

Biosurfactant mediated green synthesis of metal nanoparticles for enhancing seed germination and antimicrobial applications

**A THESIS SUBMITTED AS PARTIAL FULFILLMENT
FOR THE DEGREE OF**

**DOCTOR OF PHILOSOPHY
IN
BIOTECHNOLOGY**

To



THE ASSAM

ROYAL GLOBAL UNIVERSITY

By

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August 2023

DECLARATION

I do hereby declare that the content embodied in the PhD thesis entitled "**Biosurfactant mediated green synthesis of metal nanoparticles for enhancing seed germination and antimicrobial applications**" is the result of research work carried out by me in the Department of Biotechnology, The Assam Royal Global University, Guwahati, India, under the supervision of Dr. Debajit Borah, Associate Professor, Dept. of Biotechnology, The Assam Royal Global University, Guwahati, and co-supervision of Dr. Bidisha Sharma, Assistant Professor, Dept. of Botany, Cotton University, Guwahati.

In keeping with the general practice of reporting research observations, due acknowledgments have been made wherever the work described is based on the findings of other researchers.

Further, I declare that this thesis as a whole or any part thereof has not been submitted to any university (or institute) for the award of any degree/ diploma.

Date: 23/02/2024

Place: Guwahati, Assam


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CERTIFICATE FROM THE SUPERVISORS

This is to certify that the work presented in the thesis entitled "*Biosurfactant mediated green synthesis of metal nanoparticles for enhancing seed germination and antimicrobial applications*" by **Indukalpa Das**, submitted to the Assam Royal Global University for the award of the degree of Doctor of Philosophy in **Biotechnology**, is a record of the results obtained from the research work carried under our supervision.

This thesis conforms to the template and stipulated guidelines of the Assam Royal Global University, including the standard related to plagiarism, and has a plagiarism index of zero percent (0 %), excluding the bibliography.



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1 Introduction

In recent days, nanotechnology has arrived as a leading-edge trove of knowledge having multidimensional applications due to its unique structures and physical properties. The

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application of nano-scale structures is an emerging area of nanoscience and nanotechnology.

Abbreviations

Abbreviation	Full form
BH	Bushnell and Haas
BLAST	Basic Local Alignment Search Tool
BSA	(Bovine Serum Albumin)
CNT	Carbon nanotubes
DNA	Deoxyribonucleic acid
DNS	Dinitrosalicylic acid
DTA	Differential thermal analysis
EDTA	Ethylenediaminetetraacetic Acid
EPS	Exopolysaccharides
EU	European Union
FDA	Food and Drug Administration
FTIR	Fourier Transform Infrared Spectroscopy
GA	Gibberellic Acid
HL extract	Liver extract powder
HM peptone B	Meat extract powder
HR-TEM	High Resolution Transmission Electron Microscopy
IAA	Indole Acetic Acid
IDs	Identity Documents

IFAS	Institute for Food and Agricultural Standards
MBC	Minimal Bactericidal Concentration
MDR	Multidrug-Resistant
MEGAX™	Molecular Evolutionary Genetics Analysis X
MFC	Minimum Fungicidal Concentration
MH	Muller-Hinton
MIC	Minimal Inhibitory Concentration
MTT	3-[4,5-dimethylthiazol-2yl]-2,5 diphenyl tetrazolium bromide
NCBI	National Center for Biotechnology Information
NPs	Nanoparticles
NRL	Numaligarh Refinery Limited
PBS	Phosphate Buffer Saline
PDA	Potato Dextrose Agar
POPs	Persistent Organic Pollutants
RBC	Red Blood Cells
ROS	Reactive Oxygen Species
S.D.	Standard Deviation
SDS	Sodium Dodecyl Sulphate
SEM	Scanning Electron Microscopy
SOD	Superoxide Dismutase
TE	Tris-Ethylenediaminetetraacetic Acid
TEM	Transmission Electron Microscopy
TGA	Thermo-Gravimetric Analyzer

UN	United Nations
USD	United States Dollar
USEPA	United States Environmental Protection Agency
UV	Ultraviolet
WHO	World Health Organization
XRD	x-Ray Diffraction

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