Synthesis of Copper Nanoparticles Biologically by *Conocarpus erectus* L. Aqueous Leaves Extract

Rihab Edan Kadhim[1] Sumaya Yahya Abd[2]

[1]*Biology Department, College of Sciences, University of Babylon, Hilla, Iraq, E-mail: rihabedan@gmail.com*

[2]*Biology Department, College of Sciences, University of Babylon, Hilla, Iraq*

Abstract

Biologically, the nanoparticles of copper synthesized by aqueous leaves extract of *Cono- carpus erectus* L. The copper nanoparticles appear rapidly with change in color when the leaf extract mixed with $CuSO_4$ (0.1mM). The copper nanoparticles were character- ized by UV Visible Absorption Spectrometer (UV-S), X-Ray Diffraction (XRD), Fourier Transform infrared (FTIR), and Scanning Electron Microscopes (SEM). By using UV-S, the wave length was around 400 nm, while the size of copper nanoparticles was around 39 nm characterized by XRD and SEM. The technique of FTIR showed the presence of active sites for alcoholic, phenolic, amines and other compounds.

Keywords:*Conocarpus* sp., Copper nanoparticles, UV-S, XRD, FTIR, SEM, Aque- ous extract.

الخلاصة

تم تخليق دقائق النحاس النانوي حيوياً بالمستخلص المائي لاوراق نبات الدمس.*Conocarpus erectus* L. ظهر تغير سريع جداً في اللون عند مزج المستخلص النباتي (٥%) مع محلول كبريتات النحاس (0.1 ملي مولر). وقد شخصت الدقائق النانوية للنحاس بتقنية الامتصاص للاشعة المرئية وفوق البنفسجية UV وبأنعكاس الاشعة السينية XRD وبمطياف الاشعة تحت الحمراء FTIR وبالمجهر الالكتروني الماسح SEM. وكان الطول الموجي بحدود 300-400 نانوميتر بتقنية UV-S، في حين كان حجم دقائق النحاس النانوي بحدود ٣٩ نانوميتر والتي شخصت بتقنيتي XRD وSEM. وقد وضحت تقنية FTIR وجود المواقع الفعالة لكل من المركبات الكحولية والفينولية والامينات وغيرها.

الكلمات المفتاحية: *Conocarpus* sp.، دقائق النحاس النانوي، UV-S، XRD، FTIR، SEM، والمستخلص النباتي.

1-Introduction

The copper nanoparticles were synthesized by chemical reducing agents with different sizes depending on the concentration of these agents [1]. In recent years, the copper nanoparticles synthesized biologically by plants, because of their availability, easy handling, the safety of it, and for the wide range of biomolecules like alkaloids, terpenoids, phenols, flavonoids and others which are important in synthesis of nanoparticles [2].

The nanoparticles have special characteristics as the large surface area, high ability to reaction with substrate, different in shape and size of particles. For these characteristics, the nanoparticles are used in many application as cell picturing, transport of drugs inside the target tissue, cancer treatment, and some of them effect negatively on microorganisms growth [3] [4] [5].

Some researches referred that the copper is widely used in electronical, optical, and medical applications, also is used as antifungals and antibacterial [6]. Copper is important in some applications such as food package and water treatments because of its toxic effect on microorganisms and at the same time its safe for human [7].

Conocarpus sp. leaf extract used in treatment of anemia, fever, diarrhea and other diseases because it rich with antioxidants. This plant easy to reproduce and distribute, also is capable to resist the difficult environments such as salty soils, drought, high temperature and biotic factors [8] [9]. The aimed of the study is synthesized a copper nanoparticles by using a simple and safe method with a wide spread plant leaves extract is the *Conocarpus erectus* L.

2-Materials and Methods

3-Leaves collection

The leaves of *Conocarpus erectus* L. are collected, washed, dried under room temperature, then grind well and stored for using at time.

4-C. erectus L. leaves extraction

Prepared 5% (w/v) of dried leaves with boiling distilled water (d/H_2O) for 5 minutes, filtered with 3 layers of gauze, after that, filtered with a filtration paper no. F2042. The filtration stored in fridge for using at time.

5-Copper nanoparticles preparation

Mixed 30 ml of leaves extract (5%) with 170 ml of $CuSO_4.5H_2O$ (0.1 mM), when color of mixture is changes, determined the wavelength by UV-S (T80 UV/Vis spectrometer, Shi- madzu), the mixture centrifuged at 12000 rpm for 15 minutes. The supernatant discharged and then added the d/H_2O to the precipitation [10]. These steps repeated 3 times. At the last step, the precipitation dried, then performed the following techniques: XRD (DX-2700, X-Ray Diffractometer), FTIR (IR Affinity-1, Shimadzu),

SEM (inspect S50 FEI Company, Netherland) and determined the energy dispersed X-ray (EDX) by using SEM. These techniques are important to determine the nanoparticles for many elements [11] [12] [13].

6-Results and Discussion

7-Coloring change

There was a change in color from red to yellow with appearance of red precipitation (Fig.1) in few minutes after the mixing of $CuSO_4$ (0.1 mM) with leaf extract of *C. erectus* L. (5%). Depending on this result, the change in color is the first note in nanoparticles syn- thesis biologically. The color change takes place rapidly within few minutes that is very short duration, when it compared with some researches [14]. The purification of copper nanoparticles showed a powder with black color (fig.2). Depending on plant species the color is change, some may be blue as in *Eucalyptus* sp. [14]

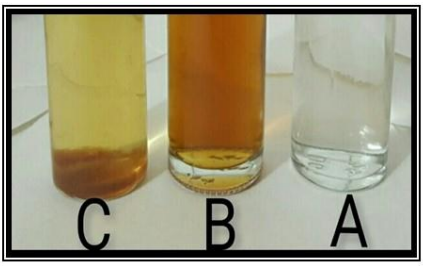

Figure1: Coloring change with appearance red precipitation in the mixture solution of $CuSO_4$ (0.1 mM) with leaf extract (5%). A: $CuSO_4$ (0.1 mM), B: Extract of *C. erectus* L. Leaf, C: Mixture of A and B (yellow color and red precipitation).

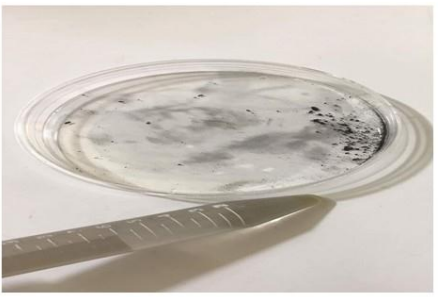

Figure 2: Powder of copper nanoparticles prepared by *C. erectus* L.

8-UV-Vis spectra Analysis

By UV-Vis spectroscopy, the wave length of copper nanoparticles was in between 390 and 400 nm, the highest absorption peak was at 395 nm by *C. erectus* L. leaf extract (Fig. 3). There was a range in wave lengths depending on the plant type and extraction method, also the broadness of absorption peak is reflect the wide size nanoparticles distribution, where the peak of copper nanoparticles absorption was around 560 nm, which synthesized by different salts of copper treated with papaya extract [15].

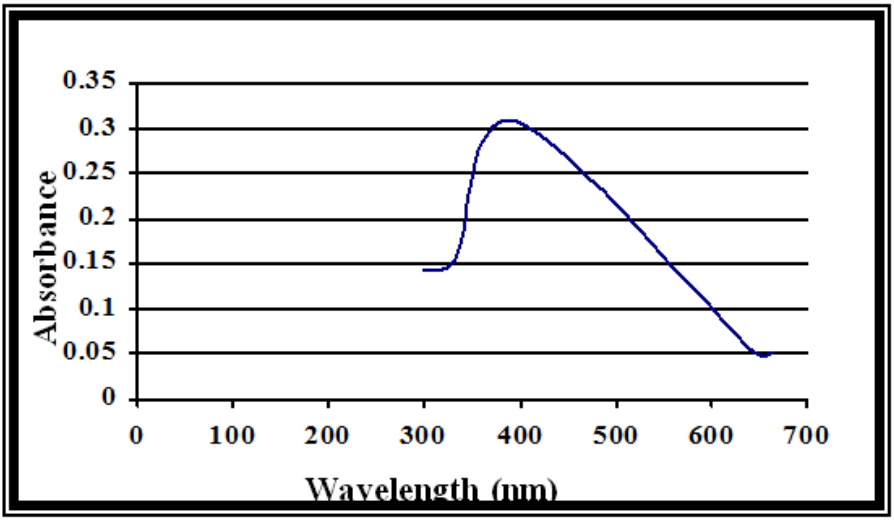

Figure 3: Wavelength of copper nanoparticles synthesized by leaf extract of *C. erectus* L.

9-XRD

As in figure 4 which is showed the patterns of diffraction of X-ray by copper nanoparticles. In this technique the angles were between 26.8 Å and 31.6 Å. Depending on the Scherrer equation: $D=k\lambda/\beta \cos\theta$, where D is the particle size, k is the Scherrer's constant (0.9 to 1.0 for spherical particle), β the width at half maxima of peaks in XRD, θ the corresponding angle for peaks and λ is the x-ray wavelength, the size of copper nanoparticles is around 39 nm at angle 26.8 Å. This size of copper nanoparticles in near to the result of Kulkarni *et al.,* (2015) which was 38.62 nm, but is very far from others [15] [10].

9-FTIR

By this technique, the chemical biomolecules in leaf extract alone (Fig. 5) and in a mixture (Fig. 6) were identified. There was a broad bands at 3441 and 1028 cm^{-1} which indicate the presence of O-H, -NH, -CH_2, C=O, and NH_2 groups (Fig. 5), while in fig.6; there was a shifting in bands. The broad bands at 3427 and 781 cm^{-1} which illustrates the stretching frequency of hydroxyl group indicates the present of it in the surface of the copper nanoparticles. The presence of active sites (figures 5 and 6), which are responsible as agents for capping and reducing copper as a copper nanoparticle. The band at 781 cm^{-1} may be indicating the presence of copper. The synthesis of copper nanoparticles according to [14]. was surrounding by a variety of chemical biomolecules such as alcohols, phenols, carboxylic and proteins.

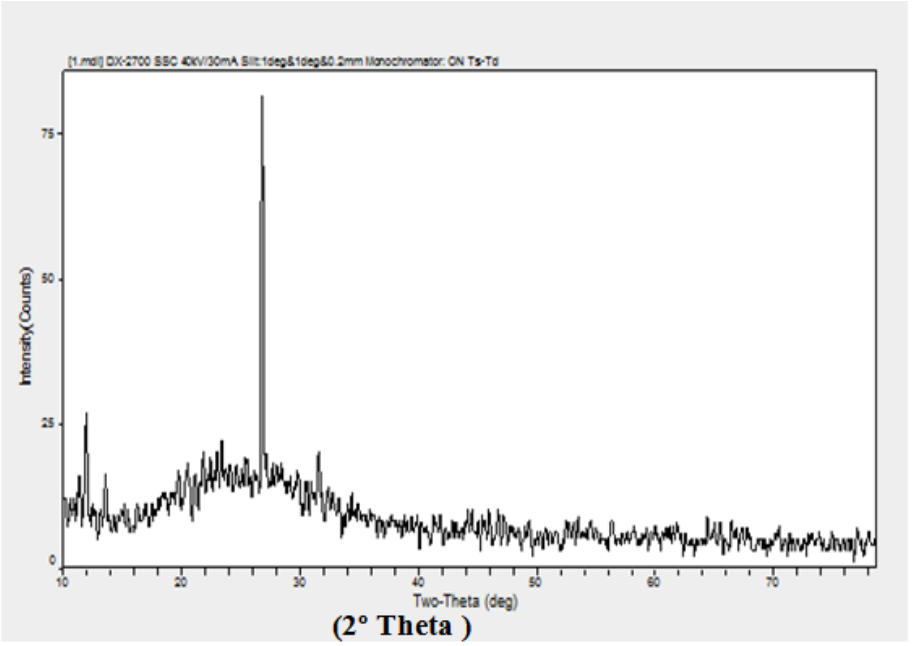

Figure4: Patterns of X-ray diffraction XRD for copper nanoparticles synthesized by leaf extract of *C. erectus* L.

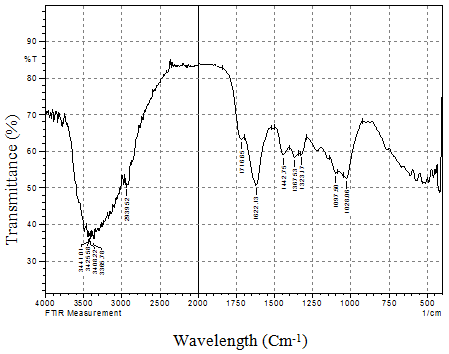

Figure 5: FTIR spectra for leaf extract of *C. erectus* L. without copper.

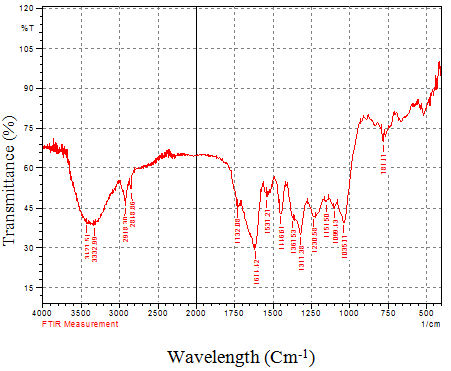

Figure 6: FTIR spectra for leaf extract of copper nanoparticles in *C. erectus* L.

10-SEM

The copper nanoparticles synthesized by the leaf extract of *C. erectus* L. was showed as image of SEM (Fig. 7). The particles showed as monodispersed distribution, and the average of copper nanoparticles size was around 39 nm which was equal to XRD result. For more determination of copper nanoparticles composition, there was a further probed by energy dispersive X-ray (EDX) analysis (Fig. 8). The pattern of copper nanoparticles prepared by leaf extract of *C. erectus* L., indicate the presence of Cu and oxygen in a small amount. These techniques were compatible with [15], they indicate the presence of copper nanoparticles as pure particles and a small amount of it is oxidized which showed by EDX analysis.

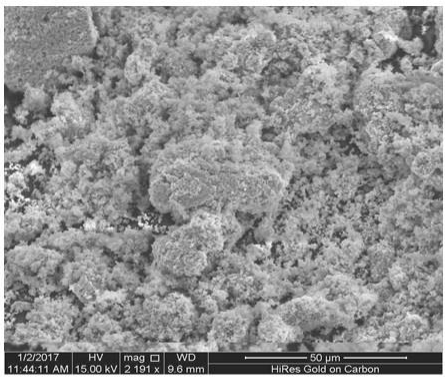

Figure 7: SEM image of copper nanoparticles synthesized by *C. erectus* L. leaf extract.

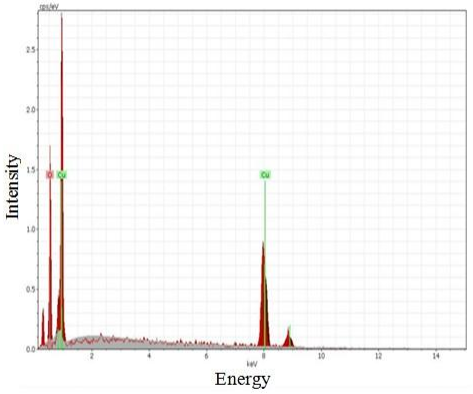

Figure 8: EXD pattern of copper nanoparticles synthesized by *C. erectus* L. leaf extract.

11-Conclusions

The synthesis of copper nanoparticles using leaf extract of *C. erectus* L. is a simple, effi- cient and represent a rapid method.

References

[1] S. Chandra, A. Kumar, and P. K. Toma, "Synthesis and characterization of copper nanopaticles by reducing agent," *J. Saudi Chemical Society*, vol. 18, pp. 149–153, 2014.

[2] K. S. Kavitha, S. Baker, D. Rakshith, H. U. Kavitha, H. C. Y. Rao, B. P. Harini, and S. Satish, "Plant as green source towards synthesis of nanoparticles," *International Research Journal of Biological Sciences*, vol. 2, pp. 66–76, 2013.

[3] L. Harhaji, A. Isakovic, N. Raicevic, Z. Markovic, B. Todorovic-Markovic, N. Nikolic, S. Vranjes-Djuric, I. Markovic, and V. Trajkovic, "mechanisms underlying the anticancer action of nanocrystalline fullerene," *Eur. J. Pharmacol*, vol. 568, pp. 89–98, 2007.

[4] X. Sun, Z. Liu, K. Welsher, J. Robinson, A. Goodwin, S. Zaric, and H. . Dai, "Nano-graphene oxide for cellular imaging and drug delivery," *Nano Res*, vol. 1,2008. pp. 203– 212.

[5] K. Yang, S. Zhang, G. Zhang, X. Sun, S. T. Lee, and Z. . Liu, "Graphene in mice: Ultrahigh in vivo tumor uptake and efficient photo thermal therapy," *Nano Lett*, vol. 10, 2010.pp. 3318–3323.

[6] U. Klueh, V. Wagner, S. Kelly, A. Johnson, and J. D. . Bryers, "Efficacy of silver-coated fabric to prevent bacterial colonization and subsequent device-based biofilm formation," *J. Biomed. Mater. Res*, vol. 53,2000. pp. 621–631,0.

[7] K. Saranyaadevi, V. Subha, R. S. E. Ravindran, and S. . Renganathan, "Synthesis and characterization of copper nanoparticle using capparis zeylanica leaf extract," *International Journal of Chem. Tech. Research CODEN (USA)*, vol. 6,2014. pp. 4533– 4541, 0.

[8] M. C. L. Cohen and R. J. . Larra, "Temporal change of conacorpus erectus in amazonia," *Wetland Ecology and Mangement*, vol. 34, 2003.pp. 1342–1356.

[9] E. S. Abdel-Hameed, S. A. Bazaid, M. M. Shohayeb, M. M. El-Sayed, and E. A. El-Wakil, "Phytochemical studies and evaluation of antioxidant, anticancer and antimicrobial properties of conocarpus erectus l. growing in taif, saudi arabia," *European J. Medicinal Plants*, vol. 2, 2012.pp. 93–112, 2012.

[10] U. Kathod and H. P. Gajera, "Synthesis of copper nanoparticles by two different methods and size comparison," *Int. J. Pharm. Bio. Sci*, vol. 5, no. 3, pp. 533–540, 2014.

[11] E. J. Mary and L. Inbathamizh, "Green synthesis and characterization of nano silver using leaf extract of morinda pubescens," *Asian Journal of Pharmaceutical and Clinical Research*, vol. 5, no. 1, pp. 159–162, 2012.

[12] K. S. Kavitha, S. Baker, D. Rakshith, H. U. Kavitha, H. Y. Rao, B. P. Harini, and S. Satish, "Plant as green source towards synthesis of nanoparticles," *International Research Journal of Biological Sciences*, vol. 2, no. 6, pp. 66–76, 2013.

[13] V. Kulkarni, S. Suryawashi, and P. kukarni, "Biosynthesis of copper nanoparticles using aqueous extract of eucalyptus sp. plant leaves," *Current Science*, vol. 109, no. 2, pp. 255–257, 2015.

[14] Y. Suresh, S. Annapurna, G. Bhikshamaiah, and A. K. Singh, "Copper nanoparticles: green synthesis and characterization," *International Journal of Scientific and Engineering Research*, vol. 5, no. 3, pp. 156–160, 2014.