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Eco-friendly green synthesis of copper nanoparicles using leaf extract of medicinal plant Jatropha gossypfolia

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***ABSTRACT**--In this study, we have synthesized copper nanoparticles (CuNPs) from the plant Jatropha gossypfolia leaf extract. The formation of CuNPs were confirmed by various spectroscopic and microscopic techniques such as UV, FT-IR, AFM and SEM –EDAX. Phytochemical screening studies of the plant extract were performed which indicated the presence of flavanoids, phenols, saponins, tannins, alkaloids, phytates and steroids. The surface morphology of the synthesized copper nanoparticles was examined as spherical in shape with an average diameter varied from 28-86nm by SEM analysis. The copper nanoparticles have good potential of antioxidant activity.*

***Key words**--Jatropha gossypfolia, copper nanoparticles, phytochemicals and antioxidant activity.*

I. INTRODUCTION

In recent days plant mediated synthesis has been turned more attractive due to its non-toxic, eco-friendly and cost-effective nature. The secondary metabolites present in plants and pigments perform nanoparticle synthesis by reduction. Biosafe synthesis of metal nanoparticles are achieved by different kinds of plants [1].

Because of their distinctive properties, extra-ordinary performance and biological activities metal nanoparticles handed down in many fields. Their high potential medical applications in drug-resistant infections have revolutionized the field of medicine [2]. Among the metal nanoparticles, copper nanoparticles have attracted by its cost effectiveness and the ability to interact with biological entities, administrated in the various fields such as antibacterial [3], superstrong materials [4], and non cytotoxicity[5].

II. METHOD AND MATERIALS

2.1. Collection and preparation of plant extract

Jatropha gossypfolia collected from natural geographical landscapes of Athimarapatti, Thoothukudi, in India. *Jatropha gossypfolia* leaves were thoroughly washed and sliced into small pieces. The leaf extract was

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prepared by boiling about 40g of sliced leaves with 200 mL of distilled water for 30 minutes in a 1L beaker. The *Jatropha* gossypfolia leaf extract was cooled well and filtered using Whatmann filter paper No.1

2.2.Synthesis of copper nanoparticles

20mL of *Jatropha gossypfolia* leaf extract was introduced into 80ml of 1 mM copper sulphate solution and stirred well for 2 hours (60°C) in a magnetic mixer. There was a visual change of colour from light blue to deep brown showed the formation of copper nanoparticles (CuNPs). The synthesised copper nanoparticles were refrigerated for future use.

III. RESULT AND DISCUSSION

3.1. UV-visible *spectroscopic study in CuNPs synthesized from Jatropha gossypfolia leaf extract*

The UV/Vis spectrum of copper nanoparticles showed a broad absorption band with maximum absorbance at (340-370) nm(Fig.1)

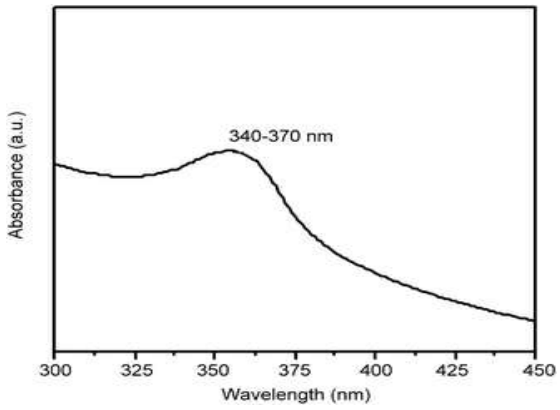

Figure 1: UV-visible spectra of CuNPs

3.2. FTIR spectroscopy:

The FTIR analysis (Fig.2) showed different stretches of bond as follows: It exhibits broad absorption peaks at 3346.70 cm−1 confirming the existence of O–H group in carboxylic acid. The weak peak observed at 2112.74 cm−1 due to the stretching frequency of triple bond in between two carbon atoms of alkynes. The intense peak at 1638.73cm-1 due to C=O stretching vibration of primary amines. The peaks at 1335.36 cm-1 was due to terminal CH_3 group.

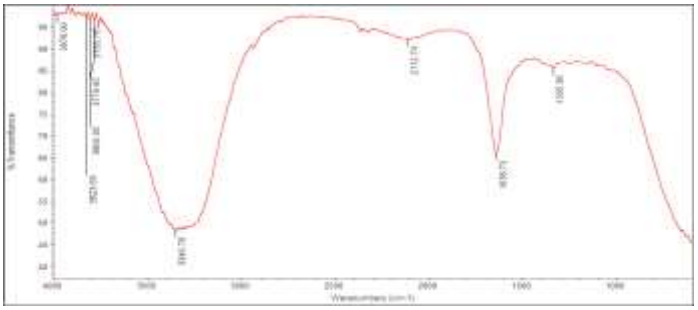

Figure 2: FTIR spectra of copper nanoparticles

3.3. AFM studies of Copper nanoparticles

Surface morphology was measured using an AFM and are shown in figure 3.The copper nanoparticles showed a smoother and porous surface. The average surface roughness was found to be 32.483nm.

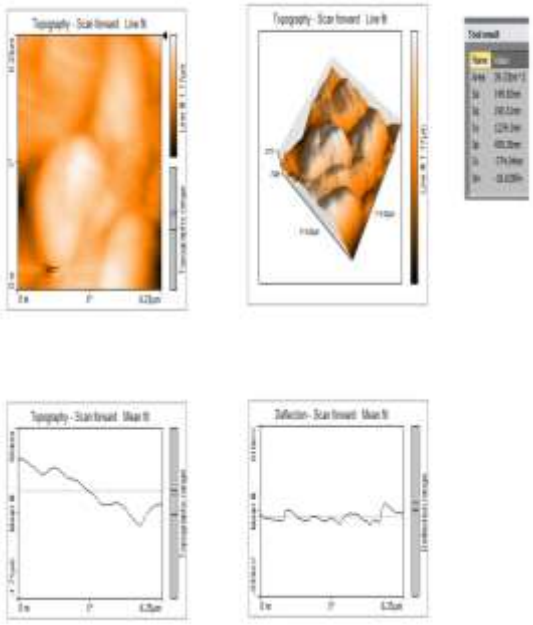

Figure 3: Topography of CuNPs

3.4. SEM-EDAX analysis of CuNps

The surface morphology of the copper nanoparticles showed spherical structure with an average diameter varied from 28 to 86 nm (Fig.4) as examined by SEM analysis

EDAX spectral analysis confirmed Cu alone as the major element. The elements C and O were found as contaminants. Furthermore small peaks for P, S, Na and Ca, which forms the evidence for the other substances attached to the CuNPs. EDAX result indicated. the synthesized nanoparticles were crystalline in nature

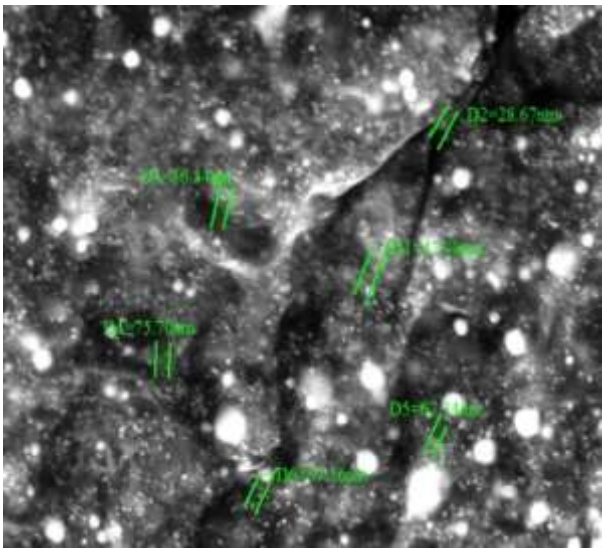

Figure 4: SEM analysis of CuNps

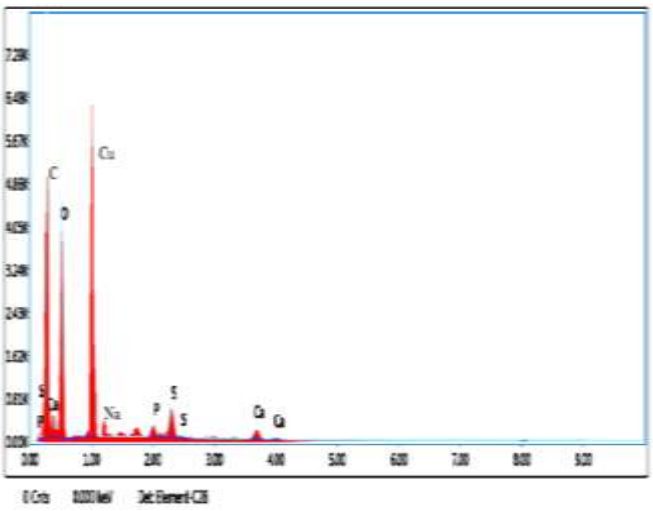

Fig 4.: EDAX image of CuNPs

3.*5. Phytochemical Screening Analysis:*

Table 1: EDAX studies of CuNPs

Element	Weight%	Atomic%	Net Int.
Cu K	54.54	34.65	464.55
C K	28.84	3.46	245.65
O K	12.14	1.94	103.40
Na L	1.14	0.26	9.71
P K	1.08	0.42	9.19
S K	0.96	0.30	8.17
Ca K	1.30	0.52	1.07

The phytochemical active compound of *Jatropha gossypfolia* were qualitatively analysed and the results were given in Table 2.

Table. 2: Phytochemical screening analysis of *Jatropha gossypfolia* leaf extract .

S.No	**Phytochemicals**	***Jatropha gossypfolia* leaf extract**
1	Flavanoids	Detected
2	Phenols	Detected
3	Saponins	Detected
4	Tannins	Detected
5	Alkaloids	Detected
6	Phytates	Detected
7	Steroids	Detected

8	Carbohydrates	Not detected
9	Oils & Resins	Not detected
10	Terpenoids	Not detected

3.6. Antioxidant studies in copper nanoparticles

Total Antioxidant activity by Phosphomolybdenum method in copper nanparticles are shown in Fig.5

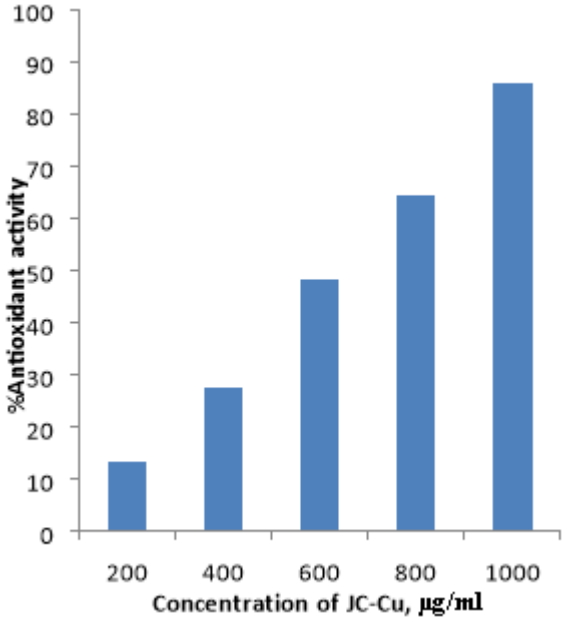

Figure 5: Antioxidant activity of CuNps

Antioxidants are the agents capable of neutralizing the free radicals in living system. However, due to insufficient nutrition and aging cell lose its capability to fight against free radicals and leads to disease. From this results, it is concluded that nanoparticles are good potential of antioxidant activity..

IV. CONCLUSION

In this study, we synthesized copper nanoparticles (CuNPs) by utilizing an aqueous solution of *Jatropha gossypfolia* leaf extract as a bioreducing substance. The synthesized copper nanoparticles are crystalline, spherical in nature and size in between 28-86 nm. Apart from the characterization studies, phytochemical screening studies were performed which indicated the presence of flavanoids, phenols, saponins, tannins, alkaloids, phytates and steroids. Antioxidant studies revealed that the copper nanoparticles are good potential of antioxidant activities.

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