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Synthesis and Characterization of Silver Nanoparticles Using Curry (Murraya Koenigii) Leaf Extract

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ABSTRACT

In this study simple method was applied for the synthesis of silver nanoparticles using Curry (Murraya koenigii) leaf extract. The plant extract acts as reducing agent as well as capping agent. Characterization of synthesized nanoparticles was done by different techniques like SEM, TEM and UV-Visible spectrophotometer. UV-Visible spectrophotometer showed absorbance peak in range of 430-440 nm. The silver nanoparticles showed sole detection of Cd(II) ions in the aqueous systems with good selectivity, sensitivity. Results showed simple and eco-friendly, nontoxic and an alternative conventional physical/chemical methods. Only 30 min were required for the conversion of silver ions into silver nanoparticles at room temperature.

Keywords : Silver nanoparticles, Green synthesis, Cd(II), Curry (Murraya koenigii) leaf

I. INTRODUCTION

As we know that water one of the very important natural resources in the world. It is very important to survive living part and the development of human beings. Heavy metals pollution inside water is a global environmental issue now a days. Heavy metals are releasing into water mainly through the mining, electroplating, metallurgy, chemical plants, agriculture and household wastewater etc. Heavy metals like Cr, Al, Pb, Zn, Cu, Hg, Cd are very harmful for human's health [1]. Moreover, heavy metals can also exert adverse effects on the environment and are highly toxic [2]. Therefore, the removal of heavy metals from wastewater is of great importance and has drawn great attention during last decade.

During this last decades, nanomaterials have gained a lot of attention. Nanomaterials properties contribute to their extraordinary adsorption capacity and reactivity, which are favourable for the removal of heavy metal ions. Therefore, studies on nanomaterials have been carried out to investigate their applications on heavy metal removal from water warter and they have shown great potential as good alternative for absorbance of heavy metals from wastewater [3,4]. On the basis of the above concept, this work reviews the latest development of nanomaterials which are used to remove heavy metals from wastewater.

In this work synthesis and characterization of the silvernanoparticles were discussed. In this work, a systematic and short overview of the following the zero-valent metal nanoparticles, metal oxide materials have been presented. The perspective of silvernanoparticles in heavy metal conaining water treatment has been discussed.

Generally the high levels of cadmium in water can be seen in the plating and coating of pipes and fittings, soldering with silver-coated tubes places [5]. Literature reveals that Cadmium is toxic for human and animals. Therefore, the attention has been made to study the removal of cadmium in contaminated water and its methods at low concentrations.

II. Materials and Methods

Preparation of Curry tree leaf extract

Silver nanoparticles were prepared by using Curry tree (Murraya koenigii) leaf extract on the basis of cost effectiveness, ease of availability and its medicinal property. Fresh leaves were collected from college campus in month of January-February. They were surface cleaned with running tap water and then washed with distilled water to remove debris and other contaminated contents. Then air dried at room temperature crushed in Mixure. About 30 gm of finely crushed leaves were kept in a beaker containing 500 mL double distilled water and boiled for 30 min. Then cooled down it and filtered with Whatman filter paper no.42 and then extract was stored at 4^0 C for further use.

Preparation of AgNPs

Silver nitrate GR used as such (purchased from Merck, India). 100 mL, 1 mM solution of silver nitrate was prepared in 100 ml beaker. Then 1, 2, 3, 4 and 5 mL of extract was added separately to 10 mL of $AgNO_3$ solution of conatainig the con 1 mM. Silver nanoparticles were also synthesized by varying concentration of $AgNO_3$ (1-5 mM) keeping extract concentration constant (5 mL). This setup was kept in a dark cupboard to minimize photoreduction of silver nitrate at room temperature. Reduction of Ag^+ was confirmed by the colour change of solution. The formation silver nanoparticles was confirmed by using UV-Visible spectroscopy.

Characterization of synthesised silver nanoparticles

Spectral analysis was reported by using Shimadzu UV-visible spectrophotometer (UV-1800, Japan). UV-Vis spectrophotometer with a resolution of 1 nm between 200 and 800 nm was used this spectral analysis. 1ml of sample was taken into a cell and subsequently analysed at room temperature. The determination of average size of synthesized silver nanoparticles by Dynamic light scattering (Spectroscatter-201). The particle size and surface morphology was analysed by Transmission electron microscopy (TEM), operated at an accelerated voltage of 120 kV.

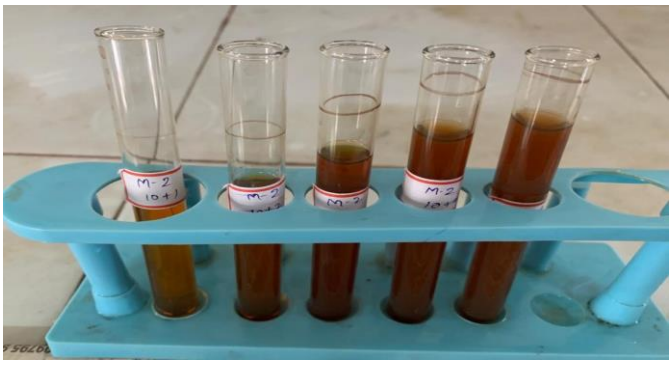

Fig. 1 Image of synthesised silver nanoparticles with different
Concentrations (1-5) of CLE

Fixation of different parameters

The reaction was monitored at different time intervals. Different concentration of silver nitrate has been taken to monitor this reaction (1 mM, 2 mM, 3 mM, 4 mM and 5 mM) and it was also done by varying leaf extract solution (1-5 mL) and then absorbance was measured.

III. Results and discussion

Visual observation and UV-Vis spectroscopy

All experiments were carried out by addition of plant extract of Curry tree into the beakers containing aqueous solution of silver nitrate led to the change in the colour of the solution to yellowish to reddish brown within reaction duration due to excitation of surface plasmon vibrations in silver nanoparticles [11]. On addition of different concentration (1-5 mL) of leaf extracts to aqueous silver nitrate solution keeping its concentration 5 mL (1 mM) constant, the colour of the solution changed from light yellow to brown indicating formation of silver nanoparticles. Different parameters were optimized including concentration of silver nitrate and Curry tree leaf extract, and time which had been identified as factors affecting the yields of silver nanoparticles. Silver nanoparticles were synthesized at different concentrations of leaf extract such as 1-5 mL using 1 mM of silver nitrate were analysed by UV spectra of Plasmon resonance band observed at 436-446 nm similar to those reported in literature [7]. If we increase the leaf extract concentration to 4 mL, there is increase in wavelength up to 448 nm as presented in Fig. 3. The slight variations in the values of absorbance signifies that the changes are the particle size [10]. On increasing concentration of extract there is increase in intensity of absorption. UV-Vis spectroscopy is used for examination of size and shape of nanoparticles in aqueous solutions. Regular changes in colour was observed when different concentrations of AgNO3 was used by keeping Neem extract (1 mL) constant. The brown colour appeared due to the excitation of the Surface Plasmon Resonance, typical of AgNPs having absorbance values which were reported earlier in the visible range of 446-448 nm [6]. There is increase in intensity of absorption peaks after regular intervals of time and the colour intensity increased with the duration of incubation. It was also observed from Fig. 2 that the intensity of absorption peaks increases with increase in the concentration of the silver nitrate salt. All the results are very close already reported in literature showing absorbance at 445 nm of silver nanoparticles synthesized by Cochlospermum religiosum extract [8] and by Pithophoraoe dogonia extract [9]. The UV-vis spectra recorded, implied that most rapid bio reduction was achieved using A. indica leaf extract as reducing agent. The UV-vis spectra and visual observation revealed that formation of silver nanoparticles occurred rapidly within 15 min. Fig.2 exhibits the plasmonic absorption bands of Cd-AgNPs synthesized. The absorption bands overlap at 440 nm with the same intensities. This confirms the synthetic reproducibility of our prepared probe. The synthetic reproducibility was further confirmed by TEM images of Cd-AgNPs (Fig. 4)

Confirm the high selectivity of the prepared NPs for the Cd ions in the aqueous systems that lead to the aggregation of Cd-Ag NPs.

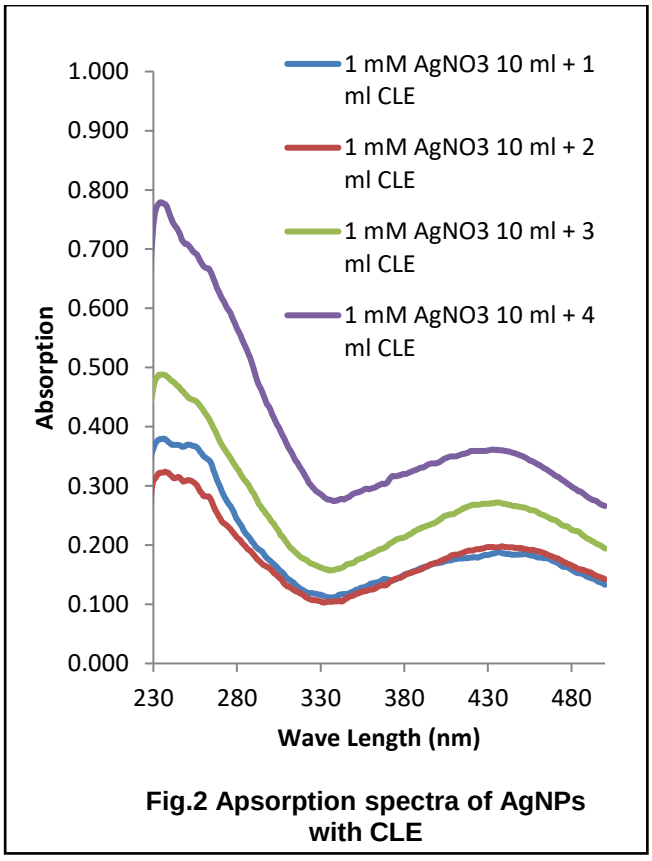

Fig.2 Apsorption spectra of AgNPs with CLE

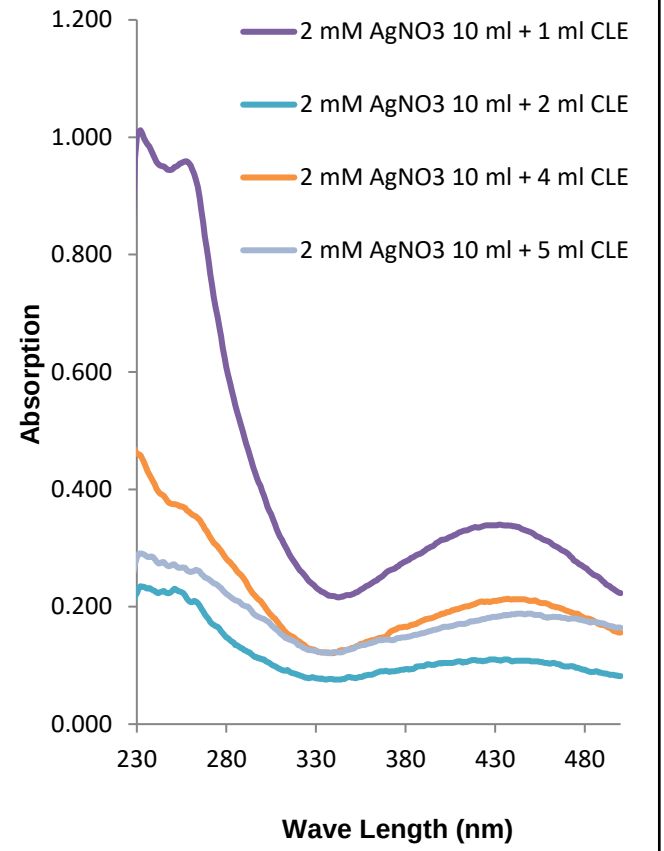

Fig.3 Apsorption spectra of AgNPs with CLE

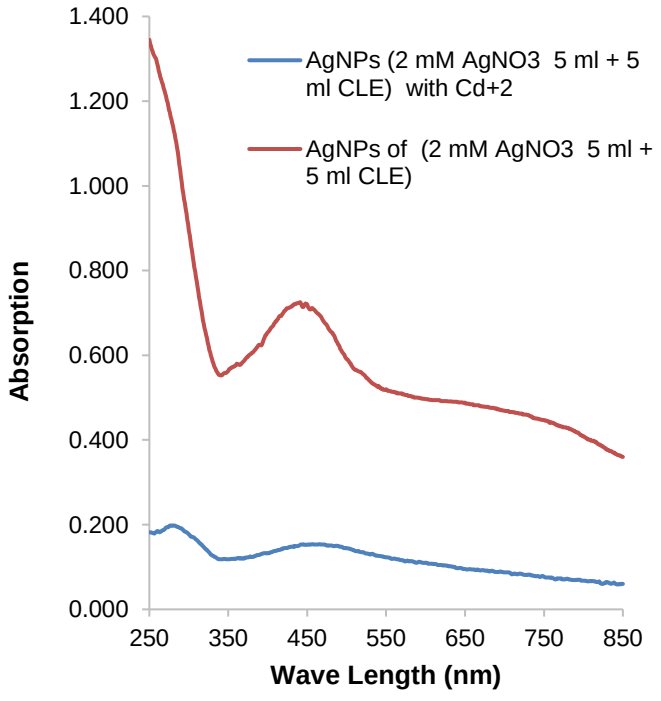

Fig.4 Apsorption spectra of CLE-AgNPs and AgNPs-Cd+2

TEM analysis

Transmission electron microscopy (TEM) has been used to identify the size, shape and morphology of nanoparticles. It reveals that the silver nanoparticles are well dispersed and predominantly spherical in shape, while some of the NPs were found to be having structures of irregular shape as shown in Fig. 5. The nanoparticles are homogeneous and spherical which conforms to the shape of SPR band in the UV-visible spectrum. These indicates that the size of these silver nanoparticles is 10 to 24 nm. Some distribution at lower range of particle size indicates that the synthesized particles are also in lower range of particle size.

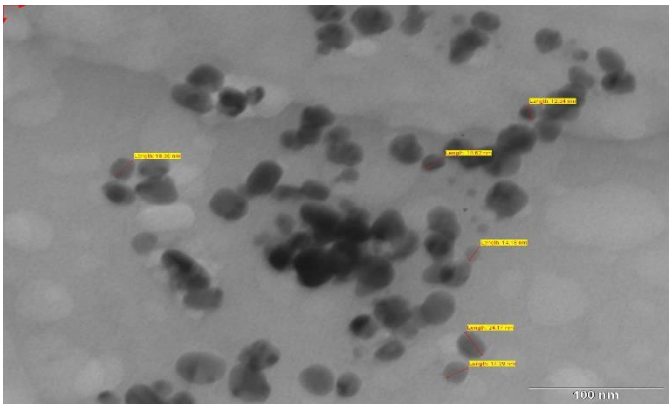

Fig. 5 TEM image of AgNPs with CLE

After the addition of the Cd(II), a redshift from 404 to 432 nm along with a decrease in the plasmonic peak intensity of CLE–AgNPs was observed while the rest of the metal ions did not induce any such change after the addition of CLE–AgNPs. These results confirm the excellent selectivity of the prepared NPs for Cd(II) ions over the rest of the metal ions. Cd(II) is a hard acid; therefore, according to HSAB principle, it prefers to bind with hard base [12]. The Curry tree extract collected from the Pilvai college campus has polyphenolic contents, thus Cd(II) forms a bond with the oxygen atom present in the extract. Therefore, metal-ligand interaction between the Cd(II) and oxygen atom causes the aggregation of NPs. This interaction was confirmed with TEM, analysis. Figure

6 shows the TEM images after the addition of the Cd(II) ions onto prepared NPs solution. The enhanced selectivity of the prepared CLE-AgNPs was further determined in the presence of other reactive cations.

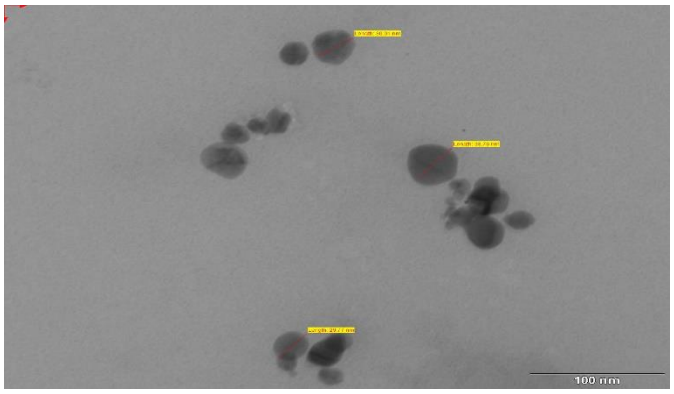

Fig. 6 TEM image of CLE-AgNPs-Cd^{+2}

IV. Conclusion

A very simple green synthesis of silver nanoparticles using Curry tree (Murraya koenigii) leaf extract at room temperature was reported in the present study. Curry tree leaves were collected from our college campus. It is observed that the synthesis was efficient in terms of reaction time and stability of the synthesized nanoparticles which exclude extra stabilizers or reducing agents. It proves that eco-friendly, rapid green synthesis providing a cheap and efficient root for the synthesis of silver nanoparticles. Therefore, this reaction pathway satisfies all the conditions of a green chemical process. Moreover, an attempt has been made to bind a metal like Chromium with Silver Nanoparticles. It is observed that the synthesised silver nanoparticles showed sufficient detection of Cd(II). The prepared Cd(II)–AgNPs also displayed long term stability against aggregation which could be useful for environmental applications. The Cd(II) ions assisted aggregation of AgNPs can be determined by the UV–Vis spectrophotometer. The prepared probe can be successfully used in the real water samples too. It can also be easily applied for the detection of Cd(II) ions and does not require costly chemicals and instrumentation. Thus, the present method is user-friendly, as well as suitable for onsite detection tests.

V. Acknowledgement

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