SYNTHESIS, CHARACTERISATION AND ASSESSMENT OF ANTIMICROBIAL ACTIVITY OF DOPED ZINC OXIDE NANOPARTICLES AGAINST SELECTED WATERBORNE PATHOGENS

Dissertation submitted in fulfilment of the requirements for the *M Technologiae* in Biotechnology at Vaal University of Technology

In the Faculty of Applied and Computer Sciences

Department of Biotechnology

Name of Student: Nomasamariya Elsie Volofu

Student number: 207045160

Supervisor: Dr M. Klink

Co-supervisors: Mr N. Laloo and Dr F. Mthunzi

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DECLARATION

This work had never been accepted in substance for any degree.

Signed.....

Date.....

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DEDICATION

This dissertation is dedicated to my family; my sister Cokiswa who fully believed in me and supported me emotionally. My father Thabile Volofu, who groomed and supported me financially to achieve what I have been dreaming of; my mother Louisa Volofu, who trained and nurtured me to become a determined individual. I also dedicate my degree to NRF bursary for paying fees for my research since I have started.

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ABSTRACT

The aim of the study is to synthesise, characterize and assess the antimicrobial activity of cobalt oxide, zinc oxide and cobalt-doped zinc oxide nanoparticles against selected waterborne pathogenic fungi (yeasts and moulds) and bacteria. Various types of oxide based nanomaterial are an attractive option for the disinfection of water due to its high chemical stability and non-toxicity towards human cells. Synthesis of Co -doped ZnO and Co_3O_4nanoparticles was done through mechanochemical synthesis and urea based synthesis and microwave heating was employed for the preparation of ZnO nanoparticles.

The ZnO nanoparticles were produced in short reaction and it was white color. Cobalt oxide (Co_3O_4) nanoparticles appeared as a pink precipitate but was turned black after being calcined. The synthesis of Co- ZnO nanoparticles was successfully prepared and blue solid was obtained from pink cobalt ion solution. The nanoparticles were characterised by X- Ray Diffraction (XRD), Fourier Infrared Spectroscopy (FTIR), UV–visible spectroscopy, Transmission Electron Microscopy (TEM) and Scanning Electron Microscopy (SEM) (Yang *et al.* 2003).

In this research project, the antibacterial activities of NPs were carried out by well diffusion method and minimum inhibitory concentration (MIC). MIC is the lowest concentration of a chemical, usually a drug, which prevents visible growth of bacterium. Bacterial strains used in the study are: *Salmonella enterica, Escherichia coli, Shigella sonnei* and *Staphylococcus aureus*, yeast and mould is: *Candida albicans* and *Aspergillus niger.* The antimicrobial results obtained showed that ZnO nanoparticles are more effective than Co- ZnO and Co_3O_4 nanoprticles against all the microorganisms used. The toxicity studies were performed using DAPHTOXKIT F and the 24h EC50 and 48h EC50 were calculated according to the

manufactures' instructions. The results showed that Co- ZnO nanoparticles is less toxic to *Daphnia magna* compared to ZnO and Co_3O_4 NPs.

Key words: Nanoparticles, antimicrobial activity, reactive oxygen species

ABBREVIATIONS

Co_3O_4	Cobalt oxide
DMS	diluted magnetic semiconductors
FTIR	Fourier Infrared Spectroscopy
SEM	Scanning Electron Microscopy
TEM	Transmission Electron Microscopy
UV	Ultra violet
XRD	X- Ray Diffraction
ZnO	Zinc oxide
NP	Nanoparticle
ROS	Reactive Oxygen Species
GSH	(g-L-glutamyl-L-cysteinylglycine) oxidation methods

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