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Eco friendly synthesis method of AgNP nanoparticles from eletarria cardamomum husk extract and its antibacterial activities

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Abstract

Silver nanoparticles were synthesised by many methods. Our focus of interest is green synthesise method. Elettaria cardamomum extract has the potential to reduce silver nitrate resulting in the formation of AgNPs. Various characterisation techniques used were UV-Vis spectroscopy, Infrared spectroscopy, scanning electron microscope, X-ray diffraction studies and particle size analyser. The morphology, size distribution, and crystalline nature were revealed by the above studies. Phytochemical analysis of the Elettaria cardamomum husk extract was done for the presence of natural products. Further studies confirmed its ability against gram +ve and gram -ve bacteria. The gram +ve bacteria like Bacillus subtilis, staphylococcus aureaus and gram - ve bacteria like Escherichia coli and proteus vulgaris.

Keywords: Eco friendly synthesis, AgNPs, Eletarria cardamomum husk extract extract, characterization techniques, Antibacterial activity.

Introduction

Nanotechnology connects the areas of science and engineering nanometre scale are utilised in the designing and application of materials to various fields. In general, it may be assumed that the application of nanotechnology strengthens the life of humans and serves the mankind. Exploring the connectivity of interdisciplinary research and applications that support the world in its development. It is truly a multidisciplinary and interdisciplinary field. Nanotechnology is rooted in revolutionize industry sectors and sustainability of the environmental preservation. It is now possible to use nanoparticle coated packaging material which is against bacteria. The biological synthesis is eco-friendly and ease method of synthesising AgNPs. The size of the Ag nanoparticle formed can be optimised by the reaction conditions, which relates the application of it with the toxicity[1-3].

Significance and need of green chemistry: A Design synthetic method maximizes incorporation of AgNPs in various final products. Synthetic methods must generate materials of environmentally friendly for usage Harmless methodology were preferred one. Solvents and extractants used must be eco-friendly. All the materials used in a chemical process should be were less risk of causing the side effects.

Eletarria Cardamomum Composition of natural products: *Elettaria cardamomum* is a member of the ginger family. Eletarria cardamomum are used to add flavour to both food and drink as cooking species and also as a medicine. High amounts of anti-oxidants, helps in reducing blood pressure, has anti-inflammatory properties, may help in improving digestive problems and help in treating infections because of its anti-bacterial properties[4,5].

Figure-1: Eletarria Cardamomum and its flower.

Reducing pollutants: Green chemistry is very significant role in reducing pollution to the surroundings. Chemicals usage were minimised and release of hazardous substances were prohibited. Environment sustainability plays an important role in future work. Research work related to recycling and treatment protects public health and the environment associated with the release of such substances.

Methodology

Silver nanoparticles were synthesized according to the chemical reduction by using cardamom husk extract. This method can be easily being performed in any chemical laboratory and economical, thus cheaper method of synthesizing silver nanoparticles.

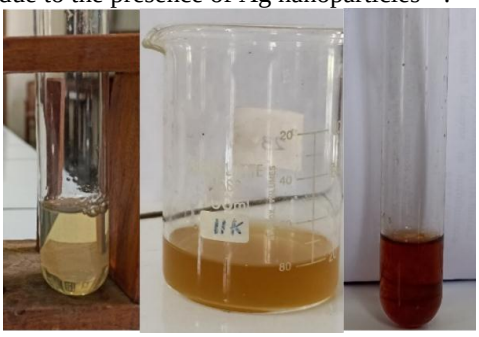
Preparation of silver nitrate solution: Accurately weighing 1.6g of silver nitrate ($AgNO_3$) as obtained from the chemistry laboratory. It is made up to 100ml standard flask by adding sufficient amount of distilled water to get 0.01N of silver nitrate.

Figure-2: Picture of 0.01N of silver nitrate solution.

Preparation of eletarria cardamomum husk extract: The husk washed twice with distilled water and dried well. 5g of Elettaria cardamomum husk weighed in a weighing machine and 100ml water taken in a beaker. It is boiled for 15 minutes. The plant material is filtered by Whatman no 40 filter paper a collecting the extract. This extract used as a reducing and stabilizing agent for the synthesis of silver nanoparticles in this method.

Figure-3: Elettaria cardamomum husk extract.

AgNPs Synthesis: 10ml of 0.01N Silver nitrate solution is added with 10ml of Elettaria cardamomum husk extract in the ratio 1:1. it is heated for 20 minutes. A brown colour formed which is due to the presence of Ag nanoparticles[6-8].



(a) (b) (c)

Figure-4: Picture of silver nanoparticle solution. (a) Elettaria cardamomum husk extract (b) 0.01n silver nitrate solution (c) silver nanoparticles.

Results and discussion

Phytochemical constituents of cardamom husk extract: Phytochemical analysis preliminary phytochemical analysis for cardamom husk extract was done using standard test procedures, it confirms the availability of active phytochemicals in the aqueous cardamom husk extract. The healthful properties of edible plants are perhaps due to the presence of a variety of phytoconstituents such as alkaloids, polysaccharides, flavonoids, glycosides, phenols, saponins, tannins, etc. The preliminary screening tests are useful in the detection of these bioactive constituents. The results of phytochemical screening depicted below[23-25].

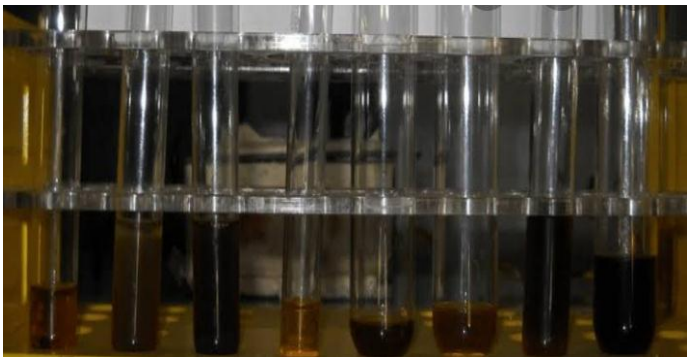


Figure-5: Picture of Phytochemical test.

Table-1: phytochemical screening tests of cardamomum husk juice extract.

Juice Husk components	Name of the test	Colour/observance	Elettaria cardamomum husk extract
Glycosides component	Molisch's test	No specific change	Negative
Alkaloid component	Wagner's test	Brownish colour	Positive
Tannins component	Tannin's test	No specific change	Negative
Steroid component	Salkowski test	Red colour	Positive
Saponins component	Saponin's test	No specific change	Negative
Carbohydrate component	Fehling's test	No specific change	Negative

Various test with the extract solution done by following the standard procedure[9,10].

UV-Visible spectra: The SPR peak of AgNPs were confirmed by Ultra Violet-Visible spectrometry. The wavelength scanned range 400-500 nm formation. This SP peak is significant in the generation of NPs.

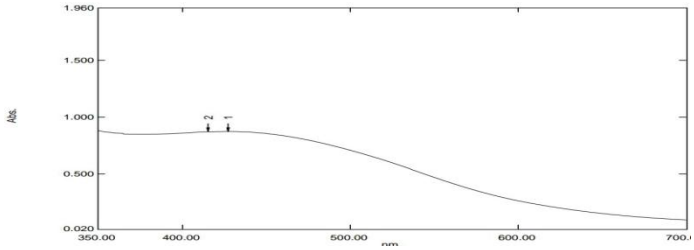


Figure-6: UV-VIS Spectra of silver Nanoparticle formed.

Addition of 5 ml of aqueous juice husk extract of cardamamom to the 5 ml of 0.0100N sinitra $AgNO_3$ solution, the colour change occurs after 15 minutes. The proportion of 1:1 solution of cardamom husk extract and silver nitrate solution showed a change from yellow to brown color. It confirms the formation of silver nanoparticles. Two highest absorbance peak Values at approximately 444nm and 317nm observed. Absorption Peak at 444nm assigned for silver nanoparticles formation and peak at 317nm due to the alkaloid present[11-13].

XRD Analysis: XRD Studies was useful for determining the crystalline nature of AgNPs. The data obtained shows the Xrd diffraction pattern of AgNPs. The characterization peaks at distinct diffraction peaks at 2θ with values of 10.6°, 32°, 36.1°, 39.1°, 41.1°, 45.1°, 65.1°, were obtained which confirmed the formation of nanoparticles referred from the JCPDS file. The planes which correspond to the assigned peaks indicates that the silver nanoparticles formed were cubic face-centred. The above synthesised AgNPs solution kept within an aluminium foil and dried well. This coated foil with sample used in the XRD studies[14,15].

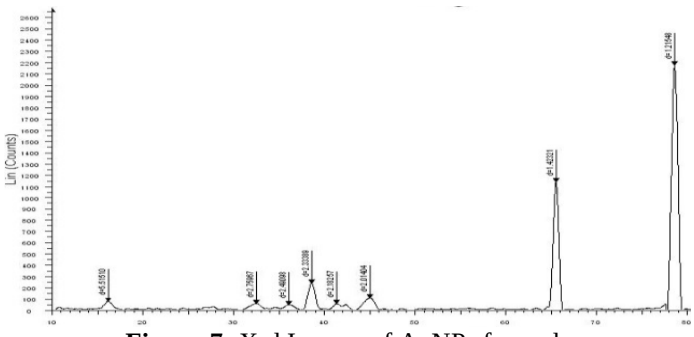


Figure-7: Xrd Images of AgNPs formed.

Scanning Electron Microscopy (SEM): Scanning electron microscopy (SEM) is widely used techniques used in characterization related to the morphology. The chemical composition of the sample and its surface area scanned in this method. SEM picture shows the AgNPs of size ranging from 64nm-81nm. Spherical shape of AgNPs and agglomeration of the nanoparticles also seen which leads to varying size distribution. The AgNPs were not distributed with uniform size which are synthesized by this method [16].

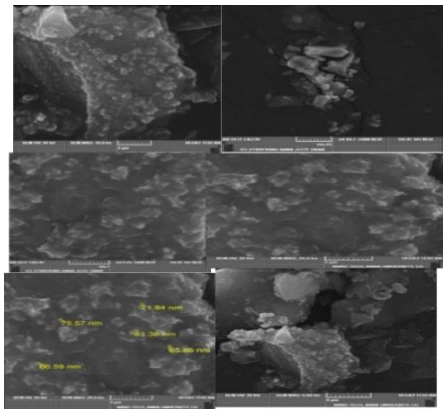


Figure-8: SEM picture of AgNps formed by using Elettaria cardamomum husk extract.

Particle Size analyser: The particle size determination used for characterization of nanoparticles Uniform distribution of NPs and its size is significant. The AgNPs formed ranges from 10nm to 1000nm. Aggolmeration occurred confirmed the greater percentage obtained from the results seen.

From the results obtained, smaller nanoparticles of 10nm are formed. After duration of time, the size of AgNPs increases from 10nm to 100nm. Again, the size of AgNPs increases to 1000nm. The AgNPs formed were not in uniform size and leads to agglomeration of the nanoparticles formed[17-19].

Particle size Analyser confirms the above information with peak obtained as above.

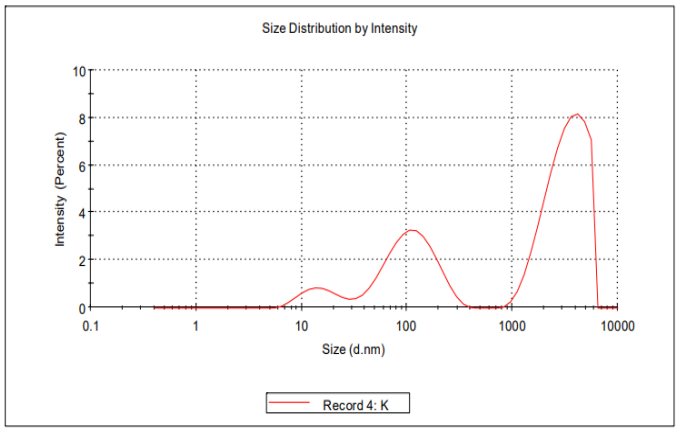


Figure-8: Particle size analyser about the size distribution of AgNPs formed.

Antibacterial ability of Ag nanoparticles: Well diffusion assay analysis method used to find out the area of inhibition in various samples. We took four bacteria which are Escherichia coli, Staphylococcus, P.v-proteus vulgaris and Bacillus subtitles bacterial. The synthesised silver nanoparticles were active against these particular bacteria at all the concentration 250g/ml, 500g/ml, 750g/ml, 1000g/ml. Finally, silver nanoparticles have the potentiality and active against the following bacteria – The short forms can be elaborated as B.s indicates Bacillus Subtilis S.a indicates Staphylococcus, P.v indicates proteus vulgaris and E. Coli indicates Escherichia Coli[20-22]. As the concentration of AgNPs increases, the zone of inhibition also increases for both gram positive and gram negative bacteria.

Table-2: The antibacterial activity of the synthesised AgNPs.

Name of the Sample	Concentration / Sample (µg/mL)	Zone of inhibition (nm)			
		B.s	S.a	E.coli	P.v
E	250	12	13	13	13
	500	14	16	15	15
	750	16	18	16	16
	1000	18	20	18	18

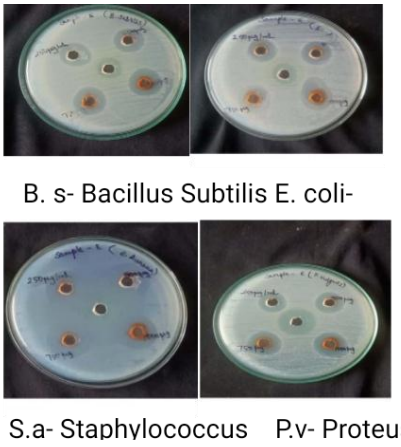


Figure-9: Antibacterial activity of Bacillus Subtilis, E. coli- Escherichia coli, S.a- Staphylococcus and P.v- Proteus vulgaris.

Conclusion

We have developed eco-green synthesis method for the synthesis of silver nanoparticles from silver nitrate using cardamomum extract husk at ambient temperature. Spherical, polydispersed silver nanoparticle were obtained. SEM analysis used for characterization of silver nanoparticles. SEM reveals that the size of silver nanoparticles ranging from 65nm-81nm. Particle size analysis is used to characterise the size distribution of particles in a given sample. The anti-bacterial activity of synthesized silver nanoparticles as evaluated and active against both gram positive and gram-negative bacteria.

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