Biosynthesis of copper oxide nanoparticles using herbal formulation and its characterisation

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**Abstract**

To study the biosynthesis of copper oxide nanoparticles using herbal formulation and its characterisation. To study the copper oxide nanoparticles biosynthesis using Moringha oleifera (I) Synthesis of nanoparticles using copper sulphate (II) Characterisation of nanoparticles using UV-visual spectroscopy. The size of the synthesised nanoparticles are found to be 2-100nm. The graph reached its peak at the wavelength of 300nm using UV-vis spectroscopy. The shape is spherical. These TEM and UV spectroscopic analysis confirmed the synthesis of copper oxide nanoparticles. Overall results, confirmed the size and shape of CuO nanoparticles using this process and suggested their applications in biomedicine. The biosynthesized copper oxide nanoparticles are spherical in shape with an average size of 2-100nm. The present research about the biosynthesis of copper oxide nanoparticles using the plant extract Moringa Oleifera has excellent biocompatibility. The particles which are smaller in size shows more immunity. Hence the nanoparticles are expected to be used in future for the effective drug systems and immunity against diseases.

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**INTRODUCTION**

Copper is the basic and biocompatible element possess most of the therapeutic and effective anti microbial activity. Copper oxide nanoparticles are spherical and well dispersed, which has gained interest among the scientific world. They are crystalline in nature and synthesized by both biological and chemical methods. These are eco-friendly, cost-efficient and has diverse utilisation all over the medical field (Tiwari et al., 2016; Karthiga et al., 2019; Rajeshkumar et al., 2018a). The major disadvantage of usage of CuO nanoparticles is its toxic effects (Karthiga et al., 2018; Rajeshkumar, 2018; Rajeshkumar et al., 2018b). Besides, it is significant for its involvement in biomedicine for the treatment of Tumours, arthritis and pneumonia. It also helps in the cosmetic industry and pharmacological aspects (Rajeshkumar et al., 2018c; Perreault et al., 2012).

The herbal formulation plays a great role in naturally synthesising nanoparticles. The nanoparticles from plant extract shows better anti microbial and anti cancer activity (Grigore et al., 2016; Sivaraj et al., 2014). Various researchers discovered biosynthesis of CuO nanoparticles from plant extracts like Aegle Marmelos, Aloevera, Aloe barbadensis etc. which provides a higher yield. They show good immunogenicity and act as a protective agent.

The nanoparticles are characterised by various methods. Methods are based on optical properties and morphometric analysis. The size of CuO nanoparticles mediated in each plant extract differs.
from one another calculated by X-ray diffraction. For example, Sangeetha et al. stated that it varies from 15-30 nm from Aloe barbadensis, whereas Rajeshwari et al. stated it ranges from 26-30 nm extracted from Acalypha Indica. The shape is spherical. The characterisation are done using SEM, TEM, PL, XRD and UV-vis techniques and also observed that the CuO nanoparticles has got proteins bound to the surface which prevents agglomeration and stabilise in the medium (Gunalan et al., 2012).

MATERIALS AND METHODS

Synthesis of nanoparticles

20 millimolar of copper sulphate dissolved in 80 ml of double-distilled water. The plant extract is added with the metal solution and was made into a 100 ml solution. The colour change was observed visually, and photographs were recorded. The solution is kept in an orbital shaker for nanoparticle synthesis.

Characterisation of nanoparticles

The synthesised nanoparticles solution is preliminarily characterised by using UV-vis-spectroscopy. 3 ml of the solution is taken in curette and scanned in double beam UV-vis- spectrophotometer from 300 nm to 700 nm wavelengths. The results were recorded for the graphical analysis. The prepared nanoparticles powder is morphologically analysed using a transmission electron microscope.

RESULTS AND DISCUSSION

Visual observation

The plant extract is observed to be dark green, and the copper oxide nanoparticles are seen to be in light yellowish in colour indicate the nanoparticles synthesis (figure 1).

UV visual spectroscopy

UV-spectra of CuO particles synthesised from with and without ALE at room temperature. It is generally recognised that UV-vis spectra could be used to examine the size and shape-controlled nanoparticles in aqueous solution with 200-800 nm wavelength range. The particle shape is spherical and size in a range of 2-100 nm. The graph reached its peak at the wavelength of 300 nm. The optical absorption spectra of noble metal nanoparticles are known to exhibit unique optical properties due to the property of surface plasmon resonance (SPR), which proceeds to longer wavelength with increasing particle size. Figure 2 shows,

TEM

TEM studies show spherical shape, dispersion and versatile CuO nanoparticles prepared with Moringa oleifera extract. They nanoparticles appear to be arranged into open, quasi-linear and cluster like su-
perstructures. They show FCC crystalline structure of CuO nanoparticles. The size ranges from 2-100 nm. Figure 3 shows,

CONCLUSIONS

The biosynthesized copper oxide nanoparticles are spherical in shape with an average size of 2-100nm. The present research about the biosynthesis of copper oxide nanoparticles using the plant extract *Moringa Oleifera* has excellent biocompatibility. The particles which are smaller in size shows more immunity. Hence the nanoparticles are expected to be used in future for the effective drug systems and immunity against diseases.

REFERENCES

Grigore, M., Biscu, E., Holban, A., Gestal, M., Grumezescu, A. 2016. Methods of Synthesis, Properties and Biomedical Applications of CuO Nanoparticles. Pharmaceuticals, 9(4).

Gunalan, S., Sivaraj, R., Venckatesh, R. 2012. Aloe barbadensis Miller mediated green synthesis of mono-disperse copper oxide nanoparticles: Optical properties. Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy, 97:1140–1144.

Karthiga, P., Ponnanikajamiedeen, M., Rajendran, R. S., Annadurai, G., Rajeshkumar, S. 2019. Characterization and toxicology evaluation of zirconium oxide nanoparticles on the embryonic development of zebrafish, Danio rerio. Drug and Chemical Toxicology, 42(1):104–111.

Karthiga, P., Rajeshkumar, S., Annadurai, G. 2018. Mechanism of Larvicidal Activity of Antimicrobial Silver Nanoparticles Synthesized Using Garcinia mangostana Bark Extract. Journal of Cluster Science, 29(6):1233–1241.

Perreault, F., Melegari, S. P., Costa, C. H. D., Rossetto, A. L. D. O. F., Popovic, R., Matias, W. G. 2012. Genotoxic effects of copper oxide nanoparticles in Neuro 2A cell cultures. Science of The Total Environment, 441:117–124.

Rajeshkumar, S. 2018. Synthesis of Zinc oxide nanoparticles using algal formulation (Padina tetrastromatica and Turbinaria conoides) and their antibacterial activity against fish pathogens. Research Journal of Biotechnology, 13(9):15–19.

Rajeshkumar, S., Agarwal, H., Kumar, S. V., Lakshmi, T. 2018b. One-Pot Synthesis of Zinc Oxide Nanoparticles Using Orange Peel Extract and Its Potential Anti. Bacterial Activity International Journal of Pharmaceutical Research, 10:574–578.

Rajeshkumar, S., Kumar, S. V., Ramaiah, A., Agarwal, H., Lakshmi, T., Roopan, S. M. 2018c. Biosynthesis of zinc oxide nanoparticles using Mangifera indica leaves and evaluation of their antioxidant and cytotoxic properties in lung cancer (A549) cells. Enzyme and Microbial Technology, 117:91–95.

Sivaraj, R., Rahman, P. K. S. M., Rajiv, P., Narendhran, S., Venckatesh, R. 2014. Biosynthesis and characterization of Acalypha indica mediated copper oxide nanoparticles and evaluation of its antimicrobial and anticancer activity. Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy, 129:255–258.

Tiwari, M., Jain, P., Hariharapura, R. C., Narayanan, K., Bhat, K., Udupa, U., Rao, N., J. V. 2016. Biosynthesis of copper nanoparticles using copper-resistant Bacillus cereus, a soil isolate. Process Biochemistry, 51(10):1348–1356.