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Microwave assisted biogenic synthesis of silver nanoparticles using dried seed extract of *Coriandrum sativum*, characterization and antimicrobial activity

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Abstract: In the present study, biogenic synthesis of silver nanoparticles using the dried fruit extracts of the plant *Coriandrum sativum* using 1m M silver nitrate. The reduction of silver ions and formation of silver nanoparticles is indicated by the change in colour from pale yellow to reddish brown. The UV spectral analysis gave a prominent peak at 430 nm corresponding to the surface plasmon resonance of silver nanoparticles. FTIR analysis indicated the functional groups that acted as the capping material for the formation of the silver nanoparticles. Scanning electron microscopic studies revealed the shape and size of the silver nanoparticles. As an application to the medical field, the synthesized silver nanoparticles were tested for antimicrobial activity.
Key words: *Coriandrum sativum, dried fruit extract, silver nanoparticles, UV, FTIR, SEM.*

Introduction

Nanotechnology deals with the designing, synthesis, application and devices of materials whose size has been engineered and controlled at the nanoscale. Nanoparticles are potentially capable in applications in different fields this is because the smaller particle size will exhibit better photo catalytic activities due to the large surface area. Bionanotechnology refers to the intersection of nanotechnology and biology. Reportedly, silver nanoparticles are playing a major role in the field of biomedical nanotechnology. These particles are now applicable in data transmission and storage[1], drug delivery[2], catalysis[3], surface-enhanced Raman scattering [4], electronics[5], chemistry[6], biotechnology[7], water treatment[8] and conversion of solar energy[9]. Hence, the synthesis of nanoparticles emerging as a major research area in recent days. Nanoparticles can be synthesised by different methods like polysaccharide method, tollens method, irradiation method etc. But all these methods involve highly tedious processes and have effects on the environment. Synthesis of silver nanoparticles from the leaves of *Mangifera indica* [10], *Acalypha indica*[11], *Ocimum*[12], *Coriander sativum*[13], *Avena sativa*[14], *Azadiracta indica*[15], *Magnolia kobus*[16], *Calotropis gigantean* [17], *carob* [18], *Iresine herbstii* [19] *Achillea wilhemsii*[20], fruit extracts of *Carica papaya*[21], *Securina leucocarpus*[22], Pomegranate[23], dried fruit extract of *Cumin cymimum*[24]. These seeds are regularly used in Indian dishes. The seeds are known for their antioxidant, diuretic, carminative, hypolipidaemic properties [25]. Keeping in view of these properties, silver nanoparticles were synthesized from the extract using a domestic microwave.

Materials and Methods

The seeds of *Coriander sativum* were purchased locally. Silver nitrate was purchased from Sigma Aldrich, USA and the bacterial test cultures were procured from IMTECH, Chandigarh. The dried fruits were ground to fine powder. To 50ml of double distilled water 5 grams of the powder was added and kept on a sand bath at 60'C for 20 minutes. This facilitates the formation of the plant extract. It is then filtered through a Whatmann No. 1 filter paper. 1m M silver nitrate was prepared and stored in an amber coloured bottle. The reaction mixture was prepared in the ratio 1:9 of dried fruit extract and silver nitrate solution. The mixture was then kept for incubation in a domestic microwave for 2 min till the colour changes from pale yellow to reddish brown. The change in colour indicates the reduction of silver ions. The formation of silver nanoparticles is characterized by UV Spectral analysis and FTIR. Ultraviolet- Visible spectrophotometry (UV-Vis) refers to absorption spectroscopy in the UV-Visible spectral region [26,27,28]. UV spectral analysis was performed on a Schimadzu 2600 UV-spectrophotometer within the range 400-800 nm. A Fourier Transfer Infra Red Spectrophotometer was used to identify the capping material that is responsible for the synthesis of silver nanoparticles. Scanning Electron Microscopic studies were performed in order to determine the morphology of the formed silver nanoparticles.

Results & Discussion

Upon incubation of the reaction mixture on the sand bath at 60 ^{0}C, a change in colour from pale yellow to reddish brown was observed (Fig.1). The change in colour indicates the formation of silver nanoparticles. The UV spectral analysis results indicated a prominent peak at 430 nm which is within the characteristic range of the silver nanoparticles (Fig.2). FTIR spectra (Fig.3) indicates absorbance bands at 1643 cm^{-1} [–C=C– stretch], 2108 cm^{-1} [–C≡C– stretch] and 3304 cm^{-}1 [O–H stretch, H–bonded] which correspond to the presence of alkenes, alkynes and phenols respectively. SEM studies revealed that the formed silver nanoparticles are spherical in shape (Fig.4). The above found results are in agreement with our earlier studies with biological synthesis of nanoparticles [29-36].The synthesised silver nanoparticles exhibited antibacterial activity against human pathogens used in the study. The strains used were *Escherichia coli*, *Pseudomonas putida* and *Bacillus subtilus*. Clear zones of inhibition were observed though smaller zones than the positive standard Ampicillin (Fig. 5). The results of the antibacterial activity are depicted in table1.

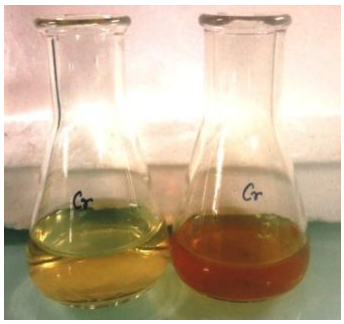

Fig.1. Colour change of the reaction mixture indicating the formation of silver nanoparticles

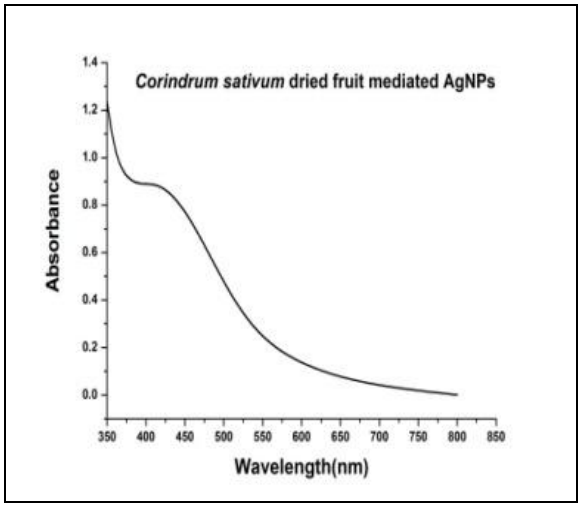

Fig.2. UV Spectra of the synthesised AgNPs

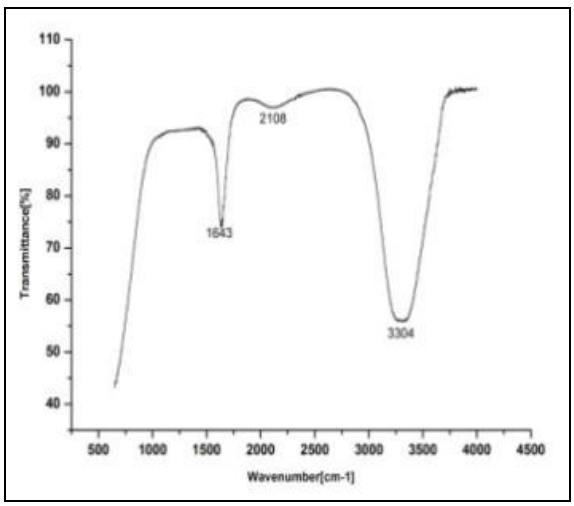

Fig.3. FTIR Spectrum of the synthesised silver nanoparticles.

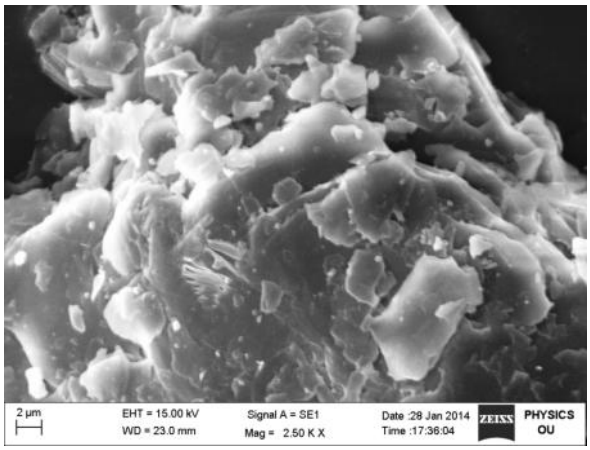

Fig.4. SEM image indicating the spherical shape of the formed AgNPs.

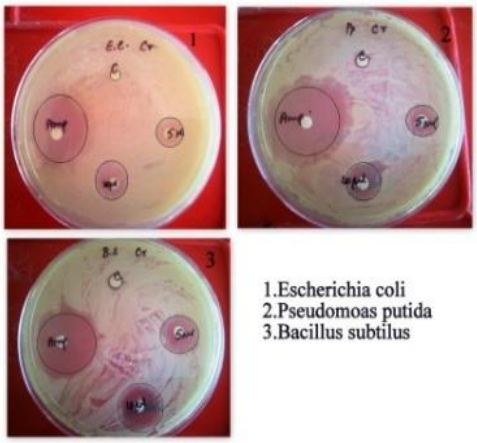

Fig.5. Activity of AgNPs against bacteria with clear zone's of inhibition.

Table1: Results of the antibacterial activity of AgNPs.

	Zone of Inhibition (mm)			
Name of the micro organism	Ampicillin (5µl)	Control (5µl)	AgNPs (5µl)	AgNPs (10µl)
Escherichia coli	40	Disc 10	20	27
Bacillus subtilus	51	Disc 10	33	40
Pseudomonas putida	50	Disc 10	25	30

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