



**International Journal of Biology, Pharmacy
and Allied Sciences (IJBPAS)**
'A Bridge Between Laboratory and Reader'

www.ijbpas.com

**FABRICATION AND CHARACTERISATION OF COPPER NANOPARTICLES
USING PLANT EXTRACT OF *VITIS VINIFERA***

SHARMA CK^{*1}, GUPTA A² AND SHARMA M³

1: School of Agriculture, ITM University, Gwalior, M. P. 474011

2: Parul Institute of Applied Sciences, Parul University, Vadodara, Gujarat

3: IIT Ashram, Vadodara, Gujarat

Former: Banasthali University, Rajasthan

***Corresponding Author: Dr. Chandra Kant Sharma: E Mail: ck21sharma@gmail.com**

Received 26th Feb. 2022; Revised 25th March. 2022; Accepted 22nd June 2022; Available online 1st Jan. 2023

<https://doi.org/10.31032/IJBPAS/2023/12.1.6713>

ABSTRACT

Nanoparticles are the tiny particles whose size range from 1-100nm, we have synthesis copper nanoparticles using plant extract of *Vitis vinifera* because it produce less toxic, ecofriendly, stable and site specific particles and can also be form in ambient temperature and neutral pH, require low maintenance, control shape and arrangement of nanoparticles, use low energy. Fruit part of the plant was used to obtain copper nanoparticles and centrifugation technique was used for separation of particles. The characterisation of copper nanoparticle was done to know the morphology of the particles with the help of zeta potential to know the size and potential, UV spectroscopy to know particle absorption range, lastly FTIR (Fourier transform infrared spectroscopy) to know the functional group present in the sample.

Keywords- *Vitis vinifera*, zeta potential, UV spectroscopy, FTIR, nanoparticles

INTRODUCTION

The term “nano” means dwarf, nanoparticles are tiny particles which have dimension less than 100nm and is surrounded with interfacial layer, this layer

consist of ions, organic molecules and inorganic molecules [1]. Nanoparticles was first used by artisans in Rome during fourth century for “Lycurgus cup” made up of

dichoric glass, later in year 1857, Michael Faraday studied the preparation and properties of colloidal suspension of Ruby gold in which there are unique optical and electronic characters of nanoparticles, he demonstrate that gold nanoparticles produced different kinds of coloured solution under certain lighting conditions. In 21st century nanoparticles has created a great deals for experiments, it was stated that plants are considered a ecofriendly biological method for synthesis of nanoparticles, we can use different type of plant extract for making nanoparticles because they have various bioactive present in them which can be used in many region of experiments. To obtain Nanoparticles plant extract is a conventional method because it produce less toxic as compare to other resources also it is a green and an eco-friendly technology to produce large scale nanoparticles [2-4]. Plant extract can be act as both stabilizing agent as well as reducing. Biological method is used because they are less expensive, highly stable, site specific [5, 6].

Copper nanoparticles was synthesis using the salt of copper sulphate, copper is said to be block D compound of period 4 elements, found to be ductile metal through a elevated electrical and thermal conductivity [7, 8]. Copper nanoparticles (CuNps) morphology occurs as round or sphere and it emerge in brown or black colour powder,

it happens to be flammable rock-solids so they are stored in cooled places away from source of ignition, they can be toxic in nature, there production cost is low, have high surface area to volume, antibacterial strength, catalytic movement, optical and magnetic property. CuNps has a great use in different sectors like – they act as an antimicrobial, antifungal, antibacterial agent so they are added in different medical products, plastics etc. [9]. Plant extract of *Vitis vinifera* was used for the synthesis of copper nanoparticles, it is phenolic rich fruit containing flavanols, proanthocyanidins, reveratol and anthocynins. *V. vinifera* belongs to the family *Vitaceae* also known as wine grape or common grape or European grape, widely grown fruit crop throughout the world, *Vitis vinifera* is a Turkish name which means “Asma” which commonly grown in tendrils. Species is perennial, woody and stems are 35cm long, Liana rising to 32cm in length which has flaky bark, a leaf of a grape are palmate lobbed and exchange in form generally 5- 15 cm long, wild species of grapes is 0.24cm in diameter, the species occurs in humid forests and streamsides. Fruits are supple, mushy berry; coat is adhere in the direction of pulp, oval or along, ellipsoid to globose covering greenish, yellowish, reddish and bluish – black or purple, huge and extended cluster. Grapes are found to be bear yearly

precipitation of 0.9 to 27.2 dm, temperature 8.3 to 28.5°C and ph is generally 4.5 to 8.7. It helps in detoxification and liver function improvement [10]. Grapes are used to fight digestive related diseases such as jaundice, constipation and thirst. It increases the blood nutrients like haemoglobin and help in muscles strengthening. Grapes also used in ayurvedic medicines to cure conditions related to respiratory such as cough, tuberculosis, bronchitis etc. We have used a

cost effective way for synthesis of nanoparticles, also plants are non toxic way for fabrication nanoparticles as they provide great stability as well as act as an natural capping agent. The main objectives of our study is to synthesize copper nanoparticles using green synthesis method and the characterisation of nanoparticles using FTIR, UV-VIS spectrophotometer, and zeta potential & seizer to know the morphology.



Figure 1: *Vitis vinifera* (Black grapes)

MATERIAL AND METHOD

Preparation of Plant extract- Fresh fruit of *Vitis vinifera* was used for the reduction of Cu^+ ions. 1kg of black grapes was washed properly and is oven dried at 50°C for 48hrs. respectively. Moreover dried grapes are grinded properly into a fine powder. Dissolve 10gm of *Vitis vinifera* dried powder in 200ml of milli Q water and keep it in rotar shaker for 42hr. and filter the solution. Filtrate is used and stored at 4°C for future use.

Copper sulphate solution- Dissolve 2.5gm of Copper sulphate crystals in 100ml of

milliQ water (blue colour solution) to make 1mM of copper sulphate solution.

Synthesis of Copper Nanoparticles- 1mM of copper sulphate was prepared in 100ml of milli Q water at room temperature. 5ml of crude extract was mixed with aqueous solution for bio-reduction process and colour change in solution was observed.

Particle Characterisation- Optical absorption measurements were carried out using UV-VIS spectrophotometer whereas morphology of copper nanoparticles were monitored using Fourier Transformation Infrared Spectrum (FTIR), Zeta potential and seizer [11].

RESULT AND DISCUSSION

With the addition of fruit extraction into aqueous solution of copper sulphate resulted in the change in colour from light green to dark greenish to blackish. Copper particles shows greenish colour because of excitation of surface plasmon resonance. We have recorded that formation and reduction rate of copper nanoparticles depend mainly on concentration of copper sulphate, temperature and fruit extract in the solution [12] (Figure 2).

OPTICAL PROPERTIES ANALYSIS

It was observed that copper nanoparticles relatably shows greenish colour because of

the excitation of surface plasmon resonance. When fruit extract of *Vitis vinifera* were added to copper sulphate solution the colour change was observe and the when the time increases from 0hrs to 72hrs. The intensity was also increased this reduction of copper ion into aqueous solution of copper nanoparticles was observed by UV-VIS spectroscopy. We have seen that the appearance of absorbance peak increased in intensity with time and formation of copper nanoparticles was monitored using UV-VIS spectra absorption at 226nm as shown in Figure 3 [13-15].

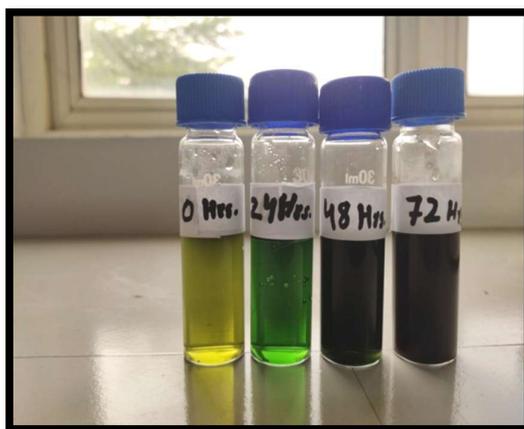


Figure 2: Change in colour at different time interval

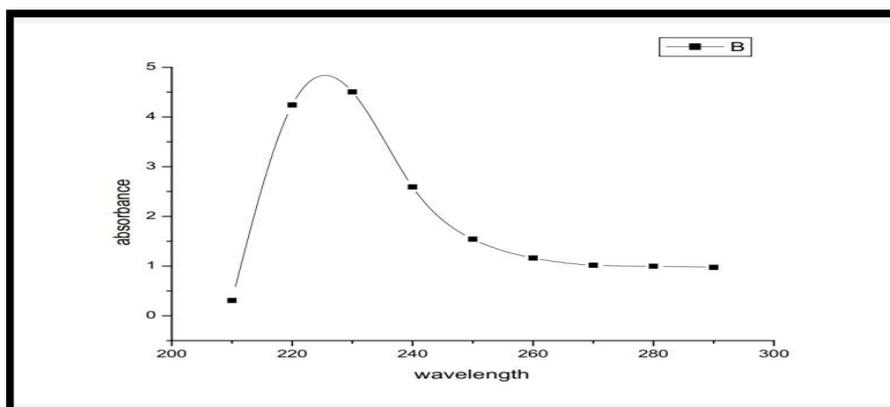


Figure 3: UV-VIS Spectra of copper nanoparticles from fruit extract of *Vitis vinifera***Particle Morphology Analysis**

To determine the morphology of copper nanoparticles the sample was measured with zeta potential and seizer. This analysis of copper nanoparticles let us know about potential present on the surface of particles and the size of the particles. Sonication was done for 30 minute at room temperature, after that small amount of sample was dissolved in NaOH and was monitor by zeta potential and seizer. This analysis shows that surface potential of copper nanoparticle is -26.7mV and the size of particle is 91nm **Figure- 4(a) & (b) [16, 17]**.

Fourier Transform Infrared Spectral Analysis

FTIR analysis was done for the characterization of the plant extract and for the identification of functional groups which are present in reducing agents. The instrument covered range from 2.5 μ m to 15 μ m or we can say

wavelength ranges from 4000 cm^{-1} to 660 cm^{-1} . FTIR spectrum of copper nanoparticle which is synthesis by using *Vitis vinifera* fruit extract which shows strong bonds as well as very broad bonds at 3275.66 cm^{-1} , 2116.49 cm^{-1} , 1636.75 cm^{-1} and functional group is O-H Bond stretching of H- Bounded alcohols and phenols at 3275.66 cm^{-1} , while at 2116.49 cm^{-1} attribute to O-H bond stretching of carboxylic acids, the band at 1636.75 cm^{-1} correspond to NO₂ bond stretching of nitro compound and presence amide I and II, this arises due to the carbonyl stretch and N-H stretch vibration in the amide linkage of the proteins [12].

(Figure 5), shows FTIR spectrum of crude plant extract of *Vitis vinifera* which shows strong bond at 1630.39 cm^{-1} , 2922.97 cm^{-1} , 3285.50 cm^{-1} and functional group is NO and OH [18, 19].

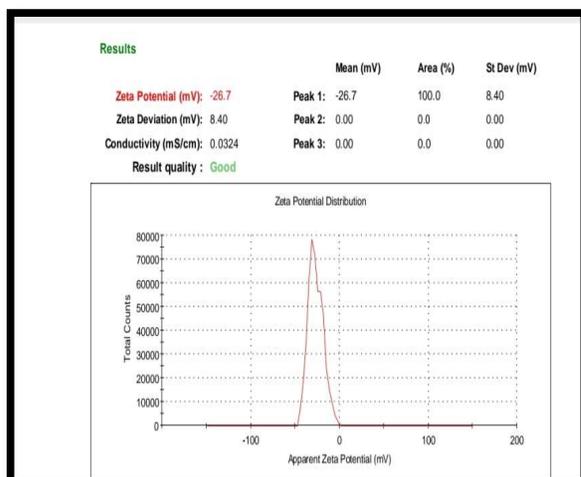


Figure 4(a) - zeta potential -26.7mV

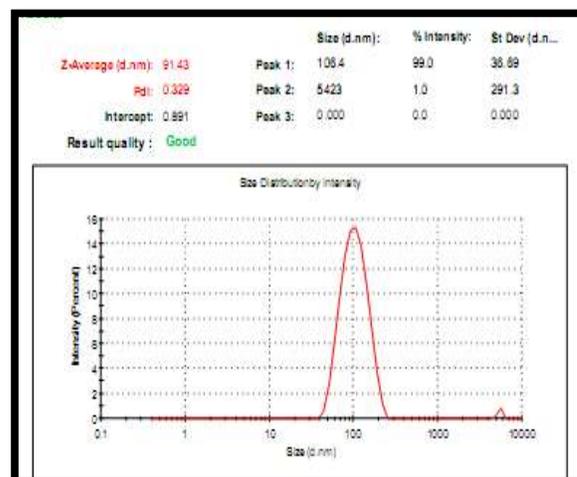


Figure 4(b) - zeta size 91nm

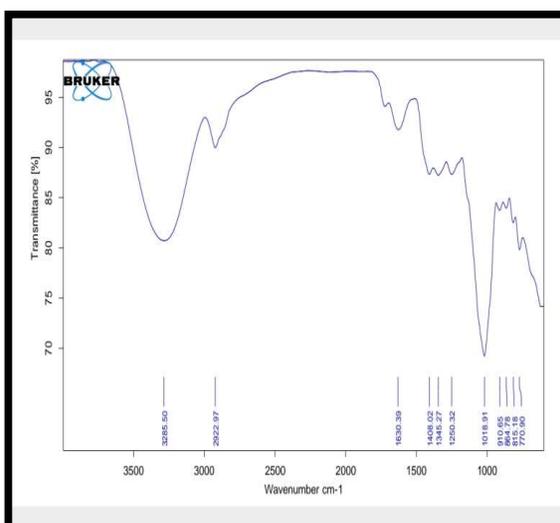


Figure 5(a)- FTIR analysis of crude plant extract

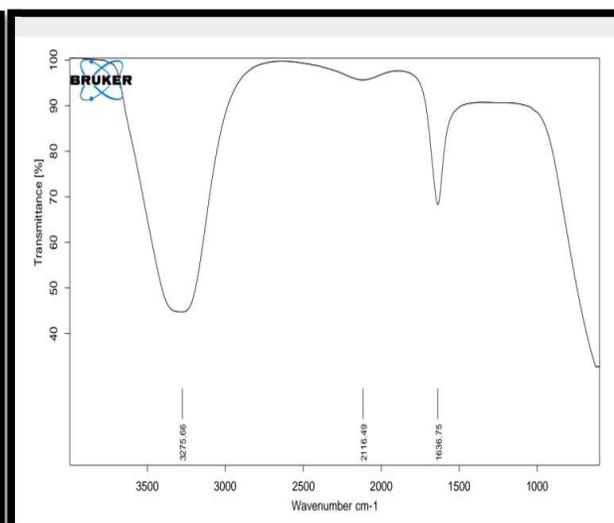


Figure 5(b)- FTIR analysis of Copper nanoparticles

CONCLUSION

By using green chemistry, the copper nanoparticles was synthesis using fruit extract of *Vitis vinifera* which is non toxic and it exhibit great stability, due to which can use copper nanoparticles for sensor and biomedical application. Thus we conclude that fruit extract of *Vitis vinifera* have great benefit because they are cost effective, non toxic and well stable in nature also eco-

friendly method was used for synthesis of copper nanoparticle which shows great results.

Conflict of interest

None

REFERENCE

- [1] Ahmed, S., Chaudhry, S. A., Ikram, S. A review on biogenic synthesis of ZnO nanoparticles using plant extracts and microbes: A prospect

- towards green chemistry. Journal of Photochemistry and Photobiology B: Biology 166, 2017, 272-284.
- [2] Sinsinwar, S., Sarkar, M. K., Suriya, K. R., Nithyanand, P., Vadivel, V. Use of agricultural waste (coconut shell) for the synthesis of silver nanoparticles and evaluation of their antibacterial activity against selected human pathogens. Microbial Pathogenesis. 124, 2018, 30-37.
- [3] Ramkumar, V. S., Pugazhendhi, A., Gopalakrishnan, K., Sivagurunathan, P., Saratale, G. D., Dung, T. N. B., Kannapiran, E. Biofabrication and characterization of silver nanoparticles using aqueous extract of seaweed *Enteromorpha compressa* and its biomedical properties. Biotechnology Reports 14, 2017, 1-7.
- [4] Pantidos, N., Horsfall, L. E. Biological synthesis of metallic nanoparticles by bacteria, fungi and plants. – Journal of Nanomedicine & Nanotechnology 5(5), 2014, 1
- [5] Acay H., Baran M.F, Eren,A. Investigation antimicrobial activity of silver nanoparticles produced through green synthesis using leaf extract of common grape (*Vitis vinifera*). Ecology and Environmental Research, 17 (2), 2019, 4539-4546.
- [6] Garima S, Riju B, Kunal K, Ashish R. S, Rajendra P. S. Biosynthesis of silver nanoparticles using *Ocimum sanctum* (Tulsi) leaf extract and screening its antimicrobial activity. J. Nanopart Res. 13, 2011, 2981-2988.
- [7] Wang Y., Chen M., Zhou F., Ma E. High tensile ductility in a nanostructured metal. 419, Nature Publishing Group, Maryland, 2002, 912-915,
- [8] Xinhuan, K., Zhibin, M., Xiaoyong Z., Peixiang C., Jinyuan, M. A sensitive nonenzymatic glucose sensor in alkaline media with a copper nanocluster/ multiwall carbon nanotube-modified glassy carbon electrode. Anal Biochem. 1,363(1), 2011, 143-50.
- [9] Pantelis K, Andreas D, Vassillis Z, Dimitrios P, Sofia A. T, Nikolaos M. Green synthesis and characterization of silver nanoparticles produced using Arbutus Unedo leaf extract. Matter. Lett. 76, 2012, 18-20.
- [10] Brown A.G, Meadows I, Turner S.D, Mattingly D.J., vineyards R. Stratigraphic and palynological data from Wollaston in the Nene

- valley, England. *Antiquity* 75 (290), 2001, 745-757.
- [11] Kavitha K.S., Bker S., Rakshith D., Kvitha H.U., Yashwantha Rao., Harini, B.P., Satish, S. Plants as green source towards synthesis of nanoparticles. *Int res J boil sci*, 2 (6), 2013, 66-76.
- [12] Boken J., Sharma M., Sharma CK, Kumar D. Synthesis of Silver Nanoparticles by Using *Ocimum Sanctum* Leaf Extract and Detection of Antibacterial Activity. *Global Sustainability Transitions: Impacts and Innovations*. 2014, 278-284.
- [13] Biswash S., Sharma G. A review on green synthesis of silver nanoparticles using fruit extract. *Word journal of pharmacy and pharmaceutical science*. 24, 2018, 2278-4357.
- [14] Caroling G., Priyadharshini G.N, Vinodhini E., Ranjitham A.M, Shanthi P. Biosynthesis of copper nanoparticles using aqueous guava extract- characterisation and study of antibacterial effects. 5, (2), 2015, 25-43.
- [15] Veerasamy. R., Vilchis-Nestor, A.R., Sanchez Mendieta, V., Camacho-Lopez, M.A., Gomez Espinosa, R., Xin, T., Gunasagaran, S., Xiang, T.F.W., Foow Xianga, T., Yanga, E.F.C., Jeyakumar, N., Valodkar, M., Bhadoria, A., Pohnerkar, J., Mohan, M., Thakore, S. Morphology and antibacterial activity of carbohydrate-stabilized Silver nanoparticles. *Carbohydrate Research*. 345, 2010, 1767 -1773.
- [16] Sharma M, Singh RK., Sharma CK. Hepatoprotective activity of *Vitis vinifera* L. Fruit against CCL4 induced toxicity. *Eco. Env. & Cons*. 27, (2): 2021, 745-751.
- [17] Nirmala J.C, Akila, S., Narendhira kannana R.T, Chatterjee S. *Vitis vinifera* peel polyphenols stabilized Gold nanoparticles induce cytotoxicity and apoptotic cell death in A431 Skin Cancer cell lines. *Advanced powder technology* 28 (4), 2017, 1170-1184.
- [18] Mahavinod Angrasan J.K.V, Subbaiya R. Biosynthesis of Copper Nanoparticles by *Vitis vinifera* Leaf aqueous extract and its Antibacterial Activity. *International journal of current microbiology and applied science*. 2319-7706, (3), 2014, 768-774.
- [19] Demete Demrici T., Haryrunnisa N., Azize A., Nudhan H. K. Biosynthesis and Characterization of Copper Oxide Nanoparticles

using cimin grape (*Vitis vinifera*
c.v) Extract .International journal
of secondary metabolite. 4, 2017,
77-84.