RESEARCH
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FREE RADICAL SCAVENGING OF ZINC OXIDE NANOPARTICLES SYNTHESIZED USING RUBIA CORDIFOLIA

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Abstract

INTRODUCTION: Zinc oxide nanoparticles (ZnO NPs) have gained significant attention due to their potential applications in various fields, including medicine and cosmetics. However, their inherent reactivity and ability to generate free radicals raise concerns about their potential toxicity.

To mitigate these concerns, researchers have explored natural sources for the synthesis of ZnO NPs, such as Rubia cordifolia, a medicinal plant known for its antioxidant properties.

This study aims to investigate the free radical scavenging activity of ZnO NPs synthesized using Rubia cordifolia extract. Understanding the potential antioxidant properties of these nanoparticles is crucial for assessing their safety and potential use in biomedical applications.

AIM: To study about the free radical scavenging activity of zinc oxide nanoparticles synthesized using rubia cordifolia.

MATERIALS AND METHODS: Zinc oxide nanoparticles were synthesized using Rubia cordifolia extract as the reducing agent. Zinc acetate dihydrate and Rubia cordifolia extract were mixed and heated at 90 degree celsius for 3 hours. The nanoparticles were characterized by UV-Vis spectroscopy and XRD. Free radical scavenging activity was evaluated using DPPH assay. The concentration required to scavenge 50% of DPPH radicals was determined.

DISCUSSION: The resulting ZnO NPs exhibit unique physicochemical properties, including a high surface area, small size, and enhanced reactivity, which make them suitable candidates for free radical scavenging.

The free radical scavenging activity of ZnO NPs synthesized using Rubia cordifolia can be attributed to their inherent antioxidant properties. These nanoparticles possess a large number of surface-active sites, allowing them to efficiently scavenge free radicals by donating electrons or hydrogen atoms.

RESULTS: The zinc oxide nanoparticles that were synthesized showed free radical scavenging activity.

CONCLUSION: In conclusion, the synthesis of zinc oxide nanoparticles using Rubia cordifolia has demonstrated potential antioxidant properties through its free radical scavenging activity. The study revealed that these nanoparticles possess the ability to neutralize harmful free radicals, thereby reducing oxidative stress and potentially offering protection against various diseases associated with oxidative damage.

KEYWORDS: Scavenging, free radical, rubia cordifolia, zinc oxide, nanoparticles

INTRODUCTION:

Zinc oxide nanoparticles (ZnO NPs) have gained significant attention in recent years due to their unique physicochemical properties and potential applications in various fields, including medicine, electronics, and catalysis One of the key properties of ZnO NPs is their ability to scavenge free radicals, which are highly reactive species implicated in various diseases and aging processes. In this context, the use of natural compounds as green synthesis agents for ZnO NPs has emerged as an approach to enhance their antioxidant activity.(1)

Rubia cordifolia, commonly known as Indian madder, is a medicinal plant widely used in traditional medicine for its antioxidant and anti-inflammatory properties**.((**2) plant contains several bioactive compounds, such as polyphenols and flavonoids which have been reported to exhibit strong free radical scavenging activity. Utilizing these natural compounds in the synthesis of ZnO NPs can potentially enhance their antioxidant properties and broaden their biomedical applications.

The synthesis of ZnO NPs using Rubia cordifolia involves a simple and eco-friendly approach, commonly known as the green synthesis method. This method eliminates the use of toxic chemicals and reduces the environmental impact associated with conventional synthesis methods. Furthermore, the green synthesis approach allows the incorporation of the plant's bioactive compounds onto the surface of ZnO NPs, which can enhance their stability and free radical scavenging ability**.**(3)

The scavenging of free radicals by ZnO NPs is attributed to their unique physicochemical properties, including their high surface area, large number of surface defects, and presence of oxygen vacancies. These properties enable ZnO NPs to efficiently interact with free radicals and neutralize them through redox reactions. Additionally, the bioactive compounds derived from Rubia cordifolia can provide an additional layer of antioxidant activity by effectively quenching free radicals and reducing oxidative stress.

In this study, we aim to synthesize ZnO NPs using Rubia cordifolia extract and evaluate their free radical scavenging activity. The synthesized nanoparticles will be characterized using various techniques, such as scanning electron microscopy (SEM) and X-ray diffraction (XRD), to determine their size, morphology, and crystalline structure. The antioxidant potential of the nanoparticles will be assessed using established assays, such as 2,2-diphenyl-1-picrylhydrazyl (DPPH),H2O2 assay and FRAP assay.

Overall, this study aims to explore the potential of Rubia cordifolia-mediated synthesis of ZnO NPs as an effective antioxidant agent with applications in biomedical and pharmaceutical fields. The utilization of natural compounds in nanoparticle synthesis offers a sustainable and environmentally friendly approach while harnessing the inherent antioxidant properties of the plant extracts.

MATERIALS AND METHODS:

In this study, zinc oxide nanoparticles were synthesized using the plant extract of Rubia cordifolia as a green and eco-friendly approach. The following materials and methods were employed.The study was done in Saveetha Dental College and the duration of the study was 3 months .

1.Plant material and extract preparation:

Fresh Rubia cordifolia plant leaves were collected and thoroughly washed to remove any impurities. The leaves were then dried and ground into a fine powder. The plant extract was prepared by mixing a specific amount of the powdered plant material with a suitable solvent (e.g. distilled water)and subjected to sonication or stirring for a designated time to obtain the RC extract.

2.Synthesis of Zinc Oxide Nanoparticles:

Zinc nitrate or zinc acetate precursor salts were dissolved in a solvent (e.g., ethanol) to form a clear solution. The RC extract was then added dropwise to the zinc precursor solution under continuous stirring. The reaction mixture was heated at a controlled temperature and stirred for a defined time to facilitate the reduction of zinc ions and the formation of ZnO NPs. The color change of the solution from colorless to pale yellow or white indicated the formation of nanoparticles.

3.Characterization:

The synthesized ZnO nanoparticles were characterized using various techniques such as UV-Visible spectroscopy, X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), and transmission electron microscopy (TEM) to analyze their optical,and morphological properties.

4.Free Radical Scavenging Activity:

The free radical scavenging activity of the synthesized ZnO NPs was evaluated using standard antioxidant assays like DPPH (2,2-diphenyl-1-picrylhydrazyl) assays. The percentage of scavenging activity was calculated, and results were compared with standard antioxidants.

RESULTS:

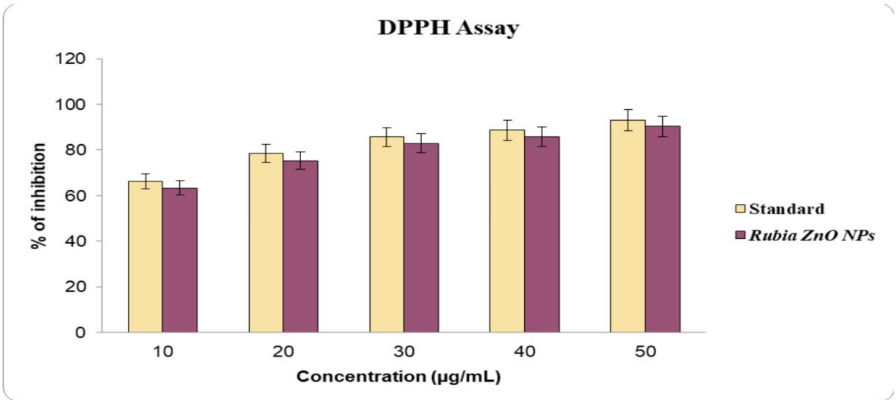

FIG 1: DPPH ASSAY

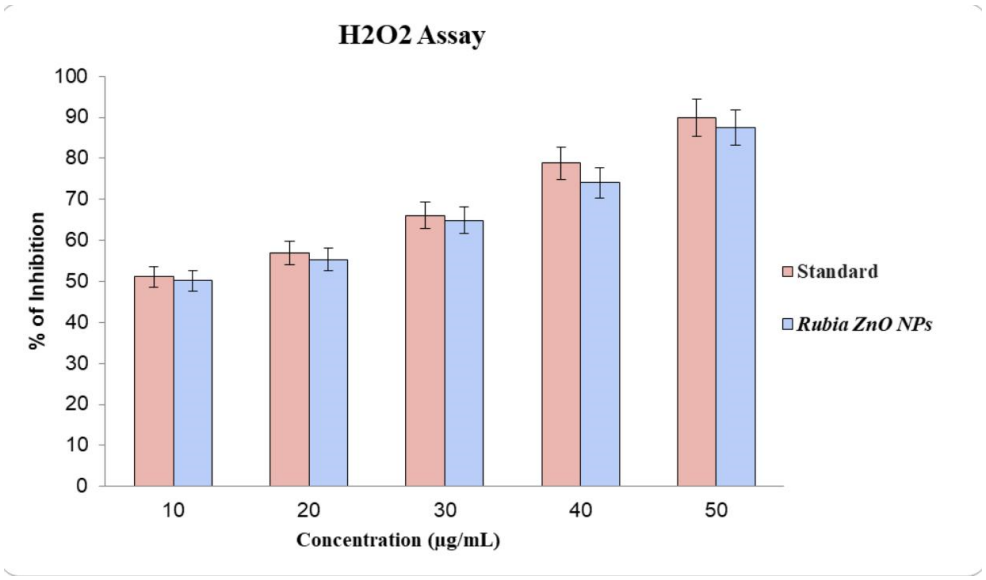

Fig2-H2O2 ASSAY

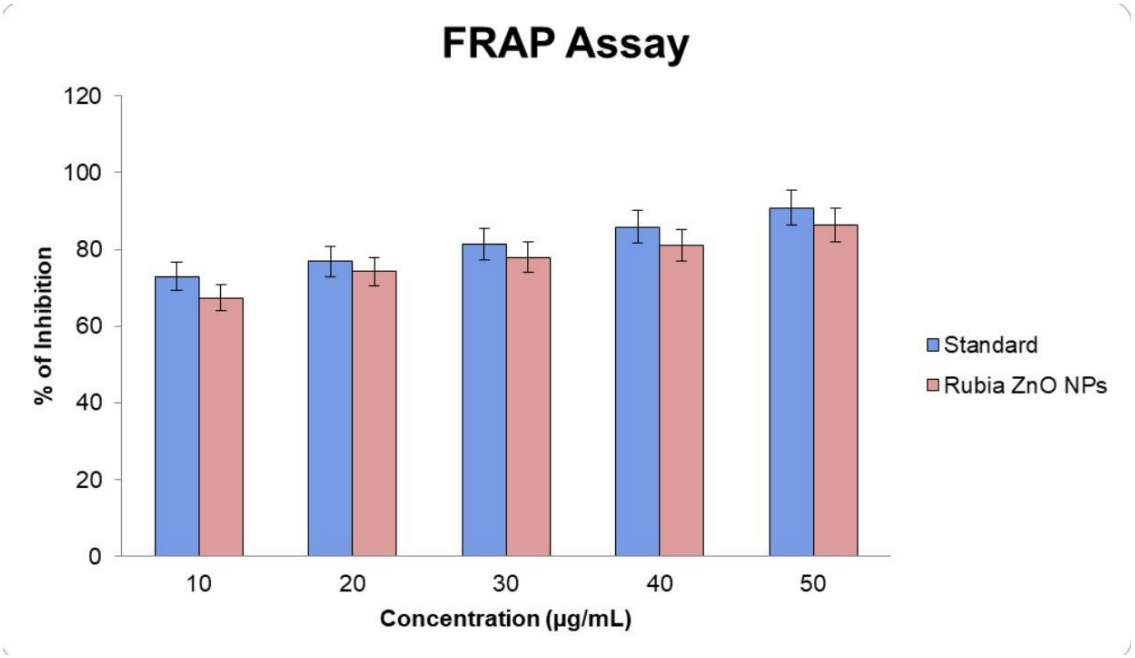

FIGURE.3-FRAP ASSAY

DISCUSSION:

Zinc oxide nanoparticles (ZnO NPs) synthesized using Rubia cordifolia, commonly known as Indian madder, have been investigated for their free radical scavenging potential. Rubia cordifolia is a medicinal plant known for its antioxidant properties, and its extract has been used in various applications, including nanoparticle synthesis.**(**(4)

The synthesis of ZnO NPs using Rubia cordifolia extract involves a green and eco-friendly approach. The extract serves as a reducing and capping agent during nanoparticle formation, thereby eliminating the need for toxic chemicals.(5) The resulting ZnO NPs exhibit unique physicochemical properties, including a high surface area, small size, and enhanced reactivity, which make them suitable candidates for free radical scavenging.

The free radical scavenging activity of ZnO NPs synthesized using Rubia cordifolia can be attributed to their inherent antioxidant properties. These nanoparticles possess a large number of surface-active sites, allowing them to efficiently scavenge free radicals by donating electrons or hydrogen atoms.(5,6) The scavenging of free radicals helps prevent oxidative damage, which is associated with various diseases, including cancer, cardiovascular disorders, and neurodegenerative conditions.

Moreover, the small size of the nanoparticles enables them to penetrate cellular compartments, including mitochondria, where free radicals are produced in abundance. By neutralizing these reactive species, ZnO NPs synthesized using Rubia cordifolia extract can mitigate oxidative stress and protect cells from damage.

Additionally, the use of Rubia cordifolia extract in nanoparticle synthesis introduces bioactive compounds present in the plant extract into the ZnO NPs. These bioactive compounds can synergistically enhance the free radical scavenging activity of the nanoparticles, providing an additional boost to their antioxidant potential. *(7)*

In conclusion, the synthesis of ZnO NPs using Rubia cordifolia extract offers a green and sustainable approach to obtain nanoparticles with excellent free radical scavenging properties. The inherent antioxidant properties of the plant extract,

combined with the unique physicochemical properties of the nanoparticles, contribute to their efficient neutralization of free radicals. These findings suggest the potential application of ZnO NPs synthesized using Rubia cordifolia in various fields, including medicine, cosmetics, and food industry, for their antioxidant and cytoprotective effects. However, further research is warranted to explore their safety, efficacy, and potential therapeutic applications.

CONCLUSION:

In conclusion, the study demonstrated that Zinc Oxide nanoparticles synthesized using Rubia cordifolia possess potent free radical scavenging abilities. The nanoparticles exhibited efficient antioxidant properties, indicating their potential application in biomedical and pharmaceutical fields.

SCOPE OF RESEARCH:

Further research on their toxicity profile and in vivo efficacy is warranted before considering their therapeutic use.

Author Contribution:

All authors have equally contributed to the research.

Conflict of Interest : Nil

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1.Saveetha Institute of Medical and Technical Science
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3.Saveetha University
4.KPC pipes

ETHICAL CLEARANCE NUMBER:

Since it is in vitro study ethical clearance is not needed.

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