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**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**

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DECLARATION

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

Signed.....

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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_4 nanoparticles 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 nanoparticles 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 Co₃O₄ NPs.

Key words: Nanoparticles, antimicrobial activity, reactive oxygen species

ABBREVIATIONS

Co ₃ O 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

TABLE OF CONTENTS	PAGE
DECLARATION.....	ii
ACKNOWLEDGEMENTS	iii
DEDICATION	iv
ABSTRACT.....	v
ABBREVIATIONS.....	vii
TABLE OF CONTENTS	viii
LIST OF TABLES.....	xii
LIST OF FIGURES.....	xiii
CHAPTER 1	1
INTRODUCTION	1
1.1 BACKGROUND	1
1.2 RATIONALE/MOTIVATION	3
1.3 PROBLEM STATEMENT	3
1.4 AIM	4
1.5 OBJECTIVES	4
1.6 THESIS OUTLINE	5
CHAPTER 2	6
LITERATURE REVIEW	6
2.1. Waterborne Pathogens	6
2.1.1. <i>Escherichia coli</i>	6
2.1.2. <i>Vibrio cholera</i>	7
2.1.3. <i>Salmonella</i>	7
2.1.4. <i>Shigella</i>	8
2.2 Traditional disinfection methods	8

2.2.1. Chlorine	9
2.2.2. Ozone	10
2.2.3. Ultraviolet (UV) light	11
2.3 Preparation methods for synthesis of metal oxides/NPs	11
2.3.1 Sol-gel	12
2.3.2 Reverse micelles	13
2.3.3 Chemical reduction	13
2.3.4 Microwave -assisted synthesis	14
2.4 Characterisation methods	15
2.4.1 UV- Vis Spectroscopy	15
4.2.2 Fourier Infrared Spectroscopy (FTIR)	16
4.3.3 Scanning Electron Microscopy (SEM)	16
2.4.4 Transmission Electron Microscopy (TEM)	16
2.5 Antibacterial activity of ZnO NPs.....	17
2.5.1 Penetration mechanism of NPs	17
2.5.2 Antibacterial activity	17
2.6 Methods used to assess antimicrobial activity	18
2.6.1 The disk diffusion	18
2.6.2 Minimal inhibitory concentration (MIC)	18
2.7 Advanced NPs for disinfection purposes and their nanocomposites	19
2.7.1 ZnO NPs	19
2.7.2 Cobalt NPs	21
2.7.3 Cobalt doped Zinc oxide NPs	22
2.8 Water toxicity	25

CHAPTER 3.....	27
3. Research methodology	27
3.1 Reagents and chemicals	27
3.2 Synthesis of nanoparticles- Experimental procedure	27
3.2.1 Urea based synthesis of ZnO nanoparticles	27
3.2.2 Synthesis of Co ₃ O ₄ nanoparticles using mechanochemical synthesis	28
3.2.3 Synthesis of Co- doped ZnO nanoparticles	28
3.3 Characterisation of the synthesised nanoparticles	29
3.3.1 FTIR	29
3.2.2 Uv- Vis spectroscopy	29
3.2.3 SEM	29
3.2.4 TEM	30
3.4 Antibacterial activity	30
3.4.1 Prerequisites	30
3.4.2 Agar deep well diffusion	31
3.4.3 Minimal inhibitory concentration	31
3.5 Toxicity test using <i>Daphnia magna</i> (Daphtox) kit	33
CHAPTER 4	36
4. Charactersation results and discussion.....	36
4.1. Introduction	36
4.1.1 Synthesized NPs.....	36
4.2. Characterisation results	36
4.1.1 ZnO NPs	36

4.1.2 Co ₃ O ₄ NPs	36
4.1.3 Co –doped ZnO NPs	37
4.2 Uv- Vis spectroscopy	37
4.3 FTIR spectral analysis	40
4.4 Transmission Electron Microscopy	43
CHAPTER 5.....	49
5 Antimicrobial results.....	49
5.1 Antimicrobial tests	49
5.1.1 Disc diffusion assay	49
5.1.2 Antibacterial activity of selected bacterial strains	50
5.2 Minimal inhibitory concentration	62
<i>S. sonnei</i>	63
<i>S. aureus</i>	65
<i>E. coli</i>	67
<i>S. enterica</i>	68
<i>C. albicans</i>	71
<i>A. niger</i>	72
5.3 Toxicity results	74
CHAPTER 6	79
6. COCLUSIONS AND RECOMMENDATIONS	79
6.1 Conclusions	79
6.2 Recommendations	81
Chapter 7	82
References	82

LIST OF TABLES

Table 3.1. Waterborne pathogens	32
Table 5.1 Mean zone of inhibition (in mm) produced by synthesised ZnO, Co ₃ O ₄ and Co-ZnO NPs against <i>S. aureus</i>	52
Table 5.2 Mean zone of inhibition (in mm) produced by synthesised ZnO, Co ₃ O ₄ and Co-ZnO NPs against <i>S. sonnei</i>	54
Table 5.3 Mean zone of inhibition (in mm) produced by synthesised ZnO, Co ₃ O ₄ and Co-ZnO NPs against <i>S. enterica</i>	56
Table 5.4. Mean zone of inhibition (in mm) produced by synthesised ZnO, Co ₃ O ₄ and Co-ZnO NPs against <i>E. coli</i>	58
Table 5.5. Mean zone of inhibition (in mm) produced by synthesised ZnO, Co ₃ O ₄ and Co-ZnO NPs against <i>A. niger</i>	61
Table 5.6 MIC values of synthesised ZnO and Co ₃ O ₄ NPs at different ratios against selected bacteria	69
TABLE 5.7: MIC values of synthesised ZnO at different ratios against <i>C. albicans</i> and <i>A. niger</i>	73

LIST OF FIGURES

Figure 2.1: Illustration of antibacterial activity	17
Figure 3.1: Concentrated salts that are used to prepare standard water.....	33
Figure 3.2: Apparatus for the dilution of NPs using standard water	34
Figure 4. 1: UV-Vis absorption spectrum recorded for ZnO NPs	37
Figure 4. 2: UV-Vis absorption spectrum recorded for Co_3O_4 NPs	38
Figure 4.3: Uv- vis spectrum recorded for Co- doped ZnO NPs	39
Figure 4.4: FTIR results for ZnO NPs at different ratios	40
Figure 4.5: FTIR results for Co_3O_4 at different ratios	41
Figure 4.6: FTIR results for Co- ZnO NPs from 0- 10%	42
Figure 4.7: TEM results for ZnO at different ratios	43
Figure 4.8: TEM results for Co_3O_4 NPs at different ratios.....	44
Figure 4.9: TEM results for Co doped ZnO NPs at different percentages (a) 1%, (b) 4%, (C) 7% and (d) 10%.....	45
Figure 4.10: SEM results for ZnO NPs at different ratios.....	46
Figure 4.11: SEM results for Co_3O_4 NPs at different ratios	47
Figure 4.12: SEM results for Co- doped ZnO NPs at different ratios	48
Figure 5.1: Antibacterial activity (zone of inhibitions) of the biosynthesized	
(A) ZnO NPs against <i>S. aureus</i>	50
(B) Co_3O_4 NPs against <i>S. aureus</i>	50

(C) Co-ZnO NPs against <i>S. aureus</i>	51
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Figure 5.2: Antibacterial activity (zone of inhibitions) of the biosynthesized

(A) Co ₃ O ₄ NPs against <i>S. sonnei</i>	53
(B) ZnO NPs against <i>S. sonnei</i> and.....	53
(C) Co-ZnO NPs against <i>S. sonnei</i>	53

Figure 5.3: Antibacterial activity (zone of inhibitions) of the biosynthesized

(A) ZnO NPs against <i>S. enterica</i>	55
(B) Co ₃ O ₄ NPs against <i>S. enterica</i> and.....	55
(C) Co-ZnO NPs against <i>S. enterica</i>	55

Figure 5.4: Antibacterial activity (zone of inhibitions) of the biosynthesized

(A) ZnO NPs against <i>E. coli</i>	57
(B) Co ₃ O ₄ NPs against <i>E. coli</i>	57
(C) Co-ZnO NPs against <i>E. coli</i>	57

Figure 5.5: Antifungal activity (zone of inhibitions) of the biosynthesized

(A) ZnO NPs against <i>C. albicans</i>	59
(B) Co ₃ O ₄ NPs against <i>C. albicans</i>	59
(C) Co-ZnO NPs against <i>C. albicans</i>	59

Figure 5.6: Antifungal activity (zone of inhibitions) of the biosynthesized

(A) ZnO NPs against <i>A. niger</i>	60
(B) Co ₃ O ₄ NPs against <i>A. niger</i> and.....	60

(C) Co-ZnO NPs against <i>A. niger</i>	60
Figure 5.7: MIC results for <i>S. sonnei</i> against Co_3O_4 and ZnO NPs at ratio 1:1 and 1: 2	63
Figure 5.8: MIC results for <i>S. sonnei</i> against ZnO NPs at ratio 1:4 and 2:1	64
Figure 5.9: MIC results for <i>S. aureus</i> against ZnO NPs at ratio 1:1, 1:2 and 2:1.....	65
Figure 5.10: MIC results for <i>S. aureus</i> against ZnO NPs at ratio 1:4.....	66
Figure 5.11: Mic results for <i>E. coli</i> against ZnO NPs at ratio 1:1, 1:2, 1:4 and 2:1.....	67
Figure 5.12: MIC results for <i>S. enterica</i> against ZnO NPs at 1:1, 1:2, 1:4 and 2:1.....	68
Figure 5.13: MIC results for <i>C. albicans</i> against ZnO NPs at 1:1, 1:2, 1:4 and 2:1.....	71
Figure 5.14: MIC results for <i>A.niger</i> against ZnO NPs at 1:1, 1:2, 1:4 and 2:1.....	72
Figure 5.15. Predicted mortality at 24 and 48 h of exposure for ZnO NPs.....	75
Figure 5.16 Predicted mortality at 24 and 48 h of exposure for Co_3O_4 NPs.....	75
Figure 5.17. Predicted mortality at 24 and 48 h of exposure for Co-ZnO NPs.....	77

