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Synthesis and Characterization of Copper Nanoparticles Using Ocimum Sanctum Leaf Extracts

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Abstract
The present study involves the green synthesis of copper nanoparticles using Ocimum Sanctum (Tulsi) leaf extract. Prepared leaf extract of Ocimum Sanctum was added to 0.62M copper sulphate solution and the colour change was observed which indicates the formation of copper nanoparticles. The leaf extract may act as reducing agent. The synthesized (FTIR), Scanning Electron Microscopy (SEM), X-ray diffraction (XRD). The synthesized CuNps were in uniform spherical and floret shape. It was observed that the Ocimum Sanctum leaf extract can reduce copper ions into copper nanoparticles. Thus, this method can be used for rapid and ecofriendly of stable copper nanoparicles.

Keywords: Synthesis, Characterization, Copper, Nanoparticles, XRD, CuNps

1. Introduction

Nano science is the study of structures and materials on an ultra-small scale, and the unique and interesting properties these materials demonstrate. Nanoscience is cross disciplinary, meaning scientists from a range of fields including chemistry, physics, biology, medicine, computing, materials science and engineering are studying it and using it to better understand our world.

Nano science involves the study of chemical and physical changes that happen at the Nano scale. Researchers and scientists are interested in the Nano scale, because when many materials get down to these tiny sizes, they start to behave differently. The article Nano science provides an overview of Nano technology-its history and some future possibilities in the nanotechnology field.

Many researchers have used green synthesis methods for different metal nanoparticles due to their growing need of eco-friendly properties. It is found to be simple, easy, low cost and eco-friendly green technique of copper nanoparticles. Hence, the present study focused on the aqueous leaves extract of Ocimum Sanctum used to synthesis copper nanoparticles and the characterization was carried out.

2. Experimental procedure

Copper nanoparticles (NPs) have been the subjects of researchers because of their unique properties (e.g., shape depending optical, antimicrobial, and electrical properties). A variety of preparation techniques have been reported for the synthesis of copper nanoparticles. Double distilled water was used for this synthesis. All the glassware's used for the synthesis were washed well, rinsed with double distilled water and dried in hot air oven.

Preparation of Ocimum Sanctum Leaf Extract

The washed leaves were cut into small pieces. About 50gm of leaves were weighted and separated and transferred into 250 mL beaker containing 100 mL distilled water and it was boiled for 10-15 minutes at 60°C. It is then cooled down and filter to remove the leafy materials, this filter was known as Ocimum Scantum leaf extract.50 mL of leaf extract was added dropwise to 50 mL of 0.62M copper sulphate solution. It was kept for incubation for 24 hours. After the precipitate got settled at the bottom. This was indicated by the formation of copper nanoparticles.

Characterisation of Copper Nanoparticles

The synthesized CuNps were characterized by UV-Visible Spectroscopy. FT-IR analysis was carried out in order to find out the biomolecules present in the leaf extract which was responsible for the reduction of copper ions to the copper nanoparticles. Morphology and mean particle size was determined by SEM analysis. The CuNps were established by XRD and average size of the CuNps was determined by using Debye-Scherrer equation.

3. Result And Discussion

3.1 X-Ray Diffraction (XRD) Analysis

The structure of copper sulphate was confirmed from X-ray diffraction analysis XRD is used to characterize particle size and structure in shown in fig 1. XRD pattern of synthesized CuNps from Ocimum Sanctum leaf extract [7] was represented in fig 1.

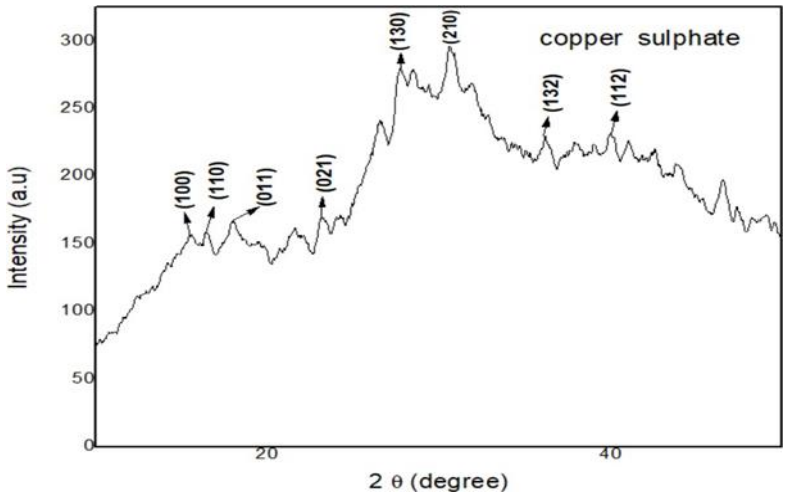


Fig .1 XRD pattern of synthesized CuNps.

The XRD analysis was carried out with diffraction angles 15.47, 16.42, 18.10, 23.21,
27.76, 30.62, 36.22, 40.03 which corresponds to copper lines indexed at (100), (110), (011),
(021), (130), (210), (132), (112). The average particle size was found to be 24nm.

3.2 Fourier Transform Infrared Spectroscopy (FT-IR) Analysis

The FT-IR Spectroscopy is used to study the interaction between different species and changes in chemical composition of mixture.The FT-IR Spectrum of CuNPs was shown in fig 2.In the spectra, the broad peak at 3184.98cm^{-1} corresponds to O-H stretching **H**-bonded alcohols and phenols. The peak at 1590.93cm^{-1} corresponds to carbonyl stretching of amides. The peak 1510.95cm^{-1} showed N-H bending primary amines. The peak at 1057.45cm^{-1} showed C-O stretching of alcohols and ethers. The FT-IR analysis of CuNps showed that the alkaloids and polyphenols present in the Ocimum Sanctum leaf extract act as a capping and reducing agent which was surrounded by the CuNps.

Vibrational peak (cm^{-1})	Mode of Vibration	Functional group
3184	O-H	Alcohols and phenols
1590	C-O	Amides
1510	N-H	Amines
1057	C-O	Alcohols and ethers

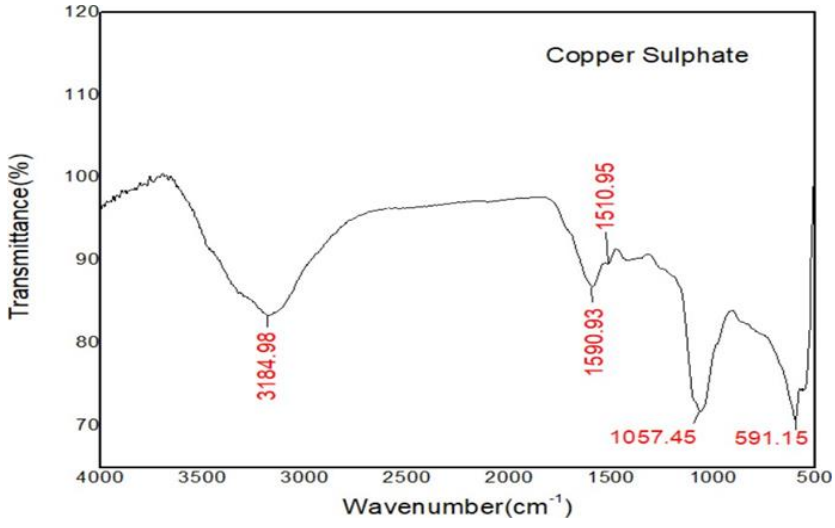
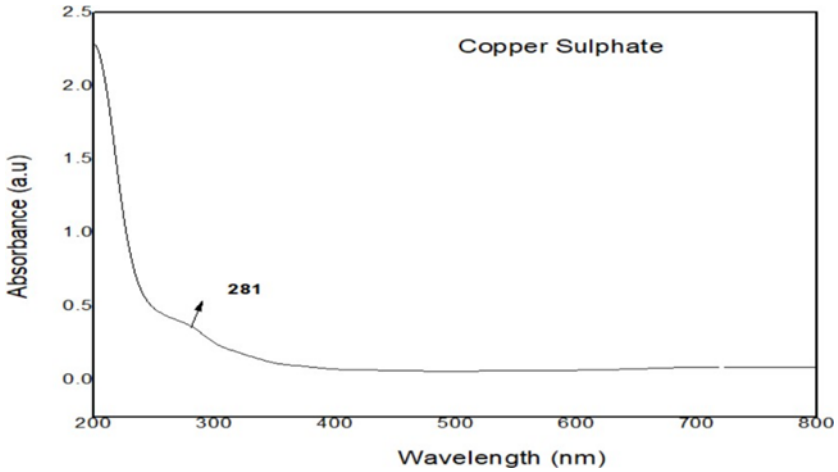


Fig. 2 FT-IR Spectrum of synthesized CuNps.

3.3 UV-Visible Absorption Spectrum

The synthesized CuNPs were characterized by UV-Visible Spectroscopy. It was analysed in the range between 200 – 800 nm. UV-Visible spectra show the peak at 281 nm which indicates the presence of CuNPs. High absorbance indicates a high conversion of cu^{2+} to Cu as nanoparticles leading to higher concentration of CuNPs [6]. The result obtained from the UV-Visible Spectroscopy analysis of the CuNPs was presented in Fig3.

UV-Visble spectrum of synthesized CuNPs



3.4 Scanning Electron Microscope (SEM) Analysis

SEM is one of the techniques for the surface study of the samples and it gives important information regarding the growth mechanicm of the particles the entire SEM picture clearly shows the average size of the nanoparticles in the order of nanometer size. The surface morphology of the CuNps was obtained by the Scanning Electron Microscopy (SEM) analysis. Fig 4 shows the morphology of CuNps synthesized by the Ocimum Sanctum leaf extract. It is shown that the spherical and uniform floret shape of CuNps was confirmed.

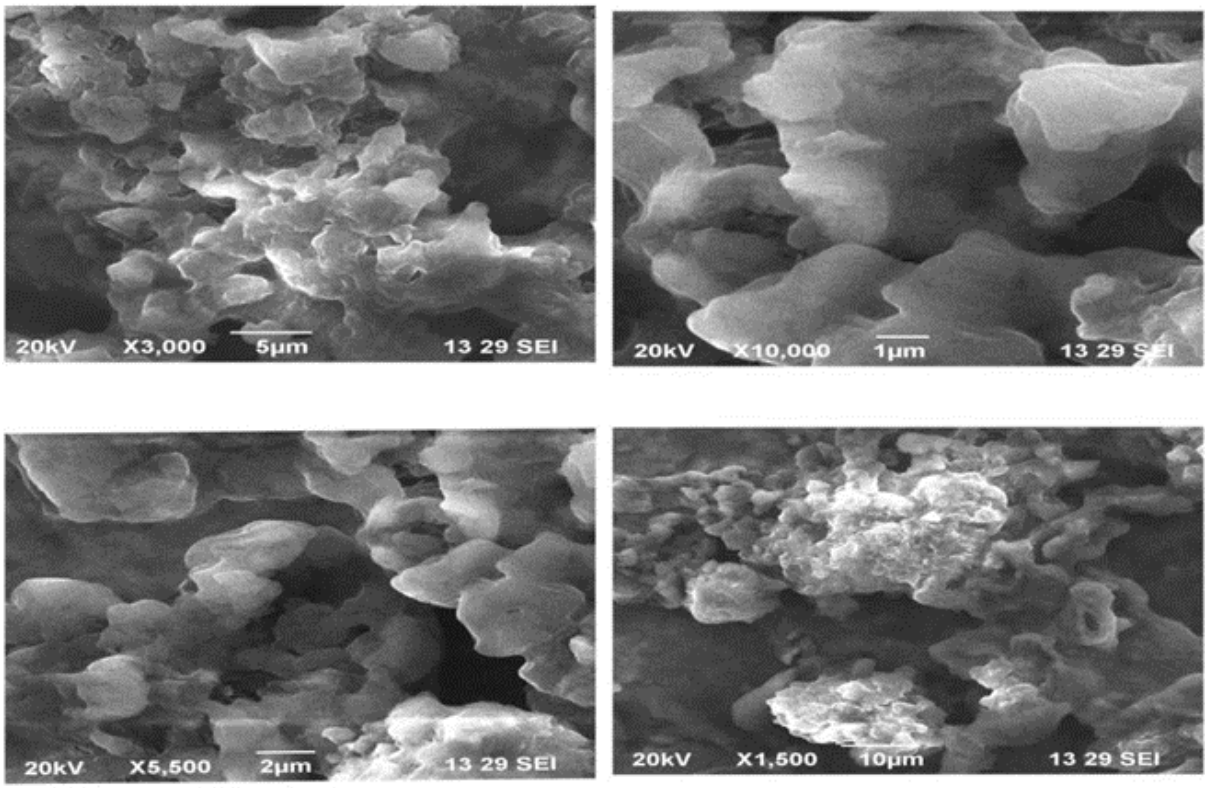


Fig. 4 SEM images of synthesized CuNps.

4. Conclusion

The copper nanoparticles were synthesized by Ocimum Sanctum leaf extract. This copper nanoparticles are eco-friendly and cost- effective. The synthesized CuNps were characterized by XRD, UV-Vis, FTIR, and SEM.In XRD analysis the synthesized copper sulphate nanoparticles size were calculated by using Debye-Scherer equation. The average size of Copper Sulphate size is 24nm respectively. In UV-Visible absorbance band range is 281nm it was confirmed that the Copper Sulphate nanoparticle formation. In FT-IR analysis several major bands of functional group of nanoparticles were seen through FTIR spectroscopy and

conforming the formation of copper sulphate nanoparticles. In SEM analysis confirm the formation of Copper Suphate nanoparticles that provide uniform spherical and floret shapes of CuNps were identified. It dissolves kidney stones, good for diabetes, reduces blood pressure and stress.

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