7. X-Ray Diffraction Studies

The values of the XRD pattern was ranging from 30 to 80° and three strong peaks were observed at 38.1, 46.3 and 64.3 were corresponds to the planes (111), (200) and (220) respectively .which are indexed to the face centered cubic structures of silver nanoparticles (JCPDS file no. 84-0713 and 04-0783). The XRD pattern of these peaks indicates the silver nanoparticles is crystalline in nature and some of the unassigned peaks were observed, it may be due to the biomolecules of stabilizing agents or enzymes or proteins in the algal extract.

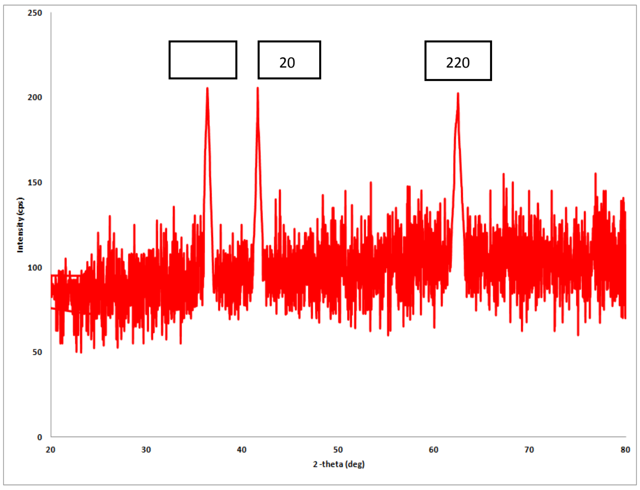

Fig. 7. XRD pattern of Biosynthesized AgNps.

8. Fourier Transform Infrared Spectroscopy (Ftir)

FTIR peaks determined the broad band which confirmed the presence of alcohol and phenol (O-H) absorption in the region 3392 cm-1,conformed the presence of nitriles(C-N),alkynes(C-C) absorption in the region 2151 cm-1 region, the region1646 cm-1 conformed presence of amines (N-H), confirmed the presence of aliphatic amines and derivatives in the region 1214 cm-1,1090 cm-1, confirmed the presence of alkenes in the region 717 cm-1 ,the region 492 cm-1 conformed presence of silver.

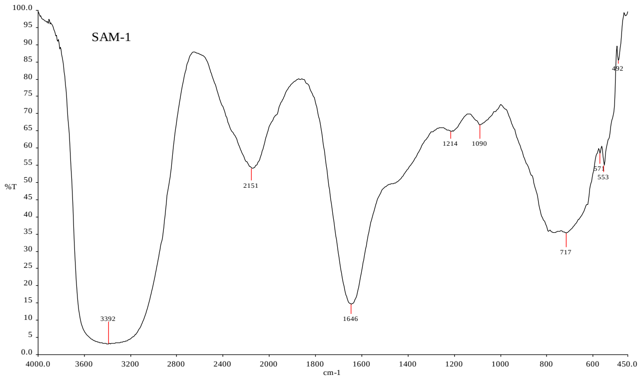

Fig 8.FTIR spectra of Biosynthesized AgNps

9. Conclusion

The results of the present study show the synthesis of Silver nanoparticles by bio-reduction of silver ions using the brown seaweed Sargassumplagiophyllum. The UV spectra of the synthesized silver nanoparticles shows that the peak positioned sat 440nm this indicated the formation of silver nanoparticles. The morphology was characterized using Scanning Electron Microscope was spherical in shape with different sizes. The values of the XRD pattern was ranging from 30 to 80° and three strong peaks were observed at 38.1, 46.3 and 64.3 were corresponds to the planes (111), (200) and (220) respectively. FTIR peaks confirmed the presence of alcohol and phenol nitriles, alkenes amines, aliphatic amines and derivatives, alkenes and silver in the sample. The biosynthesied silver nanoparticles are used for various applications

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