

**SYNTHESIS OF ZINC OXIDE NANOPARTICLES AND ANTIBACTERIAL
ACTIVITY AGAINST GRAM-POSITIVE AND GRAM-NEGATIVE BACTERIA**

MUHAMAD FAEZ BIN LUKMAN

SUPERVISOR: DR NORASHIKIN BINTI MAT ZAIN

**BACHELOR OF CHEMICAL ENGINEERING
UNIVERSITI MALAYSIA PAHANG**

LIST OF ABBREVIATIONS AND SYMBOLS

ZnO	Zinc oxide
UV-Vis	UV visible
FTIR	Fourier transform infrared spectroscopy
FESEM	Field emission scanning electron microscope

TABLE OF CONTENTS

CHAPTER 1	9
INTRODUCTION	9
1.1 Background	9
1.2 Motivation.....	10
1.3 Problem statement	11
1.4 Objectives	12
1.5 Scope of study	13
CHAPTER 2	14
LITERATURE REVIEW	14
2.1 Nanoparticles.....	14
2.2 ZnO nanoparticles	15
2.3 Application of ZnO nanoparticles	16
2.4 Synthesis route of ZnO nanoparticles.....	18
2.5 Antibacterial activity of ZnO nanoparticles.....	19
2.6 Reduction agent.....	20
2.7 Stabilizing agent.....	21
2.8 Characterization method.....	22
2.9 Microwave heating	26
CHAPTER 3	28
METHOD	28
3.1 Chemical used	28
3.2 Synthesis of chitosan–ZnO nanoparticles	28
3.3 Screening synthesis.....	29
3.4 Flowchart of ZnO nanoparticles synthesis.....	30
3.5 Characterization.....	31
3.5.1 UV-Vis spectrophotometry	31
3.5.2 Field emission scanning electron microscope (FESEM).....	31
3.5.3 Fourier transform infrared spectroscopy (FTIR)	31
3.6 Antibacterial activity	32
3.6.1 Disc diffusion method.....	32
CHAPTER 4	33
RESULTS & DISCUSSION	33

4.1	UV-Vis Spectrophotometry	33
4.2	Fourier transform infrared spectroscopy (FTIR).....	36
4.3	Field Emission Scanning Electron Microscope (FESEM).....	37
4.4	Growth Curve of Bacteria.....	40
4.5	Disc Diffusion Method	42
CHAPTER 5.....		44
CONCLUSION AND RECOMMENDATION		44
5.1	CONCLUSION	44
5.2	RECOMENDATION	45
REFFERENCES		46
APPENDICES.....		50

LIST OF TABLE

Table 2.4-1: The method and condition of producing ZnO nanoparticles.....	18
---	----

LIST OF FIGURES

Figure 2.2.1: Examples of ZnO nanoparticles structure: (a) flower rods (b) rods (c,d) wires (Kolodziejczak, 2014).	15
Figure 2.3.1 The Type of Industries that uses ZnO nanoparticles	17
Figure 2.8.1: Field Emission Scanning Electron Microscope.....	22
Figure 2.8.2: Fourier Transform Infrared Spectroscopy.....	23
Figure 2.8.3: UV-Visible Spectroscopy.....	24
Figure 2.8.4: Staphylococcus aureus under electron microscope	25
Figure 2.8.5: Escherichia coli under electron microscope.....	25
Figure 4.1.1 Effect of concentration of NaOH.....	34
Figure 4.1.2: Effect of irradiation power	35
Figure 4.1.3: Effect of irradiation time	36
Figure 4.2.1 FTIR spectra for the ZnO nanoparticles synthesized.....	36
Figure 4.3.1: FESEM Image of ZnO nanoparticles at 1.0 M of NaOH, 500 Watt and 7 minutes at 50 k	38
Figures 4.3.2: FESEM Image of ZnO nanoparticles at 1.0 M of NaOH, 500 Watt and 7 minutes at 60 k	39
Figure 4.3.3: FESEM Image of ZnO nanoparticles at 1.0 M of NaOH, 500 Watt and 7 minutes at 80 k	39
Figure 4.4.1: The growth curve of bacteria E. coli.....	41
Figure 4.4.2: The growth curve of bacteria S. aureus.....	42
Figure 4.5.1 The Inhibition effect between the two bacteria	43
Figure 5.2.1: The Control of S. Aureus bacteria	50
Figure 5.2.2: The S. Aureus bacteria that is tested with the ZnO naoparticles	50
Figure 5.2.3: The control of E.Coli bacteria	51
Figure 5.2.4: The E.Coli bacteria that is tested with ZnO nanoparticles	51
Figure 5.2.5: The ZnO nanoparticles sample after microwave heating.....	52
Figure 5.2.6: The ZnO nanoparticles after centrifuge and drying.....	52