

**IDENTIFICATION OF IRON NANOPARTICLES-
SYNTHESIZING BACTERIA**

NUR ATHIRAH BINTI ZULKIFLI

**BACHELOR OF SCIENCE (Hons.) BIOLOGY
FACULTY OF APPLIED SCIENCES
UNIVERSITI TEKNOLOGI MARA**

JANUARY 2016

ACKNOWLEDGEMENTS

At first, Alhamdulillah, the highest praise to God the Almighty for his blessing and pleasure for allowing me in completing my final year project from the start until the end. I would like to express my sincere gratitude to my supervisor, Miss Siti Suhaila bt Harith for her continuous and stimulating suggestions, patience, immense knowledge and motivation support throughout the whole process of completing this project. Her guidance helped me in all the time of research and writing of this thesis. Besides my supervisor, I would like to thank Dr. Aiza bt Harun for her encouragement and valuable guidance extended to me.

Not to forget, I take this opportunity to express gratitude to the lab assistants, Mr. Norhafidzan bin Mahbob and Mr. Suhairi bin Suib who gave access to the laboratory and for providing me with all the necessary research facilities and equipment. I also thank my parents for the continuous encouragement, attention and support. Last but not least, my sense on gratitude to one and all, who directly or indirectly have lent their hands in this final year project.

Nur Athirah binti Zulkifli

TABLE OF CONTENTS

	PAGE
ACKNOWLEDGEMENTS	iii
TABLE OF CONTENTS	iv
LIST OF TABLES	vi
LIST OF FIGURES	vii
LIST OF ABBREVIATIONS	viii
ABSTRACT	x
ABSTRAK	xi
CHAPTER 1: INTRODUCTION	
1.1 Background of Study	1
1.2 Problem Statement	4
1.3 Significance of Study	4
1.4 Objectives of the Study	5
CHAPTER 2: LITERATURE REVIEW	
2.1 Iron Nanoparticles	6
2.2 Uses and Applications of Iron Nanoparticles	
2.2.1 Environmental remediation	7
2.2.2 Nanomedicine applications	8
2.2.3 As additives in construction materials and coating	9
2.3 Potential Bacterial Strains for the Synthesis of Iron Nanoparticles	10
2.4 Bacteria Morphology	11
2.5 Biochemical Tests	13
CHAPTER 3: METHODOLOGY	
3.1 Materials	16
3.1.1 Raw materials	16
3.1.2 Chemicals	16
3.1.3 Apparatus	16
3.2 Methods	17
3.2.1 Screening of iron nanoparticles-synthesizing bacteria	17
3.2.1.1 Spectrophotometric determination of iron oxide nanoparticles	18

3.2.2	Morphological observation	18
3.2.2.1	Colony morphology	18
3.2.2.2	Cellular morphological observation	18
	a) Preparing smears for staining	18
	b) Staining procedures	19
	c) Endospore staining	19
	d) Flagella staining	20
	e) Negative staining	20
3.2.3	Biochemical Tests	20
3.2.3.1	Catalase Test	21
3.2.3.2	Citrate Utilization Test	21
3.2.3.3	Urease Test	
3.2.3.4	Methyl Red Test	22
3.2.4	Measuring bacterial size	22
3.2.5	Bacteria motility and oxygen requirements	23
3.2.6	Temperature adaptation for growth	23

CHAPTER 4: RESULTS AND DISCUSSION

4.1	Screening of Iron Nanoparticles-Synthesizing Bacteria	24
4.2	Spectrophotometric Determination of Iron Oxide Nanoparticles	25
4.3	Colony Morphology of Bacteria Sample 209	27
4.4	Bacterial Size and Shape	29
4.4	Cellular Morphology	29
4.5	Biochemical Tests	33
4.6	Oxygen Requirement for Growth and Bacterial Motility	38
4.7	Temperature for Growth	39

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS 40

CITED REFERENCES	42
APPENDICES	44
CURRICULUM VITAE	45

ABSTRACT

IDENTIFICATION OF IRON NANOPARTICLES-SYNTHESIZING BACTERIA

Iron nanoparticles synthesized by microorganisms especially bacteria provide many advantages to the human and environment due to their unique and special properties of cost-effective, non-toxicity, and eco-friendly. Thus, bacterial identification is the crucial step of exploring these iron nanoparticles-synthesizing bacteria for further uses and applications. The main objectives of this study are to screen bacteria that can synthesize iron nanoparticles, to identify the bacteria through colony and cellular morphological observations and biochemical tests. The strain was identified by first screening of the bacterial sample through the formation of iron nanoparticles using UV-Vis spectroscopy, followed by morphological observations and biochemical tests. During screening, supernatant bacteria sample labeled as 209, 49, MW1 and WW2 had 0.12 mg/mL, 0.17 mg/mL, 0.15 mg/mL and 0.19 mg/mL of Fe₂O₃, respectively. Supernatant bacteria labeled 209 contained the lowest amount of Fe₂O₃ and this indicated that more Fe₂O₃ was reduced to Fe₃O₄. Bacterium labeled 209 was proceed with identification tests. This strain was aerobic, thermophiles, motile, Gram variable and rod-shaped bacterium with the size of 0.128 μm × 0.654 μm. The colonies have irregular form and white pigmentation as well as wrinkled surface. This bacterial strain was an endospore-former and containing extracellular protective capsule. This bacterium shows positive catalase and citrate tests, meanwhile negative for urease and Methyl-Red tests. The strain was identified as *Bacillus sp.*