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Green synthesis of copper nanoparticles from the flower extract of *Ipomea pes-caprae* collected from Thoothukudi coastal areas

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Abstract

We used the flower extract of *Ipomea pes-caprae* plants which are commonly known as beach morning glory to synthesize copper nanoparticles. To our knowledge, this is the first report where this flower extract was found to be a suitable source for the green synthesis of copper nanoparticle. On treatment of aqueous solution of copper sulphate with the flower extract, the copper nanoparticle was formed after keeping it at a dark room. The copper nanoparticle was characterized by UV-visible spectroscopy and Fourier transform infra-red spectroscopy (FTIR). The surface studies was carried by atomic force microscopy (AFM). The phytochemical analysis of flower extract reveals the presence of alkaloids, tannins, phenolic compounds etc.,. The flower extract was found to possess a good antioxidant property.

Keywords: *Ipomea pes-caprae* , copper nanoparticles, AFM, antioxidant study

1. Introduction:

Nanotechnology has been spread to number of areas including biomedical services, cosmetics, drug gene delivery, environmental health, food, health care, catalysis, mechanics, non linear optical devices, optics, photo-electrochemical application, single electron transistors, space industries[14].Recent advances in nanotechnology include the incorporation of metallic NPs into diverse industrial, medical, and household products[5,6,8].The escalating demand of "green" NP fabrication has now urbanized new routes

to combat physical and chemical methods[3].Green synthesis is rely on the different process parameters and reaction conditions such as temperature, pH, solvent medium, stirring time and reducing agents etc. for the greater stability, high yield and controlled size and shape morphology. Not only size but also shape and surface morphologies are vital in affecting the properties of NPs.

Plant mediated synthesis is purely a green synthetic route and are considered better candidates among the different biological entities as they provide clean, eco-friendly, cost effective, safe, conveniently utilizable and beneficial way to the synthesis of metal Nps for the large scale production. Many plants are reported to facilitate the formation of AgNPs and their potential applications[2,10,13].The amount of accumulation of NPs varies with reduction potential of ions and the reducing capacity of plant depends on the presence of various polyphenols and other heterocyclic compounds[7,12].

Copper has been recognized as a hygienic material since the beginning ofcivilization and, during the last two centuries, anecdotal evidence has been amply supported by scientific research to show that copper has antimicrobial properties i.e., it is capable of preventing the growth of dangerous pathogens- bacteria, moulds, algae, fungi, and viruses. Today, copper is used as a water purifier, algaecide, fungicide and nematocide and as an antimicrobial and antifouling agent[1,4]. In this paper we have focussed on such copper nanoparticles.

2. Materials and Methods

2.1 Collection of Flower:

Flowers of *Ipomea pes-caprae* was collected from Thoothukudi coastal areas, Tamilnadu, India.

2.2 Preparation of copper sulphate solution

The required amount of copper sulphate pentahydrate (Merck Private Limited) was dissolved in double distilled water and stored in Borosil made glass container.

2.3 Preparation of flower petal extract

About 5 g dried flower petal of *Ipomea pes-caprae* was crushed and mixed with distilled water (45 mL) and boiled for 10~15 min. The hot extract was cooled and filtered with whatmann No.1. The filtered extract was stored at 4˚C for further used. The sterility of the prepared extracts was strictly maintained without any contamination. The extract was then kept in refrigerator to use within 1 week.

2.4 Green synthesis of CuNPs

For the synthesis of CuNPs, heated $CuSO_4$ solution (1 mM) was added to the heated flower extract at 1:1 ratio and stirred well and heated in a magnetic stirrer for 50 min at 80˚C. The color of the solution changes to reddish yellow in color indicating the formation of CuNPs[11].

2.5.Characterization of CuNPs

2.5.1. UV-VIS spectroscopy

The synthesized CuNPs was primarily detected by visual observation of colour change. CuNPs were detected from the spectra by UV-Vis spectrometer (JASCO variant 630 spectrometer) where reaction mixture was subjected to optical analysis from 200 to 900 nm .

2.5.2.Fourier Transform Infrared spectroscopy

FT-IR (Thermo scientific Nicolet iS5ATR-iD1 Spectrometer) analysis was carried out which is responsible for the reduction of copper ions with the spectral range of 400–4000 cm^{-1}.

2.5.3.Atomic Force Microscopy

The surface morphology and surface roughness was studied using Nanoeasy scan 2 (AFM).

2.5.4.Total antioxidant capacity assay (TAC):

The **total antioxidant capacity** of the extracts was assessed spectrophotometrically by the phosphomolybdenum method according to the procedure described by Prieto *et al.* (1999). One milliliter of each sample extract (0.5 mg mL^{-1}) was mixed with 3 mL reagent solution (0.6 M H_2SO_4, 28 mM Sodium phosphate and 4 mM Ammonium molybdate). The blank solution contained 4 mL reagent solution only. The mixtures were incubated at 95°C for 150 min. After the mixture had cooled to room temperature, absorbance was measured at 695 nm. Total antioxidant capacity (TAC) was expressed as tannic acid equivalent (TAE).

3.Results and discussion

3.1. UV-VIS spectroscopy

It is usually recognized that the UV-Vis spectroscopy could be used to examine the size and shape-controlled nanoparticles in aqueous suspensions. The reduction of copper sulphate to copper nanoparticles was monitored by measuring the UV-Visible spectrum of the reaction medium immediately after diluting a small aliquot of the sample into distilled water. Absorption spectra of copper nanoparticles formed in the reaction media has absorbance peak at 321nm.(Fig: 1)

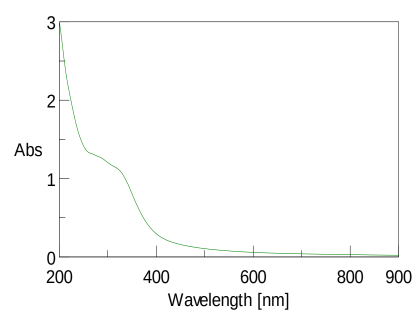

Fig : 1 UV-Vis spectrum of synthesized copper nanoparticles

3.2.FT-IR spectroscopy

The peaks at 3660.66cm^{-1} , 3696.00 cm^{-1} , 3274.74cm^{-1} were due to the -OH stretching of water molecules. The peak at 1550.31 cm^{-1} due to the -CH2 bending. The peaks at 3338.93cm^{-1} corresponds to O-

H stretching of phenolic group. The peak at 1633.09cm^{-1} is due to the presence of C=O stretching of aldehyde group. The peak at 1327.28cm^{-1} shows N=O bending vibration of nitro group[9].The peak at 1017.17 cm^{-1} is due to the C-O stretching of alcohols.(Fig:2)

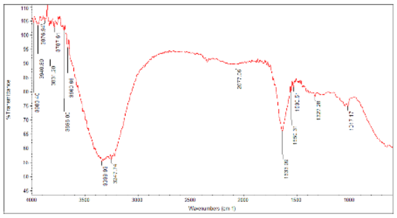

Fig:2 FT-IR spectrum of copper nanoparticles

3.3. Atomic Force Microscopy:

The copper nanoparticles synthesized were characterized by AFM for its detailed size and morphology of copper. The topographical images of irregular copper nanoparticles synthesized from flower extract of *Ipomoea pes-caprae* was shown in Fig: 3.

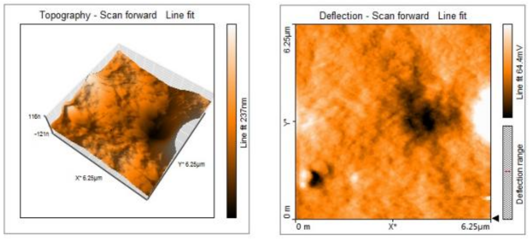

Fig:3 AFM image of synthesized copper nanoparticles

3.4. Total antioxidant capacity assay:

The total antioxidant capacity of the flower extract was shown in Table 1. The results shows that the flower extract possesses high antioxidant capacity with the standard ascorbic acid as control.

Table:1 Total antioxidant capacity

Sample	Concentration µg/ml	OD at 695 nm	TAA mg/g equivalents of ascorbic acid
Standard Ascorbic acid	200	0.050	
	400	0.350	
	600	0.380	
	800	0.630	
	1000	0.740	
Ipomoea pes-caprae Flower extract	200	0.550	5.781
	400	0.980	24.957
	600	1.650	60.587
	800	2.250	140.34
	1000	2.250	140.34

4. Conclusion

In the present work we have reported a fast, simple and eco-friendly synthesis of copper nanoparticles from the flower extract of *Ipomea pes-caprae*. The characteristics of the obtained copper nanoparticles were studied using the UV-Vis spectrophotometer which confirmed the synthesis of copper nanoparticles. In FT-IR spectrum, the peaks corresponding to various functional groups indicates the presence of various phytochemicals.

From the total antioxidant capacity assay we found that the flower extract possesses good antioxidant potential hence we conclude that the flower extract of *Ipomea pes-caprae* can be used by various food and pharmaceutical companies. However, further studies should be done to isolate the antioxidant compounds and evaluate their antioxidant potential in in-vitro systems.

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