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Article

Green Synthesis of Zno Nanoparticles Using Musa Acuminata 'Red Dacca' Peel Extract, Structural Characterization and Antibacterial Studies

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Abstract: Developments in nanotechnology are marking the researcher's interest in regards to green preparation of Nano particles. In this existing study zinc oxide (ZnO) nano particles were prepared with Musa acuminata 'Red Dacca' peel inhibiting solution. The peel extract act as a reducing agent. ZnO Nano particles formations was confirmed by the colour change when zinc acetate solution was added to peel extract. Phytochemical screening of Musa acuminata 'Red Dacca' peel extract was carried. Zinc oxide nanoparticles prepared by bio method were studied using UV-Vis analysis, XRD, SEM. Both gram-positive and gram-negative pathogens were utilized in the establishment of the antimicrobial study of the zinc oxide nanoparticles.

Keywords: Biosynthesized, Zinc Oxide Nanoparticles, Reducing Agent, Antimicrobial

Introduction

Nanotechnology is the science and innovation of tiny things specifically, things that are under 100 nanometers in size. The area of nanoscience has become progressively significant as of late [1]. Naturally, nanotechnology as defined by size encompasses a wide range of scientific disciplines, including energy storage, microfabrication, molecular engineering, organic chemistry, molecular biology, semiconductor physics, and more [2-4]. From security to medicine, nanotechnology has an impact on almost every aspect of everyday life. Analyses can be conducted down to the level of manipulating atoms, molecules, and the chemical bonds that connect them in nanotechnology. [5]. the properties of nanoparticles (NPs) can be changed and have unique structures. Because of this, they are useful in numerous real-world applications.

Preparation of Nanoparticles

Chemical or biological synthesis can produce nanoparticles. Due to the presence of some toxic chemicals that are absorbed by the surface, chemical synthesis methods have been linked to numerous negative effects. The synthesis of nanoparticles using microorganisms, enzymes, fungi, plants, or plant extracts is an environmentally friendly alternative to chemical and physical methods [6].

Green Synthesis

This green synthesis method outperforms other methods in several ways, including its simplicity, cost-effectiveness, use of fewer toxic materials, and use of fewer temperatures [7]. Additionally, it can be used in both food and medical applications. The synthesis of various metal nanoparticles using fungi and bacteria is just one of many such experiments that have already begun. However, the most widely used method for going green is the synthesis of nanoparticles from plant extracts. [8, 9]. the plant part chosen for investigation in this study is listed in Table 1.

Table 1. Selected Plant and Plant Part

Name of the Plant	Plant Part
Musa Acuminata 'Red Dacca' (MARD)	Peel

Materials and Methods

Collection of Musa Acuminata 'Red Dacca' Peel

MARD fruit were purchased from the commercial market of Sulur, Tamil Nadu, India. The peel was separated from the fruit pulp. The peel was cleaned with water for a few times and washed with refined water for 2 – 3 times and were air dried and powdered.

Green Preparation Of Zno NP's

5 g dried, powdered MARD peel were dissolved in 100 mL of water taken in 250 mL conical flask and boiled for about 2 hours in water bath and filtered using filter paper. By dissolving 10 grams in 50 milliliters of distilled water in a clean, dry conical flask, 1 M of zinc acetate was freshly prepared and stirred for an hour. 20 mL of MARD peel extract and 50 mL of zinc acetate solution were added and mixed well. After one hour of incubation, the color of the reaction mixture changed and it was continued stirring for 3 hours. Appearance of the dirty white colour after the incubation time confirmed the synthesis of ZnO NP's. The synthesized nanoparticles were used for further characterization [10].

Phytochemical Analysis

Using qualitative methods as described by Kokate (2004) and Harborne (1998), the MARD peel extract was subjected to phytochemical analysis to identify the chemical constituents present [11, 12].

Characterization of ZnO NP's

UV-Visible spectroscopy, SEM analysis and XRD studies were applied for characterization of prepared ZnO NP's.

Anti- Microbial Studies

Agar- Well Diffusion Method

Principle

Antimicrobials existing in the MARD aqueous solution were made to disperse into the medium and combined with freshly cultivated test organisms. The subsequent zones of restraint will be consistently round as there will be an intersecting grass of development. The zone of inhibition's diameter can be measured in decimeters.

Procedure

The bacterial strains were cultured for 24 hours on petri dishes containing 20 milliliters of Muller Hinton medium. 20 milliliters of the plant extract (namely chloroform, methanol, and aqueous extracts) were added after wells were cut. The antibacterial activity was measured by measuring the diameter of the inhibition zone that formed around the well after the plates had been incubated for 24 hours at 37 °C. As a positive control, chloramphenicol disc was used [13].

Results and Discussions

Phytochemical Studies

Using qualitative methods as described by Kokate (2004) and Harborne (1998), the aqueous extract of MARD peel was subjected to preliminary phytochemical screening to determine the chemical composition of the plant.

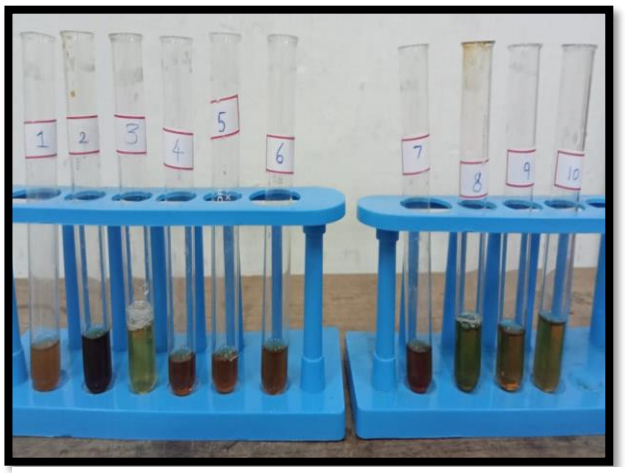

Figure 1. Phytochemical Analysis of MARD Peel Extract

Table 1. Phytochemical Analysis of MARD Peel Aqueous Extract

Phytocompounds	Present / Absent
Alkaloids	-
Tannins	+
Saponins	-
Phenols	+
Carbohydrates	+
Coumarins	+
Flavonoids	-
Reducing Sugars	+
Terpenoids	+
Quinones	+

Key words: '+'present, '-' absent

In order to make zinc oxide nanoparticles, the MARD peel extract was used as a cap and reducing agent in the reduction of the zinc ion in zinc acetate.

Characterisation of Zno Np's
Uv – Visible Spectroscopy

ZnO NPs prepared with MARD peel extract was subjected to UV - Visible spectrometer model JASCO v – 670 at Karunya Institute of Technology and Sciences, Coimbatore, to analysis the absorption peaks to predict the existence of ZnO NPs of the test solution.

Green-synthesized zinc oxide nanoparticles made from MARD peel extract were found to have an absorption peak at 320 nm in the current study (Figure 2). This suggests that the synthesized zinc oxide nanoparticles may be of the nanoscale [14].

XRD PATTERN

The synthesized ZnO nanoparticles were subjected to X - Ray diffractometer of model X - Pert Pro PANalyticalat Department of Chemistry, Avinashilingam Institute of Home Science, and Coimbatore. The values are mentioned in the Table 3,

Activity

Zinc oxide nanoparticles made from zinc acetate and MARD peel extract were tested for their ability to inhibit both gram-positive and gram-negative bacteria at three different concentrations—25 L, 50 L, and 75 L, respectively at GRG Food Quality Testing Laboratory, Coimbatore. Pseudomonas aeruginosa and Staphylococcus aureus were the studied bacteria. Figure 4 depicts the synthesized nanoparticle's antimicrobial activity.

The existences of these phytochemicals/auxiliary metabolites may be liable for the antibacterial movement of zinc oxide nanoparticles [15-18].

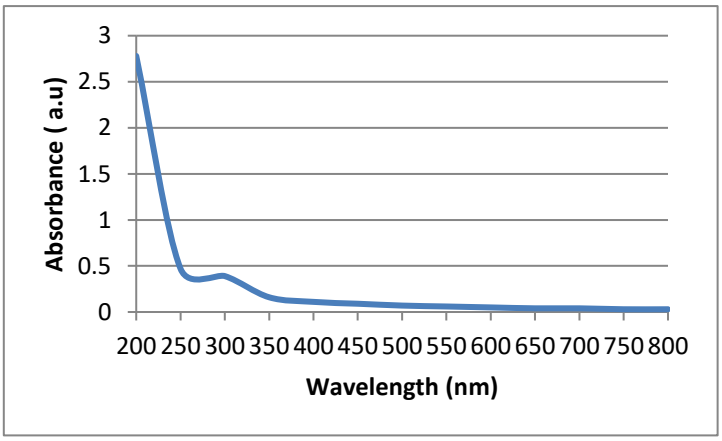

Figure 2. UV Spectrum of Prepared ZnO NP's

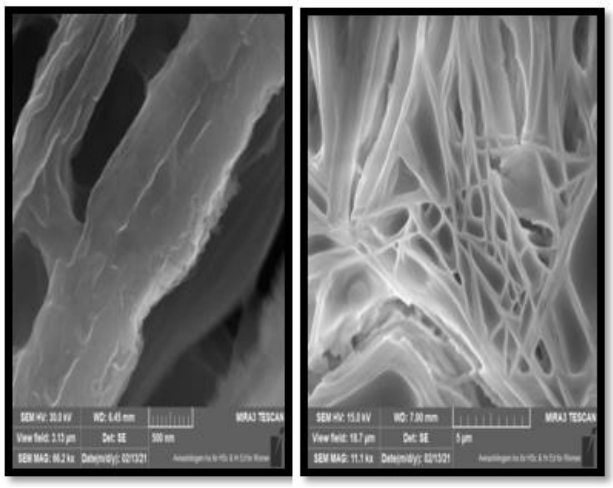

Figure 3. SEM Images of Synthesized ZnO Nanoparticle

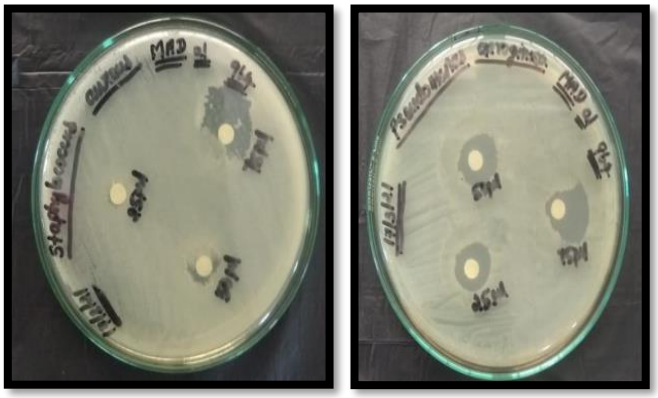

Figure 4. Antibacterial Activity of Synthesized ZnO NPs

Table 4. Zone of Inhibition for the Synthesized ZnO NPs

S. No	ORGANISMS	Standard Rifampicin (µg)	Zone of Inhibition (dm)		
			25 µL	50 µL	75 µL
1.	*Staphylococcus aureus*	13 dm	NoZone	1 dm	5 dm
2.	*Pseudomonas aeruginosa*	2 dm	5 dm	5dm	8 dm

S.No.	2 Θ (deg)	FWHM (deg)	Size (nm)
1.	36.5438	0.8029	12.34

Conclusion

Phytochemical analysis of MARD peel inhibiting solution showed the existence of tannins, phenol, and carbohydrate, coumarins, reducing sugar, terpenoids and quinone in the MRAD peel extract. The ZnO nanoparticles synthesized using MARD peel extract had rod shaped nanoparticles of rod shape with average size 12.34 nm and had good antibacterial activity against the selected bacteria.

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Conflict of Interest: The Authors has no conflicts of interest to declare that they are relevant to the content of this article.

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