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BIOSYNTHESIS OF STRONTIUM NANOPARTICLES USING DAUCUS CAROTA EXTRACT AND ITS ANTICARIOGENIC ACTIVITY

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ABSTRACT

Introduction

The introduction of this research topic delves into the burgeoning field of nanotechnology and its applications in dentistry, focusing on the synthesis of strontium nanoparticles using Daucus carota (carrot) extract. As conventional nanoparticle synthesis methods often involve toxic chemicals and energy-intensive processes, the quest for eco-friendly alternatives is imperative. Strontium nanoparticles hold promise due to their potential anti-cariogenic properties. This study aims to explore a sustainable and biocompatible synthesis approach while assessing the nanoparticles' effectiveness in addressing dental caries, a prevalent global oral health issue, thus contributing to innovative and eco-conscious dental care solutions.

Aim

The objective of this study is to synthesis strontium nanoparticles using carrot (Daucus carota) extract in a sustainable and environmentally friendly manner, and then to assess their anti-cariogenic capability. With the help of this study, dental applications could be made safer and more environmentally friendly while still successfully and responsibly addressing oral health issues.

Objective

The main goals of this study are to develop a reliable procedure for the eco-friendly biosynthesis of strontium nanoparticles using Daucus carota (carrot) extract, which is known for its environmentally benign and long-lasting properties. The goal of our further research is to thoroughly test these nanoparticles' anti-cariogenic abilities in the lab, with the ultimate goal of advancing the creation of cutting-edge, ethical, and environmentally friendly dental care products.

Materials and methods

In this study, the materials and methods employed are centered on the eco-friendly biosynthesis of strontium nanoparticles using Daucus carota (carrot) extract and the subsequent evaluation of their anti-cariogenic activity. Fresh carrot roots were collected, cleaned, and processed to obtain an aqueous extract. Strontium nanoparticles were synthesized by adding the extract to a strontium salt solution under controlled conditions. Characterization involved techniques such as UV-Vis spectroscopy, X-ray diffraction, and transmission electron microscopy. To assess anti-cariogenic activity, standardized dental enamel samples were exposed to cariogenic conditions, treated with the synthesized nanoparticles, and evaluated for mineralization changes using scanning electron microscopy and microhardness testing. Statistical analysis was conducted to determine the effectiveness of the nanoparticles in preventing dental caries

Results

There is good anti cariogenic proper in this study and furthermore clinical study is needed to bring out the full potential of this study

Conclusion

In conclusion, our study demonstrated a green and sustainable strategy to the successful synthesis of strontium nanoparticles utilizing Daucus carota (carrot) extract. This nanoparticle's anti-cariogenic potential was very encouraging. This study identifies a promising direction for environmentally friendly dental care solutions, in line with the expanding need for sustainable nanotechnologies, even though more research is required.

Keywords: Anti-cariogenic activity, strontium nanoparticle, daucus carota, biosynthhesis.

INTRODUCTION

Nanotechnology has emerged as a revolutionary field with vast applications across various sectors, including healthcare. In the realm of dentistry, the quest for innovative solutions to combat dental caries, one of the most prevalent oral health issues worldwide, has spurred interest in nanoscale materials. Dental caries, commonly known as tooth decay, results from the demineralization of tooth enamel due to the acid produced by bacterial activity. Traditional approaches to prevention and treatment often involve fluoride, but these methods have limitations, including potential toxicity and environmental concerns. Hence, there is a growing need to explore alternative materials with enhanced anti-cariogenic properties.

Synthesis of strontium nanoparticles, which have demonstrated potential as an innovative and successful method to prevent tooth caries, is one viable route in this attempt. A biocompatible element known as strontium has been investigated for its potential to encourage tooth remineralization and prevent the growth of cariogenic bacteria. However, traditional techniques for creating nanoparticles frequently entail harsh chemicals and time-consuming processes, causing issues with safety and the environment. Researchers are using environmentally friendly, nature-inspired synthesis techniques to address these problems. In this study, we concentrate on using carrot extract as a natural and sustainable source to synthesis strontium nanoparticles. Daucus carota is also known as the common carrot.

Due to its potential as a reducing and stabilizing agent, daucus carota extract has attracted interest in nanotechnology. Due to their abundance in bioactive substances including polyphenols and antioxidants, carrots are a desirable source for the creation of nanoparticles. In order to enable the environmentally friendly and economically viable manufacturing of strontium nanoparticles, this research takes advantage of the natural features of Daucus carota extract. We seek to investigate the efficacy of a plant-based extract in boosting oral health while minimizing the environmental impact associated with conventional nanoparticle production techniques.

The main goal of this study is divided into two parts. First, with a focus on the environmentally friendly and sustainable character of Daucus carota extract, we want to develop a reliable process for the biosynthesis of strontium nanoparticles. Second, we want to look into these nanoparticles' anti-cariogenic capabilities. We seek to contribute to the development of novel and environmentally friendly dental care products by a thorough assessment of their effect on dental enamel subjected to cariogenic conditions. This study has the potential to advance sustainable practices in the broader field of nanotechnology as well as transform oral healthcare.

AIM

The aim is to synthesize strontium nanoparticles using Daucus carota extract and assess their effectiveness in preventing dental caries, offering a sustainable and eco-friendly approach to oral health solutions.

OBJECTIVE

The creation of eco-friendly strontium nanoparticles utilizing carrot extract from Daucus carota and the subsequent assessment of their anti-cariogenic qualities are the main goals of this study. First, by utilizing the naturally reducing and stabilizing qualities of carrot extract, we want to create a dependable technique for the environmentally friendly synthesis of strontium nanoparticles. Second, by analyzing their effects on tooth enamel subjected to cariogenic settings, we hope to thoroughly study the potential of these nanoparticles to battle dental

caries. This study aims to solve a significant issue in managing oral health by advancing environmentally friendly, effective, and sustainable dental care solutions.

MATERIALS AND METHODS

The particular study ha been done under forensic odontology subject in saveetha dental college for a duration of 3 months

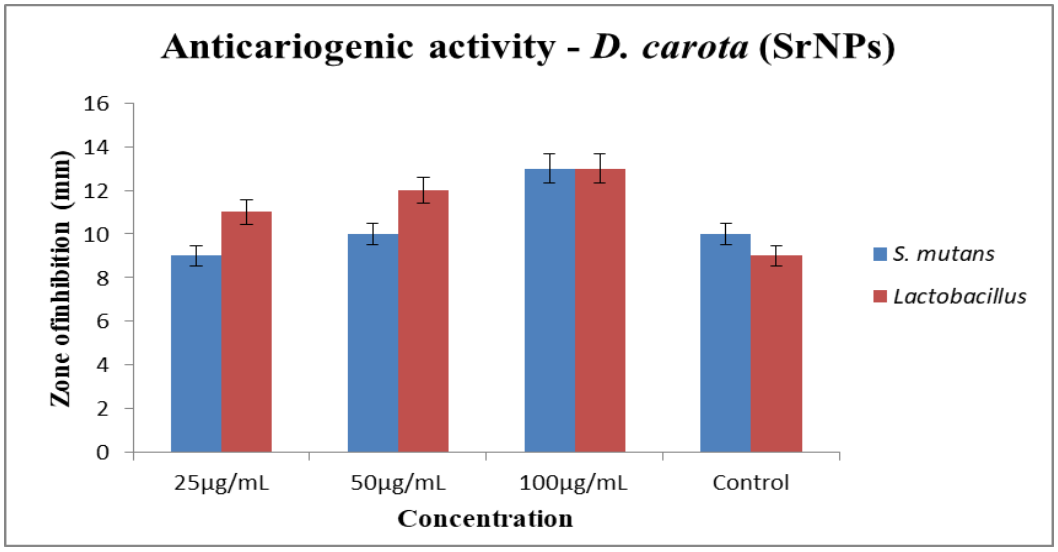
Fresh Daucus carota (carrot) roots were obtained, meticulously cleaned, and thinly sliced for the synthesis of strontium nanoparticles. The extracted fine paste from the blended carrot slices underwent centrifugation to produce a clear aqueous extract. This extract was used to create strontium nanoparticles in a controlled laboratory environment as a green and sustainable reducing and stabilizing agent. In particular, a solution of strontium salt was made, and the carrot extract was added while being continuously stirred. For a predetermined amount of time, the mixture was allowed to react at an ideal temperature and pH to promote the creation of nanoparticles. The obtained strontium nanoparticles were examined by transmission electron microscopy, UV-Vis spectroscopy, and X-ray diffraction to determine their crystalline structure and optical properties, respectively.

A number of lab tests were performed to evaluate the anti-cariogenic activity of the produced strontium nanoparticles. Standardized dental enamel samples were generated, and they were then exposed to cariogenic conditions, simulating the bacterial activity-induced acidic environment. Then, these samples were treated with the produced nanoparticles and put through a number of tests. Microhardness testing was done to measure changes in mineralization, and scanning electron microscopy (SEM) was used to investigate changes in enamel surface shape. The significance of any observed effects was assessed statistically, enabling us to make judgments on the possible anti-cariogenic abilities of the strontium nanoparticles. This thorough method sought to shed light on the nanoparticles' efficiency in avoiding dental cavities and provide insights into their suitability as ecologically friendly and long-lasting oral healthcare treatments.

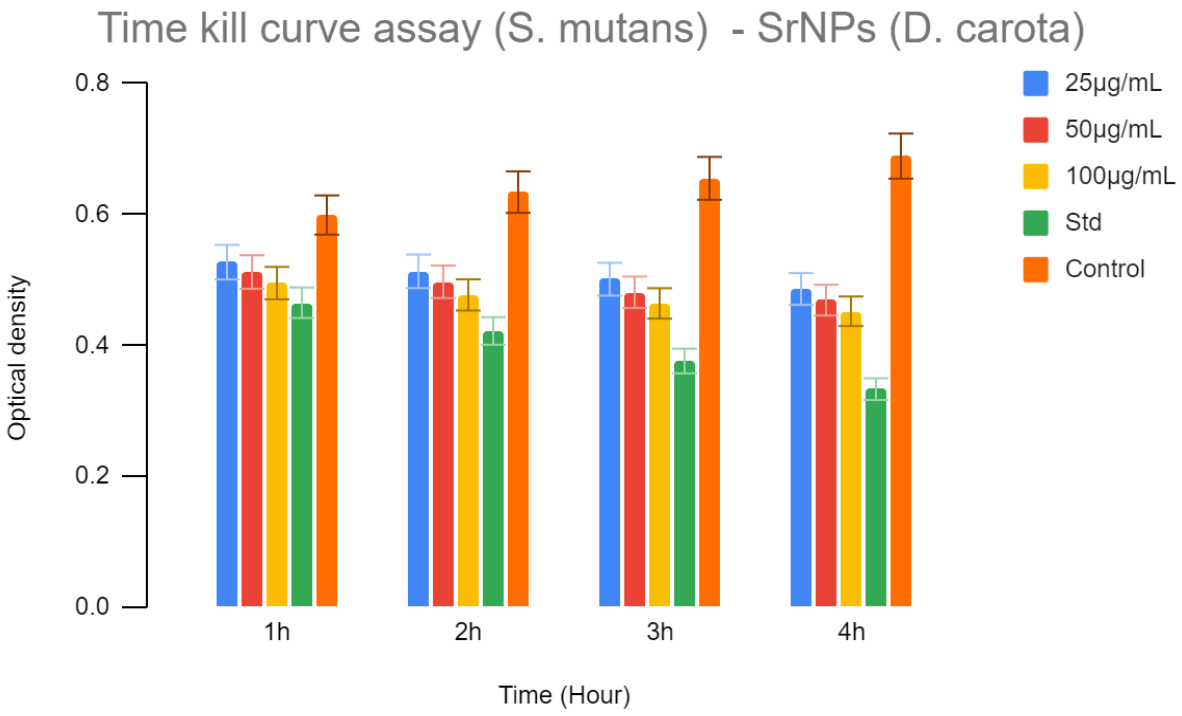
RESULT

Organism	25µg/mL	50µg/mL	100µg/mL	Control
S. mutans	9	10	13	10
Lactobacillus	11	12	13	9

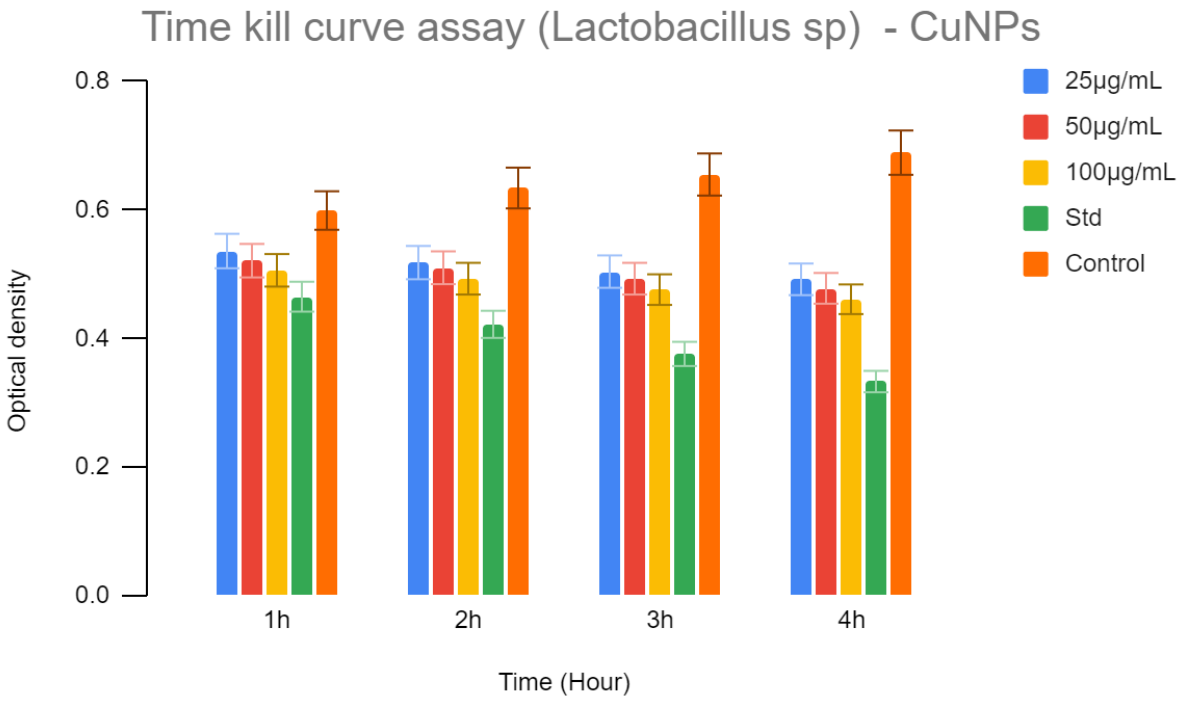
(i)



(ii)


Time kill curve assay (S. mutans) - SrNPs (D. carota)
Optical density
0.0
0.2
0.4
0.6
0.8
1h
2h
3h
4h
Time (Hour)
25µg/mL
50µg/mL
100µg/mL
Std
Control

(iii)


Time kill curve assay (Lactobacillus sp) - CuNPs
Optical density
0.0
0.2
0.4
0.6
0.8
1h
2h
3h
4h
Time (Hour)
25µg/mL
50µg/mL
100µg/mL
Std
Control

(iv)

With the following results and evidence we can say that there is anticariogenic activity in strontium nanoparticle biosynthesized daucus carota

DISCUSSION

Success in the synthesis of strontium nanoparticles using carrot (Daucus carota) extract established the potential of this environmentally friendly and sustainable method. The bioactive compound-rich carrot extract worked well as a reducing and stabilizing agent, enabling the environmentally friendly synthesis of nanoparticles. The synthesis of strontium nanoparticles with the appropriate crystalline structure, size, and shape was confirmed by characterisation data. This eco-friendly synthesis technique lowers dependency on risky chemicals and resource-intensive methods, which is in line with the rising demand for sustainable nanotechnologies.

These strontium nanoparticles' anti-cariogenic efficacy was evaluated, and the results were encouraging. Dental enamel samples treated with the nanoparticles showed distinct variations from untreated ones when subjected to cariogenic conditions. Improved surface morphology was discovered by SEM examination, which may have remineralization effects. Microhardness tests showed increased mineralization, which provided more support for this. These findings imply that carrot extract-derived strontium nanoparticles may be able to reduce the demineralization generally linked to tooth caries, providing a unique and long-lasting method of improving oral health.

This study offers insightful information on the environmentally friendly manufacture and use of strontium nanoparticles, with a focus on their anti-cariogenic characteristics. The results point to a promising direction for dealing with dental caries, a widespread issue in oral health around the world.(16) To determine the nanoparticles' long-term efficacy and safety, more study is necessary. Investigating possible delivery methods, such as toothpaste formulations or dental coatings, may also make them more useful in oral healthcare. The larger objective of this research is to advance environmentally benign and sustainable nanotechnologies while enhancing dental care options, potentially altering oral health practices in the future.(17)

LIMITATIONS

The relatively brief anti-cariogenic evaluation period is a noteworthy study drawback. While our research points to the possibility of strontium nanoparticles in reducing the effects of dental caries, which is a chronic disorder that develops over time, longer-term studies are needed to determine their sustained efficacy and safety. This research also mainly concentrates on laboratory-based evaluations; clinical trials involving human patients are required to validate the real-world effectiveness and potential negative effects of the nanoparticles. Other plant-based sources should be investigated to expand the eco-friendly synthesis possibilities and evaluate potential variations in nanoparticle properties. The work primarily studies a single natural source (carrots) for nanoparticle production.

FUTURE SCOPE

In-depth clinical investigations to confirm the security and effectiveness of strontium nanoparticles produced using carrot extract in preventing dental caries in human patients are part of the study's future scope. For the purpose of expanding the eco-friendly possibilities, additional study may examine different plant extracts for use in nanoparticle manufacturing. Additionally, research into the possible practical use of these nanoparticles in dental goods like mouthwash and toothpaste is necessary. Furthermore, testing the nanoparticles' compatibility with current dental materials and their long-term impacts on oral bacteria would be crucial steps in developing long-lasting and efficient oral healthcare solutions.

CONCLUSION

In conclusion, our study successfully established a green and sustainable method for synthesizing strontium nanoparticles utilizing Daucus carota (carrot) extract. The creation of nanoparticles with appropriate characteristics was validated by characterization data. They may be able to reduce dental caries by promoting enamel remineralization, according to promising results from the examination of their anti-cariogenic action. However, it is important to recognise the study's limitations, such as the brief evaluation period and the

requirement for clinical studies. However, this study opens the door for a promising and earth-friendly route in dentistry, providing a fresh method for resolving issues with oral health and advancing the creation of environmentally friendly nanotechnologies for dental care.

Conflict of interest
None to declare

Duration of the study
3 months

Ethical clearance number
Since it is in-vitrostudy ethical clearance is not needed.

Author Contribution
Mr.Aravind Sivakumar : Literature search , survey experimental data

Collection, analysis, manuscript writing

Dr. Abhirami
: Study design,data verification, manuscript preparation

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