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Green Synthesis of Silver Nano Particles Biosynthesized from Marine Alga *Colpomenia peregrina* and their Characterization

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The synthesis of silver nanoparticles is an active area of academic and industrial application research in the field of nanotechnology. A variety of chemical and physical procedures could be used for the synthesis of silver nanoparticles. There is an essential need to develop environmentally benign procedures for the synthesis of silver nanoparticles. One promising approach to achieve this would be by a green synthesis method. In the present study green synthesis of silver nano particles were biosynthesized from marine alga *Colpomenia peregrina* and investigating characteristics using UV-Vis spectroscopy, X-Ray diffraction studies (XRD), Fourier-Transform Infra Red (FT-IR), Thermo Gravimetric Analysis (TGA), and Transmission Electron Micrograph (TEM).

Key words: Silver nano particles, Green synthesis, *Colpomenia peregrina.*

The biosynthesis of nanoparticles as an emerging highlight of the intersection of nanotechnology and biotechnology has received increasing attention due to a growing need to develop rapid, clean, nontoxic, simple and environmentally friendly synthetic technologies. Silver nanoparticles are known to exhibit antimicrobial, antiviral properties, superior catalytic activity and improved enhancement factors for surface enhanced Raman spectroscopy (SERS)[1-3]. Silver nanoparticles have their applications in the field of life sciences especially in food chemistry[4], biomedicine[5], and agriculture[6]. A number of synthetic methods have been employed for the synthesis of silver-based nanoparticles involving physical, chemical[7] and biochemical techniques[8]. With increasing focus on green chemistry, biological methods of nanoparticles synthesisusing microorganism[9-11], enzyme[12], and algae orplant extract[13] have been used as possible eco-friendlyalternatives to chemical and physical methods.The plant or algal extracts for the synthesis of silver nano particles suggested as an advantageous methodover other processes by eliminating theelaborate process of maintaining cell cultures. It canalso be suitably scaled up for large-scale synthesis ofnanoparticles.

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MATERIALS AND METHODS

Green synthesis and characterization of silver nanoparticles

Silver nano particle synthesis was carried out by taking 1000 mg of the shade dried seaweed powder of *Colpomenia peregrina*in 500 ml Erlenmeyer flask with 10-3 M aqueous (Silver $AgNO_3^-$) solution and incubated at 37°C. The pH was observed during the course of reaction and it wasfound to be 5.07. The biosynthesis of silver nanoparticles was characterized by UV Vis spectroscopy; size and morphology by employing TEM, crystalline structure from X-ray diffraction (XRD) technique, stability by employing

Thermogravimetric analysis and possible biomolecule interaction by Fourier transform infrared (FT-IR) spectroscopy.

RESULTS AND DISCUSSION

Biosynthesis of silver nano particles were formed by the reduction of Ag+ during exposure during exposure to the extract at 60°C. The colour change from colorless to a dark brownish red indicates the formation of silver nano particles[14] (Fig.1). In this process silver nitrate is used as the metal precursor and the algal extract as the capping agent. The change in colour formation arises due to the excitation of surface plasmon vibrations in the silver metal nano particles[15]. Fig. 2 Fig 1 shows the UV spectroscopy of green synthesis of silver nano particles biosynthesized from marine alga. The silver surface plasmon resonance band occurs at 420 nm, the frequency and width of surface plasmon absorption depends upon the size and shape of the metal nanoparticles as well as on the dielectric constant.

Fig.3 shows the X-ray Diffraction patterns of silver nanoparticle were recorded according to the description of Zhang*et al.*, (2000)[16]. Samples were air dried, powdered and used for XRD analysis. The XRD patterns obtained by green synthesis of silver nano particles using the extract of alga shows characteristics peaks at (2=1), marked with {111}. A number ofBragg reflections corresponding to the{111} sets of lattice planes are observedwhich may be indexed based on the face centeredcubic structure of silver. The XRD pattern thus clearly shows that the silver nano particles are crystalline in nature. The XRD pattern of pure silver ions is known to display peaks at 2 =1. The value of pure silver lattice constant has been estimated to be = 4.081, a value that is consistent with =4.0862 A0 reported by the JCPDS file no 4-0783.This estimation confirmed the hypothesis of particle monocrystallinity. The sharpening of the peaks clearly indicates that the particles are in nanoregime.

The Fig. 4 shows the FTIR bio molecular interaction of the extract as capping agent with

Table 1. FT-IR Spectral qualities of silver nano particles

Group	Frequency Range (cm^{-1})
N-H Stretch	3419.52
C-H Stretch	2920.28
N-H Bend	1640.28
C-C Stretch	1431.04
C-H Bond	1378.95
C-H wag ($-CH_2X$)	1163.97
C-N Stretching	1113.70
C-N Stretching	1058.87
C-Br Stretching	614.02

Fig.1. Biosynthesis of silver nano particle by green synthesis (a) initial inoculum of the extract with silver nitrate precursor. (b) Silver nano particle biosynthesis after 30 minutes of incubation

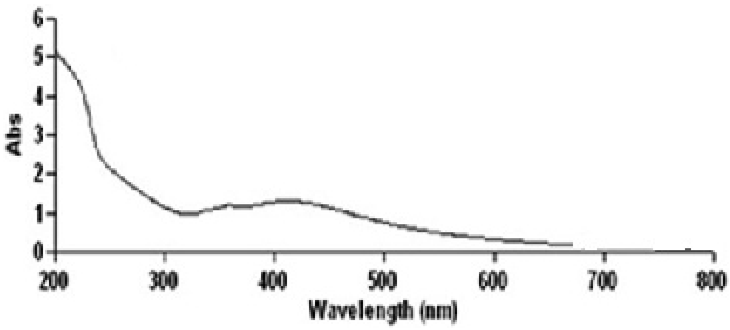

Fig. 2. UV- Vis spectroscopy of silver nano particles

silver nano particles. Table.1demonstrates FTIR spectrum analysis of silver nano particles which manifests absorption peaks. The absorption peak at 3419.52 cm^{-1} can be assigned as N-H stretching and that at 2920.28 cm^{-1} as C-H stretching, 1640.28 cm^{-1} as N-H bend stretching, 1431.04 cm^{-1} as C-C stretching, 1378.95 cm^{-1} as C-H bond stretching, 1163.97 cm^{-1} as C-H wag ($-CH_2X$), 1113.70 cm^{-1} and

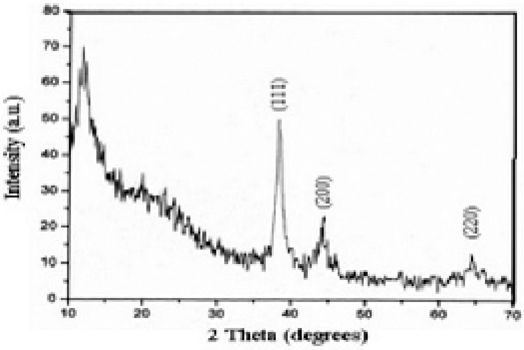

Fig. 3. XRD studies of silver nano particles

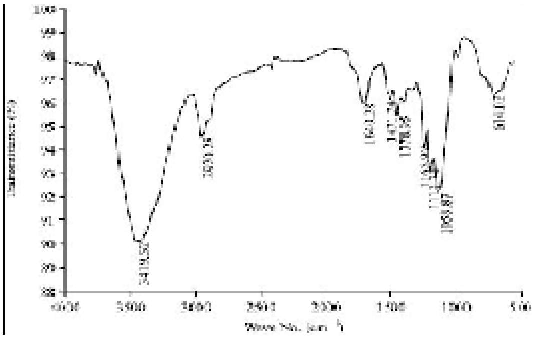

Fig. 4. Fourier Transform Infra-Red analysis of silver nano particles

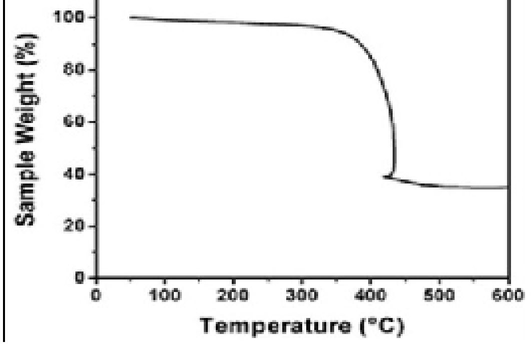

Fig. 5. Thermogravimetric analyses of silver nano particles

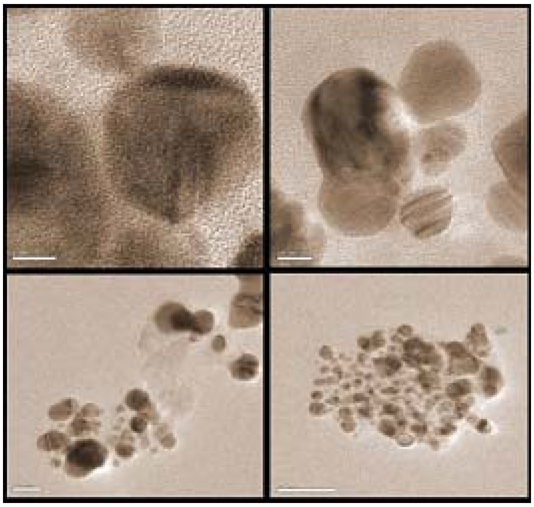

Fig. 6. Transmission Electron Micrograph of silver nano particles

1058.87 cm^{-1} as C-N stretching , whereas 614.02 cm^{-1} asC-Br Stretching The FT-IR spectrum provided information about the molecular environment of the organic molecules on the surface of nano particle. The Fig. 5 shows the thermogravimetric analysis of silver nano particles. The silver nano particles were subjected to thermo gravimetric analysis upto 400^0c to determine the purity of silver nano particles .The stability of the silver nanoparticles were observed at 250^0C and 16% of bioorganic compounds was decorated on the surface of nano particles[18], corresponding to monolayer coating which is negligible for the bio-impurities present in the sample.

The TEM samples were taken at 5 nm, 10 nm, 20 nm and 50 nm as described in Fig. 6. The Transmission electron microscopic images of silver nano particles shows the morphology which is highly variable with well formed spherical, cubical and hexagonal structures in aggregates[17] and the size of the particle ranging from 5 to 50 nm in size.

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