RESEARCH
www.commprac.com
ISSN 1462 2815

SYNTHESIS AND CHARACTERIZATION OF MAGNESIUM NANOPARTICLES AND TOXICITY STUDY IN ZEBRAFISH EMBRYOS

Kritika Vajpayee [1], Sangeetha S [2]*, Taniya M [3], M Sundaram K [4] and Lavanya Prathap [5]

[1,2,3,4,5] Department of Anatomy, Saveetha Dental College and Hospital, Saveetha Institute of Medical and Technical Science (SIMATS), Saveetha University, Poonamalle High Road, Velappanchavadi, Chennai.
*Corresponding Author Email: sangeethas.sdc@saveetha.com

DOI: 10.5281/zenodo.10964801

Abstract

Nano-herbal formulations offer a promising avenue for utilizing the therapeutic potential of traditional medicinal plants at the nanoscale. *Thespesia populnea*, known for its medicinal properties, contains bioactive compounds with diverse pharmacological activities. Incorporating *Thespesia populnea* extracts into nano-sized formulations enhances bioavailability and targeted delivery. However, ensuring the safety of these formulations is essential, necessitating the evaluation of their embryotoxicity profile. This study synthesized nanoparticles from *Thespesia populnea* leaf extracts using MgO solution and assessed their embryotoxicity using zebrafish embryos. Results revealed no adverse effects on zebrafish embryo development across various time intervals. These findings suggest the safety of the synthesized nano-herbal formulation, indicating its potential for further biomedical applications. Nonetheless, additional research is needed to explore safety, efficacy, and the broader ecological implications of magnesium nanoparticles. This study contributes to understanding the synthesis process and the potential impacts on aquatic organisms, highlighting the necessity for ongoing investigation.

Keywords: *Thespesia Populnea*, Nano-Herbal Formulation, Embryo Toxicity, Zebrafish Embryo, Nanoparticle.

INTRODUCTION

Thespesia populnea, often known as the portia tree, is a little evergreen tree that grows to a height of 6-10 m (20-33 ft), with a short, often crooked stem and a broad, dense crown(Balkrushna, Mohan et al. 2018). It has shiny green heart-shaped leaves and yellow hibiscus-like flowers. The tree grows along warm coastal areas from the east coast of Africa to South and Southeast Asia, as well as Melanesia, Micronesia, and Polynesia. It has become naturalized in tropical places ranging from the Caribbean to Africa.is a vital tree to Pacific Islanders(Ward, Friess et al. 2016). The magnificent bowls, utensils, tiny canoes, and figures are carved from the rich, dark wood. Ropes are made by twisting the bark. The trees shield you from the wind, salt spray, and the blazing sun. The seeds, leaves, and bark include medicinal and edible properties. Historically, trees were planted around temple locations. Because of overharvesting in some regions and growing urbanization in others, the tree is now more rare than in the past(Varshan and Prathap 2022, Rivers, Newton et al. 2023). The tree is simple to cultivate and should be considered for Pacific reforestation and urban forestry projects when suitable sites are available. Skin illnesses like Scabies, psoriasis, dermatitis, ringworm, and guinea worm can all be cured using the bark, leaves, blossoms, and fruits. The bark decoction is frequently used to treat skin and liver problems. Urethritis and gonorrhea can be treated with bark oil combined with vegetable oil(Osuntokun 2021, Prathap and Lakshmanan 2022). The bark, root, and fruits were employed in the treatment of dysentery, cholera, and hemorrhoids. As a traditional medicine, the leaves and bark of this tree are still used in southern India and Sri Lanka to

manufacture oil for treating fracture wounds and it also acts as an anti-inflammatory poultice for treating ulcers and boils. Nanotechnology is characterized as atomic, molecular, or macromolecular size research and development. Nanoparticles have been utilized for a very long time, with glazes for early dynasty Chinese ceramics being the most likely application(Prathap and Jayaraman 2022). There are many advantages of using improved plant-based nanoparticles over traditional physico-chemical techniques. Nanoparticles are produced using biological or green chemical synthesis to achieve an environmentally sustainable approach. Nanoparticles are the building blocks of nanotechnology, and they are defined as particles with at least one dimension of 100 nm. Particles in these size ranges have been employed by numerous businesses and humanity for thousands of years(Buzea, Pacheco et al. 2007); nevertheless, there has been a recent comeback due to the capacity to synthesis and manipulate such materials. Significant advancements in the detection, treatment, and prevention of diseases will result from the application of nanotechnology to medicine and dentistry. Nanotoxicology is a new discipline of toxicology concerned with the harmful effects of nanoparticles on human health(Krug and Wick 2011). Nanoparticles cause oxidative stress and the generation of inflammatory cytokines in human tissues and cell cultures.

MATERIALS AND METHODS

Plant leaves of *Thepesia populnea* were collected and disinfected with distilled water before grinding them using a pestle and mortar. And the extract will be used for further investigations.

5 ml of MgO solution was added to 50 ml of plant extract, kept for 1 day, and centrifuged the next day. The sedimented nanoparticles settle down. The supernatant solution was discarded.we have checked the toxicity of nanoparticles. We have incubated nanoparticles with zebrafish embryos, 3hr, 12hr, 24 hr 48-72 hr. The sedimented nanoparticles dried and were used for further XRD and FTIR characterization.

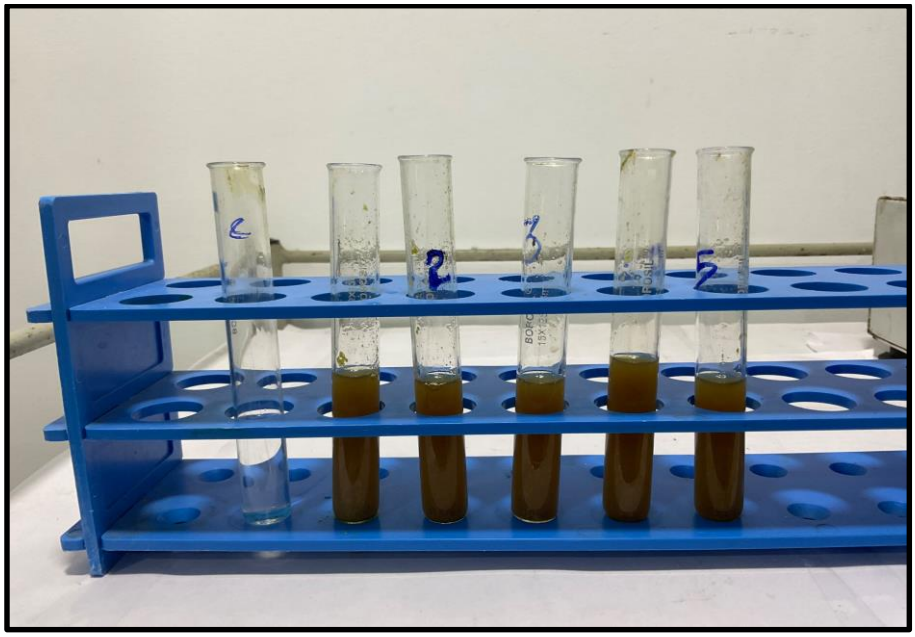

Figure 1: Extract of Thespesia Populnea Plant Leaves

Figure 2: Thespesia Populnea Extract

RESULT

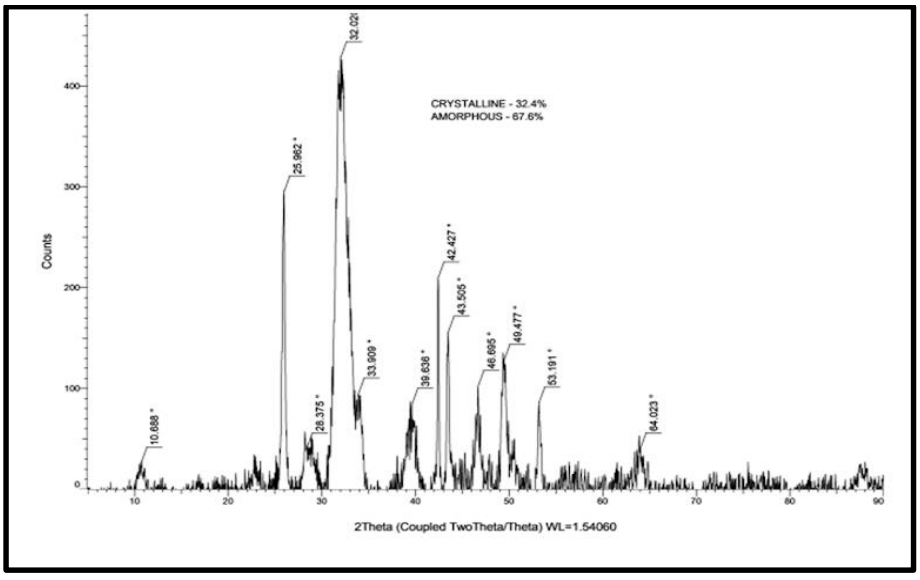

Figure 3: XRD Analysis

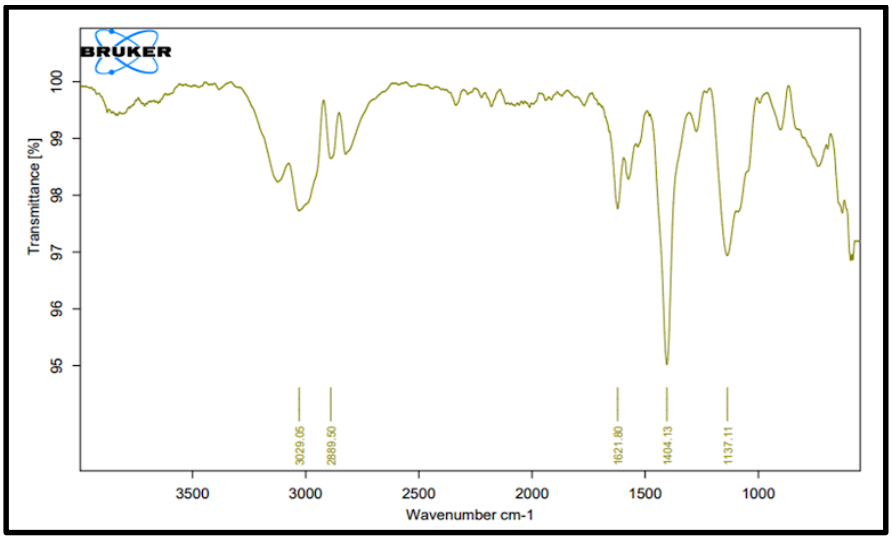

Figure 4: FTIR Analysis

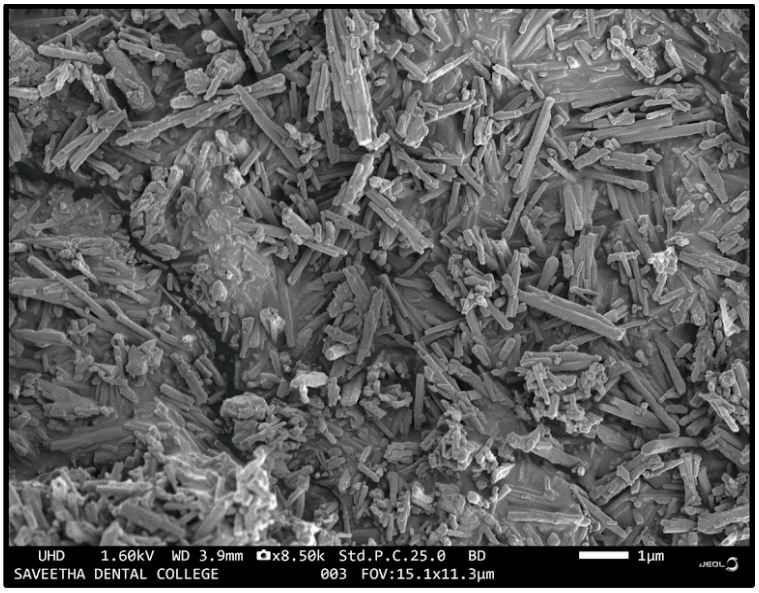

Figure 5: SEM Analysis

Figure 6: Treatment with Nanoparticles

S.No.	Wave number	Functional groups
1	3029.05	N-H stretch (aromatics)
2	2889.50	C-H stretch (alkyl)
5	1621.80	C-O stretch
6	1404.13	Mg single bond
7	1137.11	Mg-O single bond

Figure 7: Functional Groups Present

Finally, we have checked the toxicity of nanoparticles. We have incubated nanoparticles with zebrafish embryos, 3hr, 12hr, 24 hr 48-72 hr. The fish embryo grows well. So there is no toxicity in our synthesized nanoparticles. so we can use it for further biomedical applications.

DISCUSSION

Recently, the subject of nanoscience has been significantly regarded as evolving the biological principles of both physical and chemical qualities are combined in nanotechnology, also known as nanoparticle biotechnology(An and Jin 2012). An increasingly popular concept involves the use of nanoparticles in medical research. Physicists, chemists, biologists, electronics experts, farmers, and others have stated that nanoparticles (NPs) have a wide range of uses. Human toxicity study uses zebrafish (Danio rerio), a newly developed laboratory animal model(Chakraborty, Hsu et al. 2009). Zebrafish embryos have rapid development and ongoing reproduction, are translucent, tiny, and simple to handle and keep. Until it hatches, the embryo is shielded from the environment by a polypeptide structure called the chorion, which serves as a biological barrier to keep embryos safe(Ali, Champagne et al. 2011). Due to the chorion's permeability to this chemical molecule, the consequences seen after exposure are directly tied to it. An integrated nanosafety study for an ecotoxicity assessment of the emerging GO-AgNPs nanohybrid using zebrafish embryos as a biological model. The following aspects were studied: i) GO-AgNPs nanohybrid synthesis and characterization; ii) nanohybrid dispersion stability and silver dissolution in the zebrafish medium; and iii) toxicity assessment on the zebrafish embryos. The influences of chorion membrane removal and NOM on the toxicity of GO-AgNPs were reported towards more realistic and standardized methods for nano-ecotoxicology research and regulatory issues(Medeiros 2021). According to the results of the embryo toxicity test, 96 hpf exposure to nano-ZnO destroyed zebrafish embryos (at 50 and 100 mg/L), delayed embryo hatching (1–25 mg/L), decreased larval body length, and resulted in tail deformity. Only a small portion of Zn(dis) was responsible for the toxicity of nano-ZnO(Li, Schiavo et al. 2017). This study emphasizes the need for additional research on the ecotoxicity of nano-ZnO in the aquatic environment. Future research has several potential directions, but one that is particularly fascinating and multidisciplinary is the synthesis and characterisation of nano-herbal formulations for embryo toxicity studies utilizing *Thespesia populnea*. Making nano-herbal formulations more efficiently can be the subject of future research(Kumar 2023). To improve the efficacy and safety of the formulation, this may entail experimenting with different herbal extracts and nanomaterials, as well as their ratios. Analyzing how these nano-herbal compounds affect the environment is crucial. On its biodegradability and potential ecological effects, research can be concentrated(More, Yadav et al. 2014). It is critical to evaluate these compositions' safety. Future studies should examine potential side effects, biodistribution, and long-term toxicity. For regulatory approval, this information is essential.

CONCLUSION

In conclusion, the synthesis and characterization of nano-herbal formulation derived from *Thespesia populnea* for embryo toxicity studies exhibit great potential. The synthesis and characterization of nano-herbal formulation derived from *Thespesia populnea* is an intriguing area of research. Studying its embryo toxicity potential is

crucial for ensuring its safety. Nanoformulations offer enhanced bioavailability and targeted delivery, while the use of herbal compounds adds a natural aspect. This research holds promise for future applications in medicine and therapeutics. By combining nanotechnology and herbal medicine, this research opens doors for safer and more effective therapeutic applications. Further investigations and clinical trials are warranted to explore its full potential in the field of medicine. Nanoformulations offer enhanced bioavailability and targeted delivery, while the use of herbal compounds adds a natural aspect. This research holds promise for future applications in medicine and therapeutics.

Reference

1) Ali, S., et al. (2011). "Zebrafish embryos and larvae: a new generation of disease models and drug screens." Birth Defects Research Part C: Embryo Today: Reviews **93**(2): 115-133.

2) An, H. and B. Jin (2012). "Prospects of nanoparticle–DNA binding and its implications in medical biotechnology." Biotechnology advances **30**(6): 1721-1732.

3) Balkrushna, G. S., et al. (2018). "Spectroscopic Characterization of Phytol isolated from *Thespesia populnea* Leaves." Research Journal of Pharmacognosy and Phytochemistry **10**(3): 203-206.

4) Buzea, C., et al. (2007). "Nanomaterials and nanoparticles: sources and toxicity." Biointerphases **2**(4): MR17-MR71.

5) Chakraborty, C., et al. (2009). "Zebrafish: a complete animal model for in vivo drug discovery and development." Current drug metabolism **10**(2): 116-124.

6) Krug, H. F. and P. Wick (2011). "Nanotoxicology: an interdisciplinary challenge." Angewandte Chemie International Edition **50**(6): 1260-1278.

7) Kumar, R. (2023). Nanotechnology in herbal medicine: Challenges and future perspectives. Nanotechnology in Herbal Medicine, Elsevier**:** 515-548.

8) Li, J., et al. (2017). "Comparative toxicity of nano ZnO and bulk ZnO towards marine algae Tetraselmis suecica and Phaeodactylum tricornutum." Environmental Science and Pollution Research **24**: 6543-6553.

9) Medeiros, A. M. Z. d. (2021). Synthesis, characterization and ecotoxicological evaluation of hybrid graphene oxide-silver nanoparticles, Universidade de São Paulo.

10) More, T., et al. (2014). "Extracellular polymeric substances of bacteria and their potential environmental applications." Journal of environmental management **144**: 1-25.

11) Osuntokun, O. T. (2021). "Efficacy, properties and therapeutic use of some major medicinal plants for human health." Biopesticides: Botanicals and microorganisms for improving agriculture and human health **179**.

12) Prathap, L. and S. Jayaraman (2022). "Anti proliferative effect of endogenous dopamine replica in human lung cancer cells (A549) via Pi3k and Akt signalling molecules." Journal of Pharmaceutical Negative Results: 1380-1386.

13) Prathap, L. and G. Lakshmanan (2022). "Evaluation of incidence of various types of coronoid process in South Indian population." Journal of Pharmaceutical Negative Results: 1387-1390.

14) Rivers, M., et al. (2023). "Scientists' warning to humanity on tree extinctions." Plants, People, Planet **5**(4): 466-482.

15) Varshan, I. and L. Prathap (2022). "Evaluation of mandibular condylar morphology using orthopantomogram in South Indian population." Journal of Advanced Pharmaceutical Technology & Research **13**(Suppl 2): S530-S533.

16) Ward, R. D., et al. (2016). "Impacts of climate change on mangrove ecosystems: a region by region overview." Ecosystem Health and sustainability **2**(4): e01211.