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**FREE RADICAL SCAVENGING ACTIVITY OF COPPER NANOPARTICLES
SYNTHESIZED USING *Pongamia pinnata***

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ABSTRACT

One of the main subjects in nanoscience is the integration of green chemistry principles to nanotechnology. Recently the ever-increasing need to develop eco-friendly metal nanoparticle synthesis processes is observed. In this research, the ability of the bark extracts of *Pongamia pinnata* was examined as novel reducing agents for the green synthesis of copper nanoparticles (Cu-NPs). Biosynthesized Cu-NPs were characterized by UV-Vis spectroscopy, Fourier transform infrared spectroscopy (FT-IR) and Antioxidant assay. The DPPH assay clearly shows the antioxidant activity of the copper nanoparticles synthesized using *Pongamia pinnata*.

Keywords: *Pongamia pinnata*, Cu-NPs, UV-Vis, FTIR, Antioxidant

INTRODUCTION

Pongamia pinnata (Linn.) are Different parts of this plant as a remedy for various ailments have been used in traditional medicines. Its root, bark, leaves, sap, and flower also have medicinal properties and traditionally used as medicinal plants. Various Phytoconstituents belonging to alkaloids, glycosides, flavonoids, fixed oils and carbohydrates and many more pharmacological activities and a biofuel property of this plant [1]. The seed-oil of *Pongamia pinnata* possesses medicinal properties and used in itches, abscess and other skin diseases. Flowers are prescribed for glycosuria and as a remedy for diabetes. The bark is used internally for bleeding piles, beriberi and diabetes and as an antimicrobial. Seed is used as a medicinal plant, particularly with the Ayurvedic and Siddha medicine systems of India. Crude seed extract can completely inhibit the growth of herpes simplex virus type 1 and type 2 in Vero cells and also possesses hypoglycemic, anti-oxidative, anti-ulcerogenic, anti-inflammatory and analgesic properties [2]. *Pongamia pinnata* (L.) (*Malapari*) is a bio-energy tree legume with the potential for high oil seed production and the added benefit of the ability to grow on marginal land. The successful of plantation program is

seeds and seedlings procurement. The procurement of seeds and seedlings continuously need basic information on the period of flowering and fruiting, the potency of produced seeds and seedlings, as well as seedling techniques of the [3]. *P. pinnata* extract has potent wound healing capacity as evident from the wound contraction and increased tensile strength. Hydroxyproline and hexosamine expression were also well correlated with the healing pattern observed. antimicrobial activity, *Staphylococcus aureus*, *Staphylococcus pyogenes*, *Staphylococcus epidermidis*, *Escherichia coli*, *Micrococcus luteus*, *Enterobacter aerogenes*, *Salmonella typhi*, *Pseudomonas aeruginosa*, *Candida albicans*, *Aspergillus niger* also indicate that *P. pinnata* possess potent antioxidant activity by inhibition lipid peroxidation, reduce glutathione, superoxide dismutase level and increases catalase activity. Wound healing phase TNF- α and IL-6 level were found to be up-regulated [4]. Methanol and ethanol extracts of *Pongamia pinnata* L (PPE) showed higher antibacterial activity than and good bactericidal activity against the selected Hospitalized pathogens and the maximum activity evinced on *Pseudomonas aeruginosa* with zone of inhibition 20mm by methanol extract and

18.5mm on *Pseudomonas aeruginosa* in ethanol extract in comparison to Ceftazidime [5].

In this Current research is ability of the fruit extracts of *Ziziphus spinachristi* (L.) Willd was examined as novel reducing agents for the green synthesis of copper nanoparticles (Cu-NPs). Biosynthesized Cu-NPs were characterized by UV-Vis, FTIR, FESEM, TEM and XRD. Prepared Cu-NPs can be used as an efficient adsorptive nanomaterial to remove crystal violet, from aqueous extracts [6, 7, 8]. Optimization of the variables for maximum adsorption of target dye was performed using desirability function combined response surface methodology. The results are showed that 95% of CV with a high adsorption capacity (37.5 mg g⁻¹) was removed with a little amount of adsorbent (80 mg) in a short time (7.5 min). Antibacterial activity of the Cu-NPs was studied on two different (g- and g+) bacteria; *Escherichia coli* and *Staphylococcus aureus* [9]. Copper nanoparticles (CuNPs) were prepared using *Syzygium aro-maticum* (clove) bud extract through simple and eco-friendly green route. The synthesized and characterized nanoparticles were subjected to structural, morphological, optical and antimicrobial studies. The high crystalline nature of CuNPs with a face centered cubic

phase is evident from the XRD pattern. Morphological studies were used to study the shape and size of the synthesized nanoparticles. EDS attests the high intense metallic peak of copper (Cu) and low intense peaks of carbon (C), oxygen (O), chlorine (Cl) and phosphorus (P) elements due to the capping action of biomolecules of bud extract in CuNPs formation. The zeta potential of the CuNPs attests the stability of the nanoparticles. UV-vis shows the characteristic absorption peak of CuNPs. FTIR analysis shows the presence of different functional groups at various positions. The antimicrobial activity was investigated against the selected pathogens using bio-CuNPs. The positive test results of zone of inhibitions of 8 mm and 6 mm were attained against *Bacillus spp.* and *Penicillium spp* [10]. A new catalyst for synthesis of 1,4- and 1,4,5-substituted-1H-triazoles. The catalyst presents copper nanoparticles, supported on nitrogen-containing polymer matrix. Demonstrated valuable catalyst qualities such as high catalytic activity, low catalytic loading, easily recoverable for further usage, cheapness, resistance to oxidation on air and water action. By using this catalyst, Huisgen cycloaddition reaction proceeds in aerobic conditions and without any ligands at room temperature in water

with relatively short reaction time [11, 12]. The synthesis, characterization, and catalytic testing of copper and copper:gold nanoparticles in melamine-based dendrons supported on SBA-15 is reported. It was found that by first making small gold nanoparticles using the dendrons as templates, stable copper over layers could then be successfully deposited. These samples were used as catalysts for the click reaction, with the most active samples possessing rates of 8.9 mol triazole reduced/(mol copper – hour), nearly 50 times high than literature reports of copper nanoparticles in solution. The gold nanoparticles themselves are inert for this reaction, consistent with the copper being deposited as an overlayer on the gold nanoparticles (Aibolat Koishybay and Daniel F. Shantz *et al*, 2018). Preparation of copper (II) acetate from recovered Cu foils by nitric acid and sodium hydroxide, preparation of sol-gel of copper (II) acetate solution mixed with poly (vinyl) alcohol, and synthesis of Cu-NPs by electro spinning at flow rates 0.2 ml/h and voltage 23e29 kV. SEM, HRTEM, XRD, AAS, and TGA were used to examine the structure of the obtained copper (II) acetate and Cu-NPs. The results showed that the produced Cu-NPs had an average size 5 nm with a synthesis yield 84% (Cu-NPs/mass

of recovered copper). The preparation costs were >4 times lower than commercial prices of similar Cu-NPs [13].

MATERIALS AND METHODS

Collection and Preparation of Extract

Fresh barks *Pongamia pinnata* (Linn.) of were collected from Vellore; collected barks was thoroughly washed under tap water and then was washed with Milli-Q water and chopped with knife. The barks were kept in oven for drying at 60°C for 3 days, and dried barks were powdered using home mixer blender and stored in an air-tight container at room temperature till further use. 1 gm of the powder was boiled with 100ml of water and extracted under relax condition at 100 °C for 15 minutes. After two hours, the aqueous barks extract were obtained by filling the mixture through a Whatman No.1 filter paper and either directly used in the synthesis of copper nanoparticles and stored at 4 °C for further experiment.

Green Synthesis of CuNPs [14]

About 0.996 gm of copper sulphate was mixed with 70ml water and 30ml of barks extract under vigorous stirring for two hours. After the completion of the reaction, the formed dirty colored precipitate was allowed to settle for 24hours. The precipitate was separated from the reaction solution by centrifugation at 6000 rpm for 15minutes,

washed with deionised water repeatedly to remove the impurities and dried in an hot air oven on 70°C.

Characterization of the green synthesis Cu NPs [15]

The formation of copper nanoparticles was confirmed by UV-Visible spectroscopy using Deep vision model 1371 VU/Vis Spectrophotometer and Size of the CuNPs was analyzed with UV-Spectrometer in the range between 300-700nm. To determine the biomolecules present in the barks 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 Jusco5300 model FTIR instrument.

RESULTS AND DISCUSSION

Visual observation

Evaluate the optical properties of nanoparticles. **Figure 1** shows the UV-Vis absorption studies of copper nanoparticles observed at the wavelength of 300–1000 nm. Copper nanoparticles have a wide range absorption value and strong absorption peak at 352 nm.

FTIR *Pongamia pinnata* (Figure 2)

Antioxidant activity of nanoparticles

The **Figure 3** clearly shows the antioxidant activity of green mediated copper nanoparticles. The plants and its mediated nanoparticles are very good free radical scavenging against proved by many researchers [16, 17, 18, 19, 20].



Figure 1: Visual observation

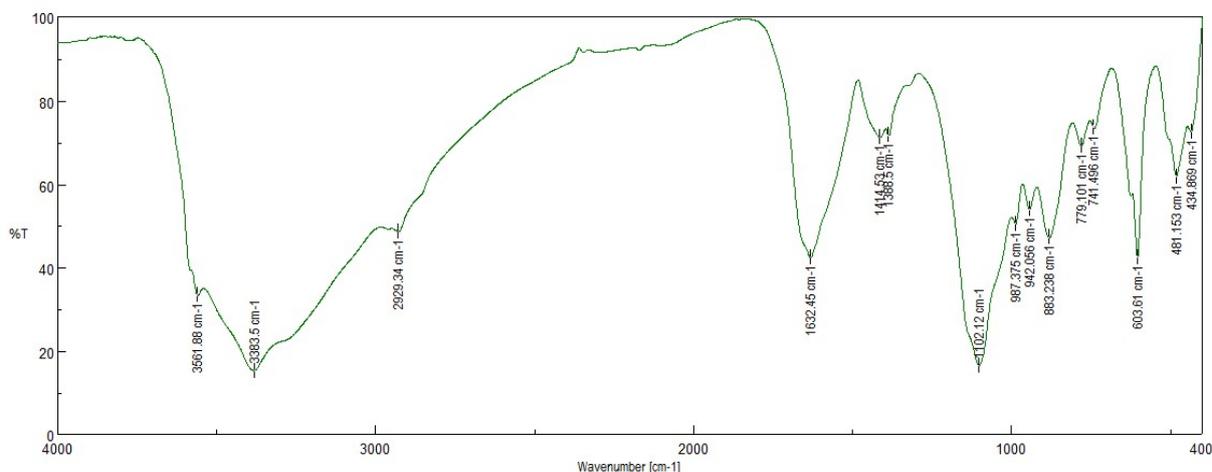


Figure 2: FTIR analysis

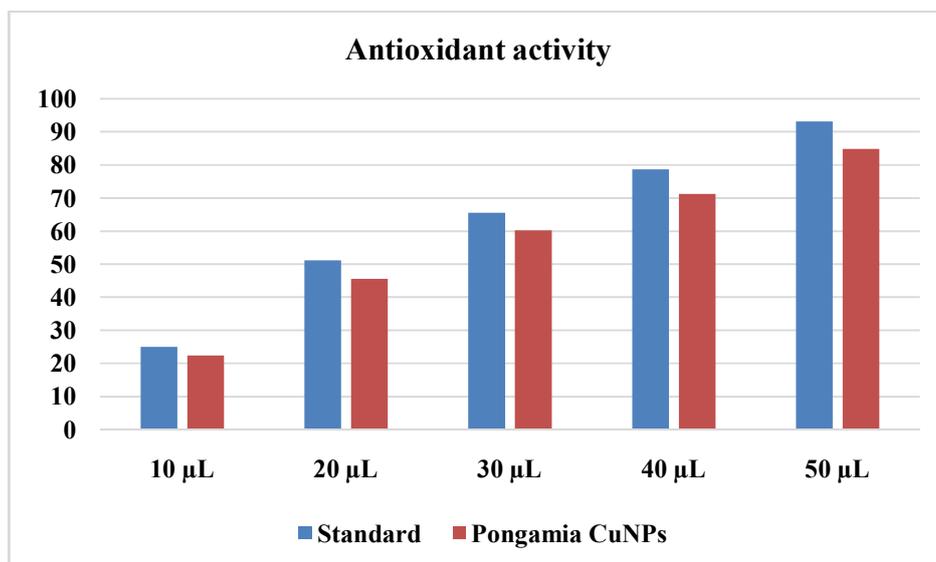


Figure 3: Antioxidant activity of copper nanoparticles

CONCLUSION

We used herbal *pongamia pinnata* for the green synthesis of copper nanoparticles. The visual observation and fourier transform infrared spectroscopy confirms the nanoparticles. In future the copper nanoparticles may used for many biomedical applications.

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