ORIGINAL ARTICLE

INTERNATIONAL JOURNAL OF RESEARCH IN PHARMACEUTICAL SCIENCES

Published by JK Welfare & Pharmascope Foundation

Journal Home Page: www.ijrps.com

Cytotoxic and Antioxidant Activity of Zinc Oxide Nanoparticles Synthesised Using *Maranta Arundinacea* Root Extract

Aparna J, Rajeshkumar S*

Department of Pharmacology, Saveetha Dental College, Saveetha Institute of Medical & Technical Science, P H Road, Chennai - 77, Tamil Nadu, India

Article History:

Received on: 17 Feb 2020
Revised on: 30 Apr 2020
Accepted on: 22 Jun 2020

Keywords:

Maranta arundinacea,
Zinc oxide nanoparticle,
Biosynthesis,
Cytotoxic activity,
Antioxidant activity

ABSTRACT

The main aim of this study was to employ *Maranta arundinacea root* extract in the synthesis of Zinc oxide nanoparticles and check the antioxidant activity and cytotoxic effect. The use of nanotechnology in medicine especially for drug delivery is shown to have numerous benefits. Nanoparticles are being used to lessen toxicity and facet results that capsules may additionally impose on the patient. The zinc oxide nanoparticles synthesized using different plant extract used for many biomedical applications such as anticancer activity, antibacterial activity, antioxidant activity, antifungal activity and many more applications used in medicine (Diagnosis and drug) Plant mediated organic synthesis of nanoparticles has been gaining importance because of its simplicity and eco friendliness. *Maranta arundinacea* mediated Zinc oxide nanoparticles were initially synthesised and characterised by UV-Visible spectrophotometer and TEM. Further the *Maranta arundinacea* mediated ZnoNPs were subjected to DPPH assay to determine the antioxidant activity. *Maranta arundinacea* mediated ZnoNPs were biosynthesised with ease and showed good antioxidant and cytotoxic activity. This study concludes that *Maranta arundinacea* mediated ZnoNPs nanoparticles have the potential to be used as an effective antioxidant. Hence, it may be employed in large scale production and may be used in many medicinal applications where there is a need for antioxidant.

*Corresponding Author

Name: Rajeshkumar S
Phone:
Email: ssrajeshkumar@hotmail.com

ISSN: 0975-7538

DOI: https://doi.org/10.26452/ijrps.v11i3.2655

Production and Hosted by

IJRPS | www.ijrps.com

INTRODUCTION

During previous decades , synthesis and uses of nanoparticles performs an important function because of their specialised and unique properties (Das *et al.*, 2011). The nanoparticles have associate degree higher range of applications like in chemical change, electronics, semiconductors, sensors and cosmetics and also in medical applications (Kołodziejczak-Radzimska and Jesionowski, 2014). To manufacture nanoparticles possessing superior features (Rajeshkumar and Sivapriya, 2020), it requires a change of surface of those materials at the millimicron level l (Finkel and Holbrook, 2000). The DPPH scavenging assay is said to be the most widespread techniques for learning the inhibitor actions of materials. During this methodology, inhibitor potential is considered and measured at close temperature to limit and stop the chance of thermal degradation of the molecules tested (Valko *et al.*, 2006). Antioxidants Possess a drastic variation of organic chemistry actions, that embrace inhibitory action of the assembly of reacting gas species , scavenging of free radicals, and ever-changing chemical reaction state (Buttke and Sandstrom, 1994). Reactive oxygen species are involved in numerous human chronic disorders like ageing and neurodegenerative disorders, like Alzheimer's disease and Parkinson's disease (Rajeshkumar and Bharath, 2017). There is a high range of medicine presently being employed for therapy, however, most of the diseases possess intensive effects, creating the command for fewer injurious therapy agents (Menon *et al.*, 2018). Zinc oxide nanoparticles (ZnONPs) measure is employed mostly incase of family and commercial purposes, particularly in beauty aids, the latex and fabrics producing industries and physical science and electro technology industries . More studies are conducted on their anti-cancer activities, though their properties and functions in medication is restricted (Santhoshkumar *et al.*, 2017). Synthetic ways employed for the manufacture of ZnONPs have injurious environmental and cytotoxic effects, exhibiting many metabolic processes and vessel diseases, that develops the employment of plant extracts as an artificial alternative (Keerthiga *et al.*, 2019). The mechanisms of toxicity from ZnO-NPs don't seem to be however fully appreciated, however the origination of chemical group radicals (OH●), anion, and per hydroxyl radicals from the surface of ZnO square measure believed to be major components (Srinisha *et al.*, 2019). Nanoparticles move along with cells, cellular protection mechanisms square measure activated to reduce damage. After all, if the extremely active free radicals production surpass the anti oxidative defensive capability of the cell, it leads to aerobic damage of biomolecules which might result in cell death (Keziah *et al.*, 2019). Advantage of (green synthesis) over chemical and physical methodology is valuable, eco-friendly, simply scaled up for a large scale synthesis and additionally there's no ought to use high energy, pressure, temperature and noxious chemicals (Abitha *et al.*, 2019). The employment of environmentally benign materials like microorganism, fungi, plant extracts and enzymes for the manufacture of Zinc oxide nanoparticles provides numerous advantages of eco-friendly and compatibility for pharmaceutical and different medicine uses. The disadvantages of setting unfriendly synthesis insisted the employment of superior and well refined ways that helped to explore benign and inexperienced routes for synthesising nanoparticles (Madhusudan and Middleton, 2005). Arrowroot (*Maranta arundinacea*. L) may be a regionally cultured tuber crop in the country. The arrowroot starch has an outshine property and is often used as a thickening in several foods like puddings and sauces, cookies and different food. Arrowroot is appropriate for neutral diets, particularly incase of those who measure feeling nauseating. It is believed that arrowroots facilitate assuage upset stomachs, that is the reason why several food stores in the country show arrowroot cookies. The arrowroot tuber possess many starch and different compounds. The starch from arrowroot flour encompasses a nutrition composition of eleven.9% water, 0.58% ash, 25.9% amylose, 0.14% super molecule, 0.84% fat, 8.7% insoluble dietary fibre, and 5.0% soluble dietary fibre (Vairavel *et al.*, 2020). Past studies reveal that the arrowroot extract may be a rich and enhanced supply of probiotics. The objectives of this analysis was done to determine the cytotoxic and antioxidant activity of zinc oxide nanoparticles by using arrow root (*Maranta arundinacea*) extracts (Raut and Thorat, 2015).

MATERIALS AND METHODS

Zinc oxide nanoparticles preparation using *Maranta arundinacea* root extract

0.57g of Zinc sulphate in 70 mL of distilled water in 30 mL of plant extract was taken in a conical flask (Figure 1). The extract was filtered and kept in the magnetic stirrer for the formation of nanoparticles. The colour change was observed visually and photographs were recorded. The solution of silver nanoparticles was centrifuged at 8000 rpm for 10 minutes using lark refrigerated centrifuge and the pellets were collected and washed with distilled water twice. The final purified pellet was collected and dried at 60°C for 2 hours and was collected and stored in airtight eppendorf tube.

Antioxidant Activity

50% methanol, DPPH solution and *Maranta arundinacea* mediated zinc nanoparticle was added in 5 test tubes ranging from 10-50 micro-litres and kept in a dark place for 10 minutes (Figure 2) and the reading was recorded using photometry.

Cytotoxic Activity

Filtered artificial seawater was Prepared, the shrimp eggs were added into the dark side of the chamber while there was a light source above the other side to attract the hatched shrimp. Two days were allowed for shrimp to mature, and then the shrimp larva was ready. 10 brine shrimp was added accordingly to the zinc nanoparticle in 5,10,15,20 micro litre and it was left for 24 hours after which the cytotoxicity activity of the nanoparticle on the brine shrimp was observed(Figure 3).

Figure 1: Preparation of Zinc Oxide Nanoparticle using *Maranta arundinacea* Root Extract

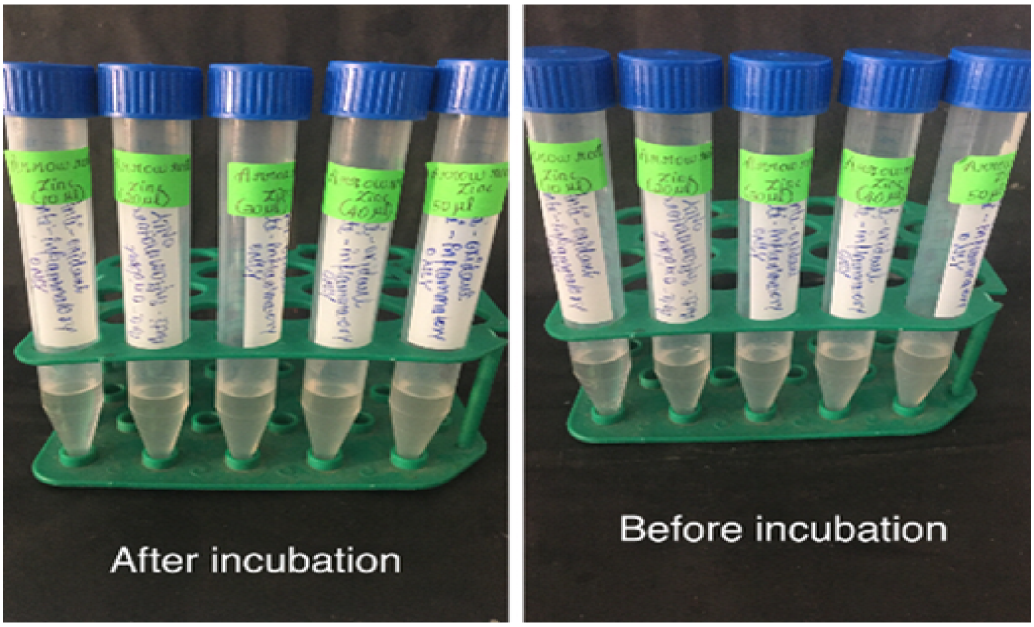

Figure 2: Changes Occurring During Incubation

RESULTS AND DISCUSSION

From the results, it is evident that as the concentration of the nanoparticle increases the cytotoxic activity also increases. The level of cytotoxicity is determined by the lethality of the brine shrimp nauplii. i.e.the control showed no cytotoxic activity, when the concentration of the nanoparticle was 5 micro-litre the cytotoxic activity was 0%, 10 micro-litre of nanoparticle showed 10% of cytotoxic activity, 15 micro-litre of nanoparticle showed 30% of cytotoxic activity, 20 micro-litre of nanoparticle showed 30% of cytotoxic activity and 25 micro-litre of nanoparticle showed the maximum of 40% of cytotoxic activity (Figure 4). Cells possessing the cytotoxic compound can bring about numerous cell fates. The cells may undergo necrosis, wherein they lose membrane integrity and cell death takes place due to mobile lysis. The cells can stop actively growing and dividing (a lower in cellular viability), or the cells can spark off a genetic program of controlled cell death (apoptosis) (Hanley *et al.*, 2008).

Figure 3: Isolation of Brine Shrimp Eggs and Incorporation of Nanoparticle

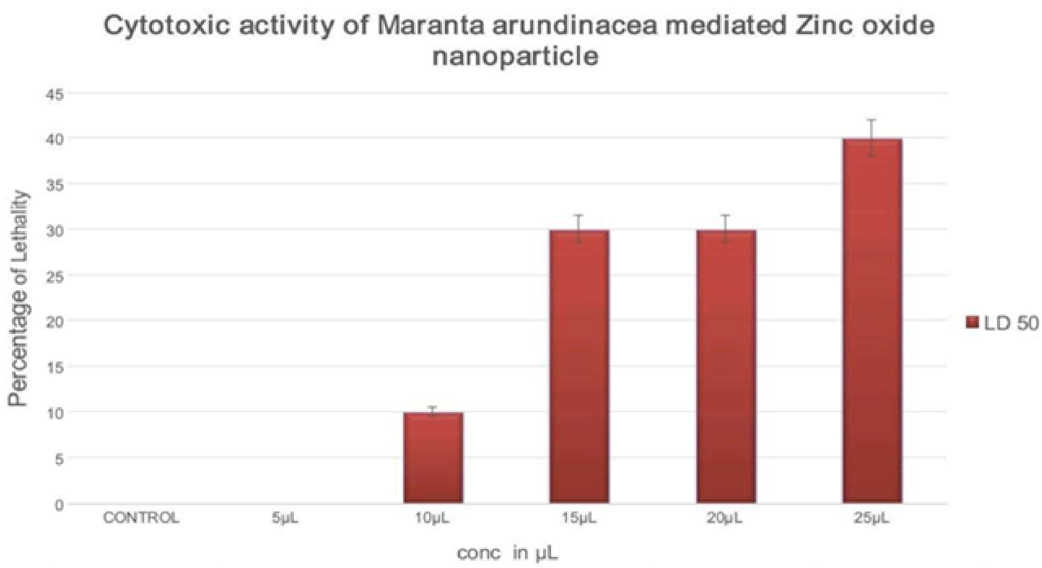

Figure 4: Cytotoxic Activity of *Maranta arundinacea* Mediated Zinc Oxide Nanoparticle

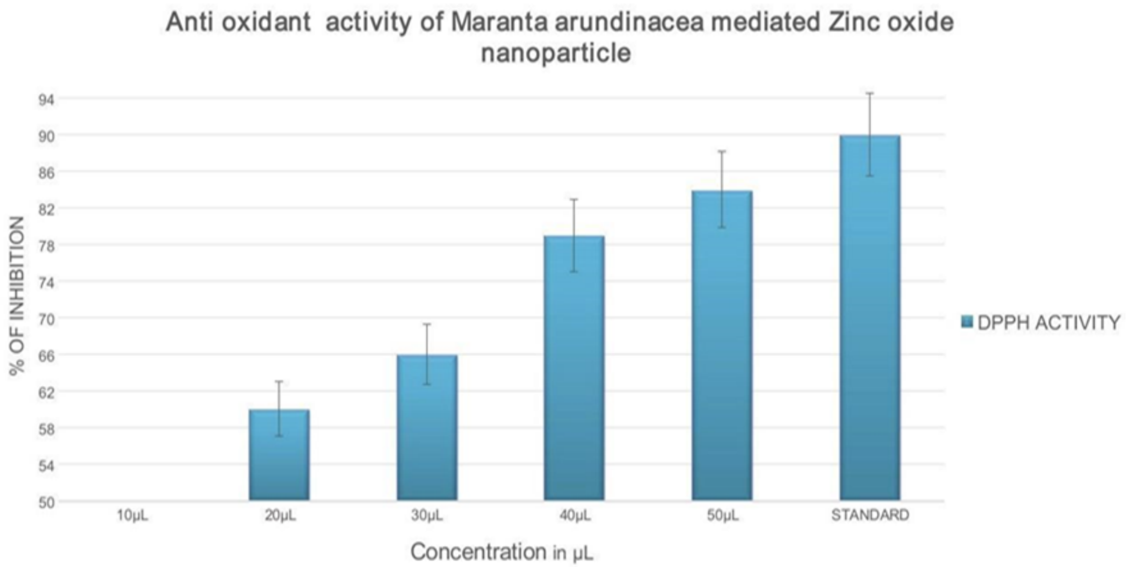

Figure 5: Anti Oxidant Activity of *Maranta arundinacea* Mediated Zinc Oxide Nanoparticle

Cytotoxicity assays are broadly utilised by the pharmaceuticals to display screens for cytotoxic activity in many cases. Researchers can either search for cytotoxic compounds, that targets rapidly dividing cancer cells, for instance; or they can screen preliminary drugs incase of undesirable cytotoxic effects earlier than making an investment in their development as a pharmaceutical (Fackler and Grosse, 2008). In this study,Assessing the lethality of the brine shrimp nauplii is one of the most commonplace approaches to determine cellular viability and cytotoxic effects. Compounds that have cytotoxic effects mostly compromise cell membrane integrity (Nagarajan and Kuppusamy, 2013). Studying about the cytotoxic activity of these nanoparticles is important because it's miles used in chemotherapy as a remedy of cancer, regularly relies on the potential of cytotoxic agents to degrade or kill and to damage cells which can be reproducing; this therefore targets rapidly dividing most cancers cells (Zare *et al.*, 2017).

From the Figure 5 results, it is evident that as the concentration of the nanoparticle increases the antioxidant activity also increases i.e.when the concentration of the nanoparticle is 5 micro litre the antioxidant activity was 50%, 20 micro litre of nanoparticle showed 60% of antioxidant activity, 30 micro litre of nanoparticle showed 66% of antioxidant activity, 40 micro litre of nanoparticle showed 79% of antioxidant activity, 50 micro litre of nanoparticle showed 84% antioxidant activity and the standard which is the ascorbic acid showed maximum of 90% antioxidant activity. During oxidation in the human body, free radicals are released. The most active free radicals leads to the breakage of bonds in DNA and causes damage to the genetic apparatus, which can therefore result in the formation of cancerous cells and other neurological diseases (Padalia *et al.*, 2018). The DPPH(Diphenyl picryl hydrazyl) scavenging scavenges these free radicals thus preventing them from damaging the DNA and protein structures (Suresh *et al.*, 2018; Jones *et al.*, 2008; Hameed *et al.*, 2016).

CONCLUSIONS

In this study, we synthesised ZnONPs using *Maranta arundinacea* root aqueous extract. The synthesised Zinc oxide nanoparticles showed significant antioxidant activity against DPPH free radicals and it was also found to be significantly toxic to brine shrimp nauplii. Thus, from this study it is evident that the synthesised Zinc oxide nanoparticles are proved to be the promising compounds for further studies biomedical applications.

ACKNOWLEDGEMENT

We would like to acknowledge Saveetha Dental College and Hospital for providing facilities to complete this research.

Funding Support

Self-funding

Conf lict of Interest

The authors declare that there is no Conflict of Interest

REFERENCES

Abitha, S. T., Rajeshkumar, S., Lakshmi, T., Roy, A. 2019. Cytotoxic effects of silver nanoparticles synthesized using amla fruit seed. *Drug Invention Today*, pages 11–11.

Buttke, T. M., Sandstrom, P. A. 1994. Oxidative stress as a mediator of apoptosis. *Immunology Today*, 15(1):7–10.

Das, A., Wang, D.-Y., Leuteritz, A., Subramaniam, K., Greenwell, H. C., Wagenknecht, U., Heinrich, G. 2011. Preparation of zinc oxide free, transparent rubber nanocomposites using a layered double hydroxide filler. *Journal of Materials Chemistry*, 21(20):7194–7194.

Fackler, O. T., Grosse, R. 2008. Cell motility through plasma membrane blebbing. *Journal of Cell Biology*, 181(6):879–884.

Finkel, T., Holbrook, N. J. 2000. Oxidants, oxidative stress and the biology of ageing. *Nature*, 408(6809):239–247.

Hameed, A. S. H., Karthikeyan, C., Ahamed, A. P., Thajuddin, N., Alharbi, N. S., Alharbi, S. A., Ravi, G. 2016. In vitro antibacterial activity of ZnO and Nd doped ZnO nanoparticles against ESBL producing Escherichia coli and Klebsiella pneumoniae. *Scientific Reports*, 6(1):24312–24312.

Hanley, C., Layne, J., Punnoose, A., Reddy, K. M., Coombs, I., Coombs, A., Feris, K., Wingett, D. 2008. Preferential killing of cancer cells and activated human T cells using ZnO nanoparticles. *Nanotechnology*, 19(29):295103–295103.

Jones, N., Ray, B., Ranjit, K. T., Manna, A. C. 2008. Antibacterial activity of ZnO nanoparticle suspensions on a broad spectrum of microorganisms. *FEMS Microbiology Letters*, 279(1):71–76.

Keerthiga, N., Anitha, R., Rajeshkumar, R. S., Lakshmi, T. 2019. Antioxidant Activity of Cumin Oil Mediated Silver Nanoparticles. *Pharmacognosy Journal*, 11(4):787–789.

Keziah, V. S., Rajeshkumar, S., Lakshmi, T., Roy, A. 2019. Free radical scavenging activity of plant-mediated zinc oxide nanoparticles. *Drug Invention Today*, pages 11–11.

Kołodziejczak-Radzimska, A., Jesionowski, T. 2014. Zinc Oxide—From Synthesis to Application: A Review. *Materials*, 7(4):2833–2881.

Madhusudan, S., Middleton, M. R. 2005. The emerging role of DNA repair proteins as predictive, prognostic and therapeutic targets in cancer. *Cancer Treatment Reviews*, 31(8):603–617.

Menon, S., KS, S. D., R, S., S, R., S, V. K. 2018. Selenium nanoparticles: A potent chemotherapeutic agent and an elucidation of its mechanism. *Colloids and Surfaces B: Biointerfaces*, 170:280–292.

Nagarajan, S., Kuppusamy, K. A. 2013. Extracellular synthesis of zinc oxide nanoparticle using seaweeds of gulf of Mannar, India. *Journal of Nanobiotechnology*, 11(1):39–39.

Padalia, H., Moteriya, P., Chanda, S. 2018. Synergistic Antimicrobial and Cytotoxic Potential of Zinc Oxide Nanoparticles Synthesized Using Cassia auriculata Leaf Extract. *BioNanoScience*, 8(1):196–206.

Rajeshkumar, S., Bharath, L. V. 2017. Mechanism of plant-mediated synthesis of silver nanoparticles – A review on biomolecules involved, characterisation and antibacterial activity. *Chemico-Biological Interactions*, 273:219–227.

Rajeshkumar, S., Sivapriya, D. 2020. Fungus-Mediated Nanoparticles: Characterization and Biomedical Advances. *Nanoparticles in Medicine*, pages 185–199.

Raut, D. P. S., Thorat, R. T. 2015. Green Synthesis of Zinc Oxide (ZnO) Nanoparticles Using OcimumTenuiflorum Leaves. *International Journal of Science and Research*, 4(5):1225–1228.

Santhoshkumar, J., Rajeshkumar, S., Kumar, S. V. 2017. Phyto-assisted synthesis, characterization and applications of gold nanoparticles – A review. *Biochemistry and Biophysics Reports*, 11:46–57.

Srinisha, M., Rajeshkumar, S., Lakshmi, T., Roy, A. 2019. Antibacterial activity of zinc oxide nanoparticles synthesized using amla fruit against oral pathogens. *Drug Invention Today*, pages 11–11.

Suresh, J., Pradheesh, G., Alexramani, V., Sundararajan, M., Hong, S. I. 2018. Green synthesis and characterization of zinc oxide nanoparticle using insulin plant (Costus pictus D. Don) and investigation of its antimicrobial as well as anticancer activities. *Advances in Natural Sciences: Nanoscience and Nanotechnology*, 9(1):015008–015008.

Vairavel, M., Devaraj, E., Shanmugam, R. 2020. An eco-friendly synthesis of Enterococcus sp.–mediated gold nanoparticle induces cytotoxicity in human colorectal cancer cells. *Environmental Science and Pollution Research*, 27(8):8166–8175.

Valko, M., Rhodes, C. J., Moncol, J., Izakovic, M., Mazur, M. 2006. Free radicals, metals and antioxidants in oxidative stress-induced cancer. *Chemico-Biological Interactions*, 160(1):1–40.

Zare, E., Pourseyedi, S., Khatami, M., Darezereshki, E. 2017. Simple biosynthesis of zinc oxide nanoparticles using nature's source, and it's in vitro bioactivity. *Journal of Molecular Structure*, 1146:96–103.

