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Green synthesis of copper nanoparticle using *Gymnema sylvestre* by different solvent extract

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KEYWORDS

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A B S T R A C T

An versatile technique was implemented for the synthesis of Copper Nanoparticle using aqueous and ethanol extract of leaves of *Gymnema sylvestre*. The reduction of copper sulphate to copper nanoparticle was confirmed by UV–Vis spectrophotometer showing a typical resonance (SPR) at about 560 nm which is specific for Cu NPs. In FTIR analysis the strong band peak at 3466.2 cm^{-1} in aqueous extract is vibration bands , which may be due to overlapping of O-H and amine N–H stretching bands. In ethanol extract of *Gymnema sylvestre* copper nanoparticles shows vibration bands at 3752.5 to 3422.8 cm^{-1} due to overlapping of O-H and amine N–H stretching bands. SEM images reveal that the particles are spherical and relatively uniform shape of the copper nanoparticles was confirmed in the range of 65-184nm in aqueous extract and 181-302 is the range confirmed in ethanol extract.

Introduction

Nanotechnology is mushrooming field that making an impact in all sphere of human life. In recent years, Green Nanotechnology attracted many researchers from various field like physics, chemistry, material science, engineering, medicine and bio technology (Vasudev D. Kulkarni *et al*., 2013). Nanotechnology involves in the process of production, manipulation and also the materials size ranging ranging from less than a micron to that of individual atom (Mohanpuria P *et al*., 2007). Physical, chemical and biological process are the wide variety of method used for synthesis of nanoparticle (Sastry *et al*., 2003).Among the nanoparticles Copper Nanoparticle gained much importance because of less cost of preparation, and has excellent physical and chemical properties. Copper Nanoparticle are very reactive due to their surface- to -

volume ratio and easily interact with other particle (Narayanan et al., 2003). Copper Nanoparticles have wide applications like Anti fouling, biocidal, Catalytic activity, gas sensor, wound dressing and solar cells.(Jung *et al*., 2006).

Plant Description

Gymnema sylvestre is one of the most important medicinal plant in India and belongs to the family of Asclepiadaceae. They are occasionally cultivated as medicinal plant. *Gymnema sylvestre* are otherwise popularly known as gurmar and Madhunashini. It is perennial, woody climber plant found in tropical and subtropical reagion. *Gymnema sylvestre* can also found in Banda, Western Ghats, Deccan extending to the parts of western and northern India (Keshavamurthy *et al*., 1990 and Kritikar *et al*.,1998). The plant description of *G.Sylvestre* is that its flowers are small, yellow in color, located in axillary and lateral umbel in cymes and its follicles are terete and lanceolate upto 3inches in length. Calyx-lobes are long, ovate, obtuse and pubescent and Its Corolla is pale yellow campanulate, corona single, with 5 fleshy scales. Anther present in *Gymnema sylvestre* are connective to produced into a memberanous tip, pollinia 2, erect, carpels 2,unilocular; locules many ovuled (Gurav *et al*., 2007 and Potawale *et al*., 2008).

Materials and Methods

Plant Collection and Authentication

The leaves of the healthy plant *Gymnema sylvestre* were selected for our study was collected from Porur, Thiruvallur district and was authenticated by Dr.D.Aravind, Assistant professor, Speciaization: Medicinal plant, Department of Medicinal Botany, National Institute of siddha, Ministry of AYUSH (Govt of India), Chennai-600047.(Authentication No: NISMB1532014)

Preparation of *Gymnema sylvestre* leaf extract

The fresh leaves of *Gymnema sylvestre* were thoroughly washed normal water and then followed by distilled water to remove impurities. The cleaned leaves were subsequently dried under sunshade to remove moisture completely, powdered by using mechanical grinder and then stored. The 5g of powdered plant leaves were taken into a beaker along with 100 ml of distilled water and transfered to Soxhlet apparatus and allowed to boil at 60°C for 30 min under reflux condition then it was cooled down to room temperature. The prepared solution was initially filtered through normal filter paper thereby powdered leafy materials will be filtered out. The filtrate was again filtered through Whatman No.1 filter paper to get clear solution. The filtrate was stored at 4°C for future works.

Green synthesis of Copper nanoparticle using leaves of *Gymnema sylvestre*

25 ml solution of *Gymnema sylvestre* leaf extract was introduced drop wise into 100ml of 1mM (0.001mM) solution of copper sulphate under continuous stirring (Abboud *et al.*, 2013). After the complete addition of leaf extract, the mixture was kept for incubation for 24hrs. Within a particular time; the green colour solution was changed into straw yellow in aqueous extract and green colour solution was changed into straw green in ethanol extract, which indicates the formation of copper nanoparticles. Then the solution was centrifuged for 15 min at 10,000 rpm and dispersed in double distilled water to remove any unwanted biological materials (Sreemanti Das *et al.*, 2013).

Characterization of copper nanoparticles pH Analysis

The pH was determined by using Digital pH meter. The pH of the reduced solution with nanoparticle synthesised in both aqueous and ethanol extract was found to be 5.80 and 5.55.

UV- Visible spectroscopy analysis

The formation of copper nanoparticles was confirmed by UV- Visible spectroscopy using Deepvision model 1371 VU/Vis Spectrophotometer, India instrument. Size of the CuNPs was analyzed with UV-Spectrometer in the range between 300-700nm.

FT-IR analysis

To determine the biomolecules present in the leaf extract, FTIR analysis was carried out which is responsible for the reduction of Copper ions with the spectral range of 400-4000 cm-1. Here the sample was centrifuged at 10,000 rpm for 20 min, dried using hot air oven and ground with KBr to form a pellet. Then the pellet was analyzed using Jusco 5300 model FTIR instrument.

Scanning Electron Microscopy

Morphology and mean particle size of the Cu were determined by SEM analysis. The samples were prepared for SEM analysis. The SEM analysis was established by using Supra Zeiss with 1nm resolution at 30 kV with 20 mm Oxford EDS detector.

Result and Discussion

Synthesis of Copper Nanoparticle

The formation of Cu NPs was initially confirmed visually. The change in color of the reaction mixture (Fig.1) due to surface Plasmon resonance singularity provides a convenient signature to indicate the formation of Cu NPs.

Characterization of Copper Nanoparticles by UV-Vis absorption spectroscopy

The absorption spectra of aqueous and ethanol extracts obtained from *Gymnema sylvestre* were compared with the absorption spectra of copper nanoparticles prepared using these extracts in order to reveal the formation of copper phyto-nanoparticles. The absorption spectra of copper phyto-nanoparticles were recorded after 24 hours after their preparation and exhibited absorbance peaks at 560 nm (Graph-1).

Characterization of *Gymnema sylvestre* Leaf-cunps by FTIR Analysis

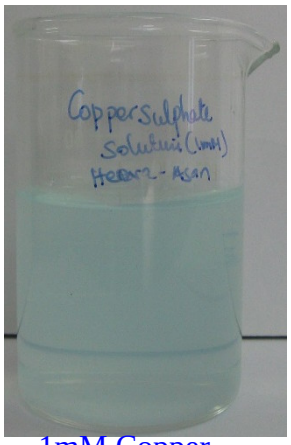
The confirmatory test was performed by studying the molecular interaction between the *G. sylvestre* water and ethanol extracts and the synthesized nanoparticles using FT-IR. Figure 2a & b indicates the spectra of pure water and ethanol mediated copper nanoparticles. The FT-IR spectra for aqueous extract of *G. sylvestre* Copper nanoparticles shows vibration bands at 3466.2 cm^{-1}, which may be due to overlapping of O-H and amine N−H stretching bands; the peak at 2345 cm^{-1} indicates aliphatic C−H stretching; 2082 and 2380 cm^{-1} indicates N−H bending; 1633.8, and 710 cm^{-1} indicates C−H bending; and 1,028 cm^{-1} indicates C−O stretching. The FT-IR spectra for ethanol extract of *G. sylvestre* Copper nanoparticles shows vibration bands at 3752.5 to 3422.8 cm^{-1} due to overlapping of O-H and amine N−H stretching bands. 2902.0 19.4 to 2122.4 90.2 cm^{-1} indicates N−H bending; peak 1638.2 84.6 cm^{-1} indicates C−H bending; peak 880.1 91.6 cm^{-1} indicates C−O

stretching. In addition, new moderate intensity peaks representing copper nanoparticles were evident at 2902 and 2973 cm^{-1} for water extract of *G. sylvestre*. The two vibration bands could also indicate an interaction between the copper nanoparticles and the *G. sylvestre extract* (Shameli *et al*., 2010).

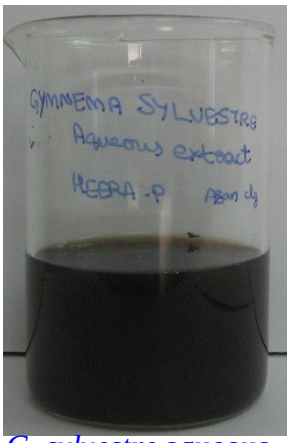
Scanning Electron Microscopy (SEM) Analysis

The surface morphology and size of the nanoparticles were obtained by Scanning Electron Microscopy (SEM) analysis. The Fig-3 a, b shows the Cu NPs synthesized by the leaves extract of *Gymnema sylvestre*. The electrostatic interactions and hydrogen bond between the bio-organic capping molecules bond are responsible for the synthesis of copper nanoparticles using plant extract. It was shown that spherical and relatively uniform shape of the copper nanoparticles was confirmed in the range of 65-184nm. The quantitative and qualitative analysis of elements may be concerned in the formation of copper nanoparticles. Whereas the ethanol extract is appearing shows that spherical and relatively uniform shape of the copper nanoparticles was confirmed in the range of 181-302nm. (Usman *et al*., 2012).

Fig.1 Synthesis of Cu NPs from the leaves of *Gymnema sylvestre* by aqueous and ethanol extract

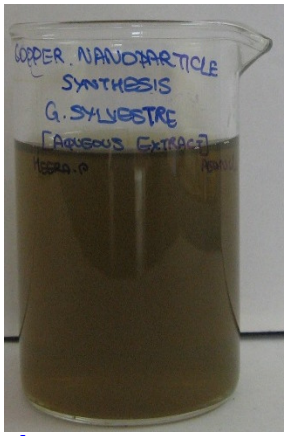


1mM Copper Sulphate Solution

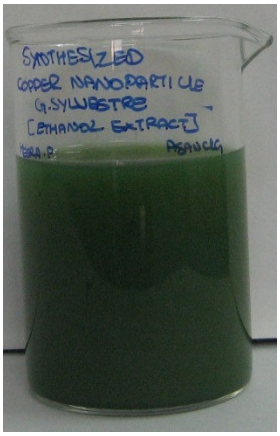


G. sylvestre aqueous extract

G. sylvestre ethanol extract



G. sylvestre aqueous extract after $CuSo_4$Solution added



G. sylvestre ethanol extract after $CuSo_4$ Solution added

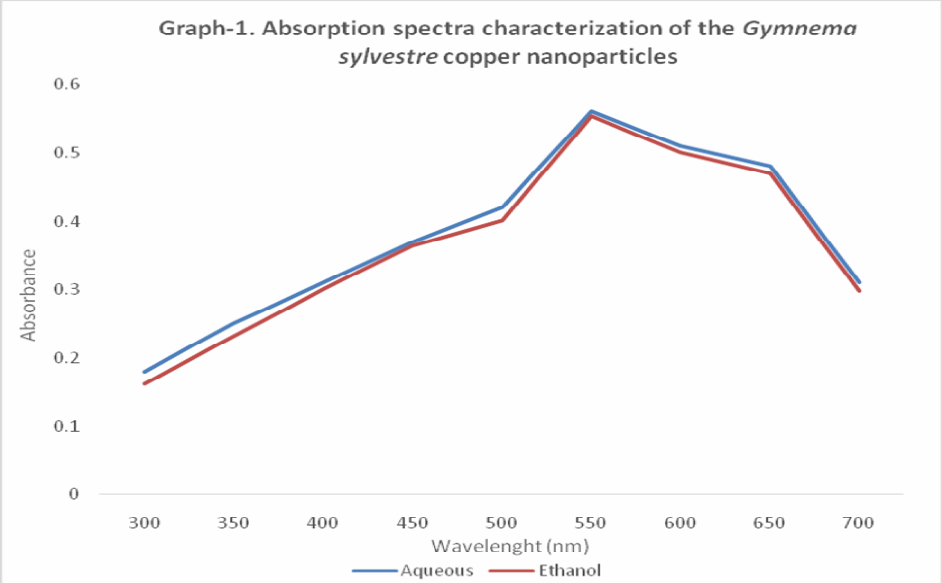
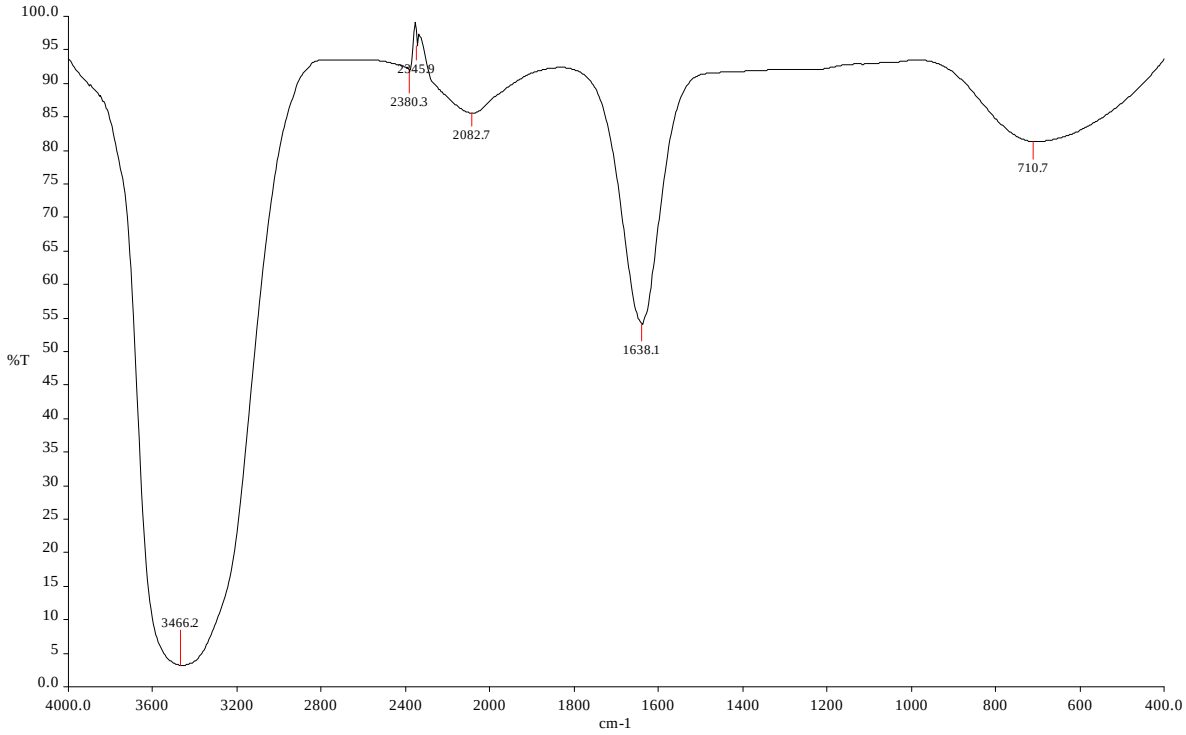


Fig.2a FTIR spectrums of aqueous extract synthesis CuNPs



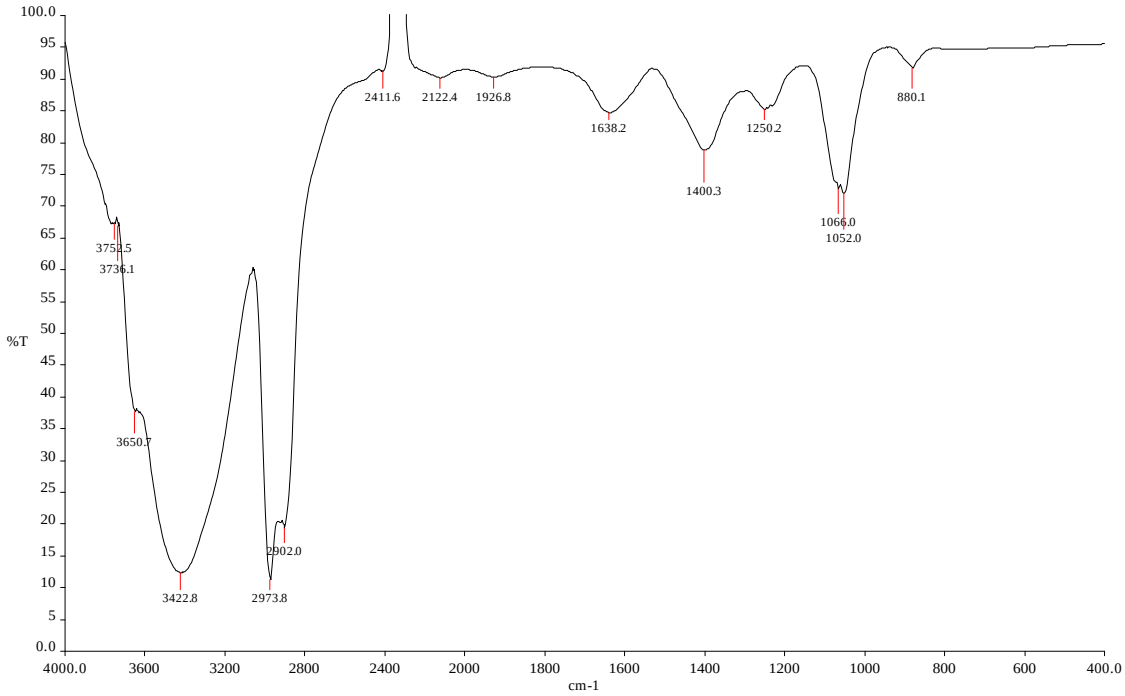


Fig.2b FTIR spectrums of ethanol extract synthesis CuNPs

Fig.3a. Morphology and size of CuNPs *Gymnema sylvestre* aqueous extract

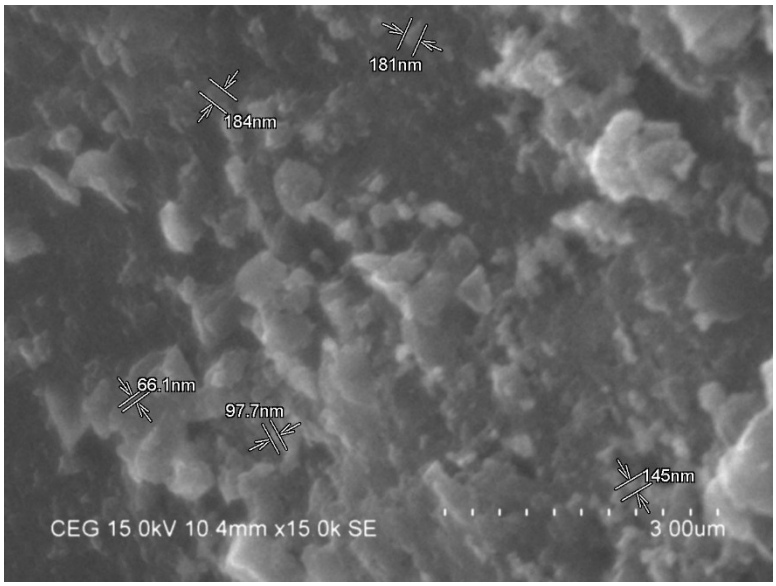
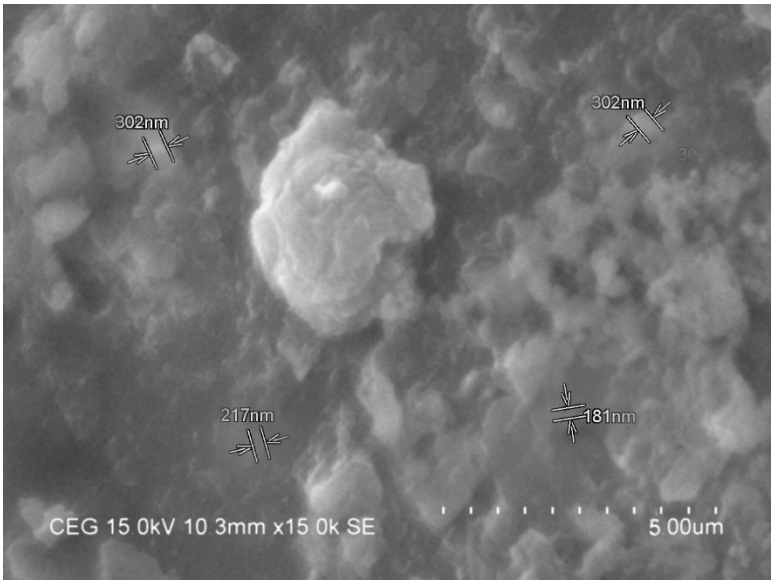


Fig.3b Morphology and size of CuNPs *Gymnema sylvestre* ethanol extract



Conclusion

In conclusion, here we report eco-friendly synthesis of Copper nanoparticles in both aqueous and ethanol extract using the leaf of *Gymnema sylvestre*. The green synthesised Copper nanoparticle was subjected to FTIR anaysis and SEM analysis. This method has merits over other reported methods are easily available starting materials, inexpensive and procedure is easy to carry out any laboratory, use of toxic reagent is avoided and pollution free.

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