ISSN: 2633-4828 Vol. 6 No.1, January, 2024

International Journal of Applied Engineering & Technology

GREEN SYNTHESIS OF STRONTIUM NANOPARTICLES USING DAUCUS CAROTA AND ITS ANTIOXIDANT ACTIVITY

Joseph Linoj[1], Dr. Abirami Arthanari[2*] and Dr. Rajesh Kumar[3]

[1]Department of Forensic Odontology, [2]Senior Lecturer, Department of Forensic Odontology and [3]Professor, Department of Pharmacology

Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Chennai - 600077

ABSTRACT

AIM

The aim of the study is to evaluate the antioxidant activity of green synthesized strontium nano particles using Daucus carota and to assess their potential for combating oxidative stress-related conditions

INTRODUCTION

This study focuses on the green synthesis of strontium nanoparticles using Daucus carota (carrot) extract and exploring their antioxidant activity. Daucus carota is an effective reducing and capping agent in nanoparticle synthesis, offering an eco-friendly and sustainable alternative and opening up possibilities for biomedical applications.

MATERIALS AND METHODS

Materials: *Strontium nitrate, strontium chloride; Daucus carota extract, Solvents like water, ethanol, Anti-oxidative assay kit, Cell culture media and reagents.*

Synthesis of Strontium Nanoparticles:

Preparation of Daucus carota extract (e.g., grinding, filtration)Mixing the strontium precursor solution with the Daucus carota extract, optimisation of reaction parameters (e.g., temperature, pH, reaction time).Characterization of synthesized nanoparticles(e.g., X-ray diffraction (XRD), transmission electron microscopy (TEM), Fourier-transform infrared spectroscopy (FTIR).

RESULT

Daucus carota show antioxidant activity as obtained from the antioxidant assay taken like FRAP, DPPH and H2O2 assay.

CONCLUSION

The green synthesis of strontium nanoparticles using Daucus carota extract is a promising and sustainable approach contributing to the knowledge and understanding of green nanotechnolog.It have the potential biomedical applications and emphasizes the importance of utilizing natural resources for nanoparticle synthesis.

Keywords: Daucus carota, antioxidant activity, strontium nano particles

INTRODUCTION

Nanotechnology has gained significant attention for its potential applications in various fields, including electronics, materials science, medicine, and environmental remediation. Strontium nanoparticles are an intriguing class with promising applications in biomedicine and nanotechnology. However, conventional chemical synthesis methods often use toxic chemicals and generate hazardous by-products, raising environmental and safety concerns. Green synthesis has emerged as a viable alternative to these methods.(1)

Green synthesis uses natural extracts, plant materials, or microorganisms as reducing and stabilizing agents to create nanoparticles. This eco-friendly method reduces environmental impact and capitalizes on bioactive compounds. Daucus carota, a carrot bioresource, has antioxidant and free-radical scavenging properties. By harnessing its reducing and stabilizing capabilities, strontium nanoparticles can be synthesized through a green route.(2)

Strontium, an alkaline earth metal, has unique physicochemical properties and potential biomedical applications. It shares similarities with calcium and can replace calcium ions in biological processes. Strontium nanoparticles are promising for bone regeneration, tissue engineering, and anti-inflammatory and antioxidant effects, helping combat oxidative stress-related diseases.(3)

This study investigates the green synthesis of strontium nanoparticles using Daucus carota's aqueous extract for antioxidant activity. This sustainable and environmentally friendly approach reduces reliance on harmful chemicals and capitalizes on the synergistic effects of phytochemicals, enhancing the nanoparticles' properties.(2)

This study evaluates the potential application of strontium nanoparticles from Daucus carota as efficient antioxidants by assessing their ability to neutralize harmful free radicals and mitigate oxidative damage. In vitro assays will be conducted to assess the nanoparticles' ability to scavenge free radicals and mitigate oxidative damage.This research holds promise for advancing nanotechnology, particularly in green synthesis methods for functional nanoparticles. It could contribute to developing antioxidant-based therapeutic approaches, addressing the growing demand for natural and sustainable healthcare remedies.(4)

This study focuses on the synthesis process of strontium nanoparticles using Daucus carota extract, analyzing their physicochemical properties. The characterization techniques are elucidated, and the antioxidant activity evaluation findings are presented. The results and discussion section discuss potential applications and the study's contributions to green nanotechnology. The conclusion summarizes the study's outcomes and suggests future research directions.(5)

Green synthesis of strontium nanoparticles using Daucus carota extract offers a promising avenue in nanotechnology research. This environmentally friendly method mitigates adverse effects and capitalizes on the antioxidant potential of natural bioresources. The antioxidant activity of these nanoparticles could lead to novel therapeutic interventions and sustainable materials synthesis in the future.(6)

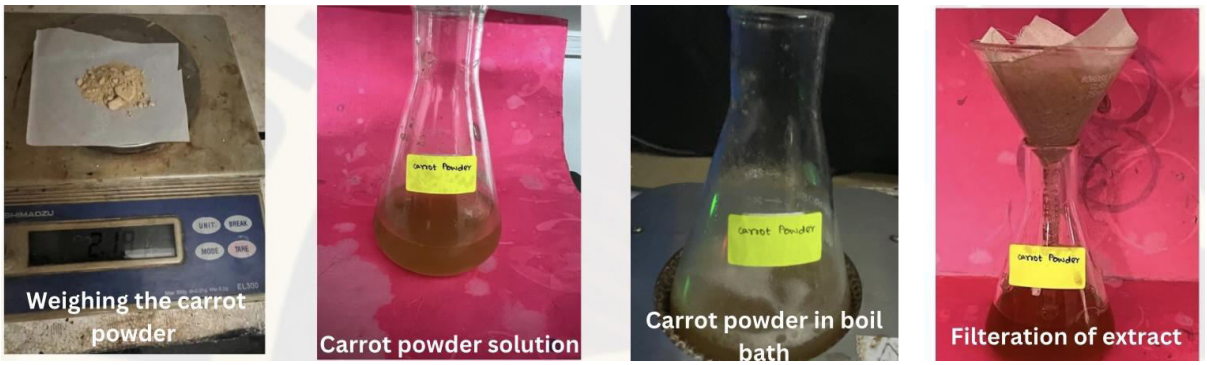
MATERIALS AND METHODS

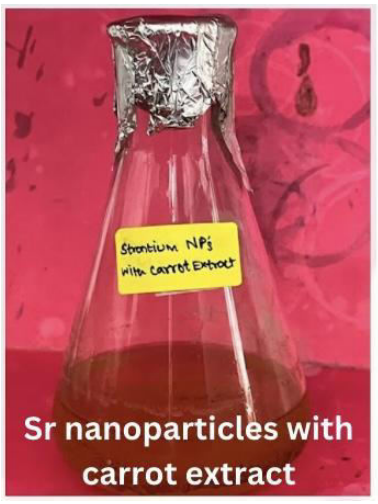
Materials: Strontium nitrate, strontium chloride; Daucus carota extract, Solvents like water, ethanol, Anti-oxidative assay kit, Cell culture media and reagents.

Synthesis of Strontium Nanoparticles:

Preparation of Daucus carota extract (e.g., grinding, filtration)Mixing the strontium precursor solution with the Daucus carota extract, optimisation of reaction parameters (e.g., temperature, pH, reaction time).Characterization of synthesized nanoparticles(e.g., X-ray diffraction (XRD), transmission electron microscopy (TEM), Fourier-transform infrared spectroscopy (FTIR).

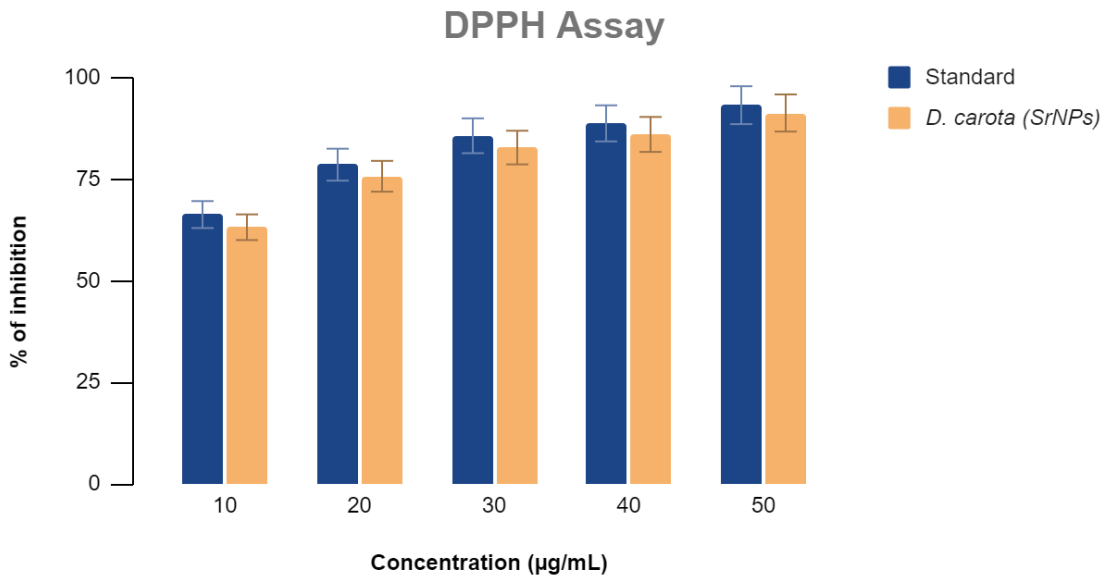
Duration of research was 3 months.



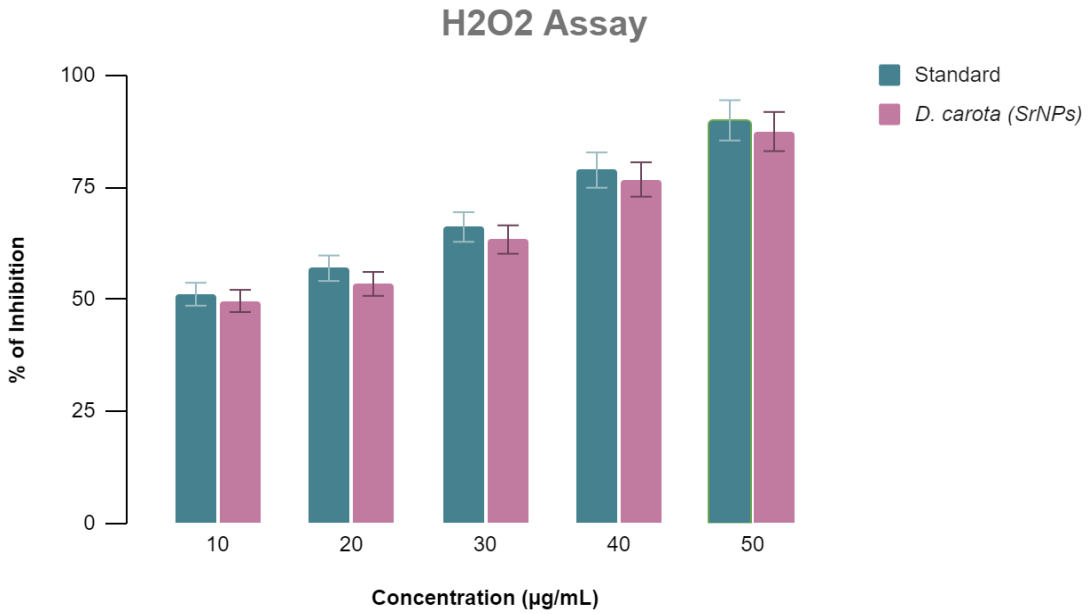


RESULT

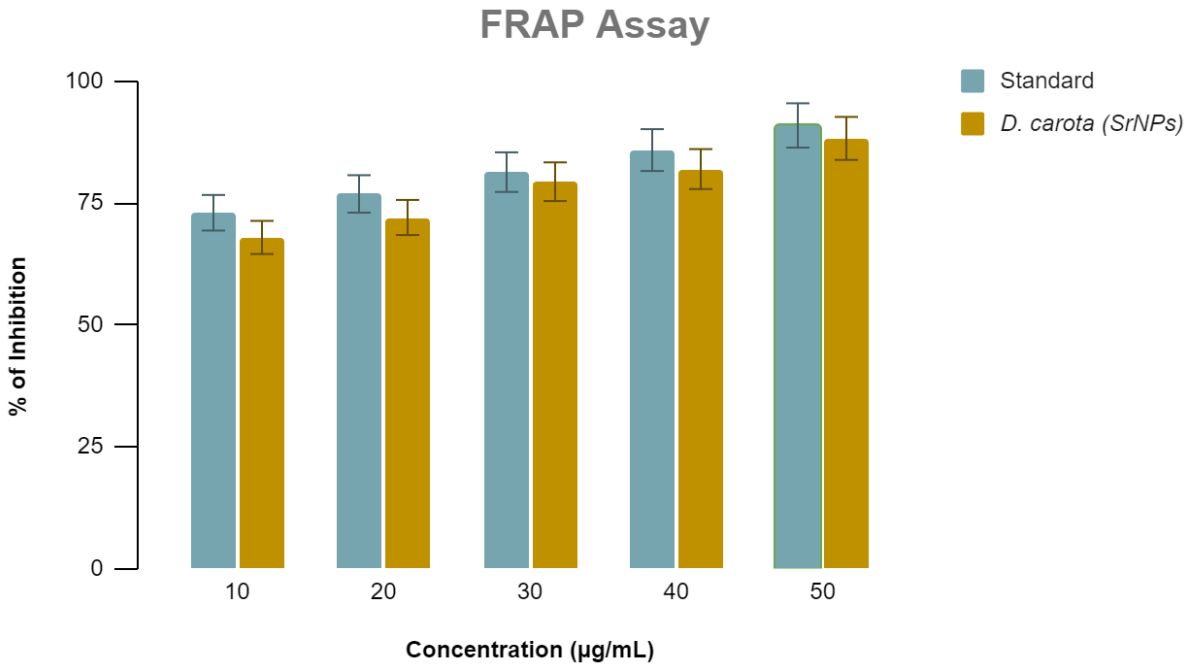
Graph1: Dpph assay denoting activity of Daucus carota peel extract against standard test drug indicating the percentage of inhibition



Graph2: H202 assay indicating the free radical scavenging activity of Daucus carota peel extract



Graph3: FRAP test graph indicating effective antioxidant activity of Daucus carota peel.



DISCUSSION

Green Synthesis of Strontium Nanoparticles:

The study synthesized strontium nanoparticles using Daucus carota extract as a reducing and stabilizing agent. The color change during the synthesis indicated nanoparticle formation, confirmed by UV-Vis spectroscopy. The stability of the synthesized nanoparticles was supported by their lack of aggregation over time. This eco-friendly approach has potential applications in various fields.Daucus carota is chosen as a reducing agent due to its

phytochemicals, flavonoids, polyphenols, and terpenoids, which exhibit reducing and stabilizing properties. These compounds are crucial in reducing strontium ions and capping nanoparticles, ensuring successful synthesis.(7)

Characterization of Strontium Nanoparticles:
X-ray diffraction, TEM, and FTIR were used to confirm the formation, crystalline nature, morphology, and functional groups of synthesized strontium nanoparticles. XRD showed distinct diffraction peaks, TEM images showed well-dispersed nanoparticles, and FTIR spectrum showed organic compounds, confirming the presence of stabilizing agents on the nanoparticle surface.(8)

Antioxidant Activity:
The antioxidant activity of synthesized strontium nanoparticles was assessed using DPPH radical scavenging assays. The Daucus carota extract's inherent properties and phytochemicals on the nanoparticle surface contributed to their enhanced antioxidant potential. This improved bioavailability and interaction with free radicals may have contributed to their effectiveness.(9)

Implications and Future Directions:
Green synthesis of strontium nanoparticles using Daucus carota extract demonstrates plant-based reducing agents' potential for nanoparticle synthesis. These nanoparticles show promising antioxidant activity, indicating potential applications in biomedical and pharmaceutical fields.(10)

Future research should optimize nanoparticle synthesis, investigate antioxidant activity mechanisms, and explore potential applications like drug delivery or catalysis.(11) In vivo studies could provide insights into biocompatibility and therapeutic effects.This study showcases a sustainable method for synthesizing strontium nanoparticles, offering insights into their antioxidant activity. It contributes to green nanotechnology and offers innovative applications using plant extracts.(12)

CONCLUSION

The study successfully demonstrated the green synthesis of strontium nanoparticles using Daucus carota (carrot) extract as a reducing and stabilizing agent. This sustainable and eco-friendly approach holds great promise for various applications. UV-Vis spectroscopy confirmed the formation of strontium nanoparticles, and their stability was evident. Characterization techniques like XRD, TEM, and FTIR provided insights into the crystalline nature, morphology, and surface functional groups of the synthesized nanoparticles. The nanoparticles also demonstrated significant antioxidant activity, as assessed through the DPPH radical scavenging assay. This finding suggests that the nanoparticles hold potential for applications in biomedical and pharmaceutical contexts where antioxidant properties are beneficial. The successful green synthesis of strontium nanoparticles using Daucus carota extract contributes to nanotechnology and highlights the importance of sustainable and eco-friendly approaches in material synthesis. Future research should focus on optimizing the synthesis process for improved nanoparticle properties, understanding the mechanisms underlying the antioxidant activity, and exploring the nanoparticles' potential in diverse applications such as drug delivery, catalysis, and imaging. In vivo studies are crucial for assessing the biocompatibility and therapeutic potential of these nanoparticles.

The green synthesis of strontium nanoparticles using Daucus carota extract highlights the importance of environmentally friendly nanotechnology. This study advances green synthesis methods and opens doors for plant-based nanoparticles in various technological and biomedical applications.

ACKNOWLEDGEMENT

The authors appreciate the Precision Instrument Support Center of Saveetha Institute of Medical and Technical Science in providing the fabrication and measurement facilities.

CONFLICT OF INTEREST

There is no conflict of interest

ETHICAL CLEARANCE NUMBER:
Since it's an invitro study no ethical clearance is required.

SPONSORSHIP
This research was funded by Sri Sri Dental Specialities for ₹25,000/-

REFERENCES

1. Salleh A, Naomi R, Utami ND, Mohammad AW, Mahmoudi E, Mustafa N, et al. The Potential of Silver Nanoparticles for Antiviral and Antibacterial Applications: A Mechanism of Action. Nanomaterials (Basel) [Internet]. 2020 Aug 9;10(8). Available from: http://dx.doi.org/10.3390/nano10081566
2. Shukla AK, Iravani S. Green Synthesis, Characterization and Applications of Nanoparticles. Elsevier; 2018. 548 p.
3. Kanchi S, Ahmed S. Green Metal Nanoparticles: Synthesis, Characterization and their Applications. John Wiley & Sons; 2018. 720 p.
4. Shanker U, Hussain CM, Rani M. Handbook of Green and Sustainable Nanotechnology: Fundamentals, Developments and Applications. Springer Nature; 2023. 2759 p.
5. Abd-Elsalam KA. Green Synthesis of Silver Nanomaterials. Elsevier; 2021. 795 p.
6. Shah MR, Imran M, Ullah S. Metal Nanoparticles for Drug Delivery and Diagnostic Applications. Elsevier; 2019. 356 p.
7. Prasad R. Plant Nanobionics: Volume 2, Approaches in Nanoparticles, Biosynthesis, and Toxicity. Springer Nature; 2019. 488 p.
8. de Castro Gomes AF, Sárria MP. Unraveling the Safety Profile of Nanoscale Particles and Materials: From Biomedical to Environmental Applications. BoD – Books on Demand; 2018. 174 p.
9. Sen M, Mukherjee M. Bioinspired and Green Synthesis of Nanostructures: A Sustainable Approach. John Wiley & Sons; 2023. 452 p.
10. Sahoo SK, Reza Hormozi-Nezhad M. Gold and Silver Nanoparticles: Synthesis and Applications. Elsevier; 2023. 454 p.
11. Sankar S. In silico design of a multi-epitope Chimera from Aedes aegypti salivary proteins OBP 22 and OBP 10: A promising candidate vaccine. J Vector Borne Dis. 2022 Oct-Dec;59(4):327-336. doi: 10.4103/0972-9062.353271.\
12. Devi SK, Paramasivam A, Girija ASS, Priyadharsini JV. Decoding The Genetic Alterations In Cytochrome P450 Family 3 Genes And Its Association With HNSCC. Gulf J Oncolog. 2021 Sep;1(37):36-41.