



**UNIVERSITI PUTRA MALAYSIA**

***Ipomoea aquatica* Forssk AS POTENTIAL PHENOL  
PHYTOREMEDIATOR**

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**FBSB 2015 108**

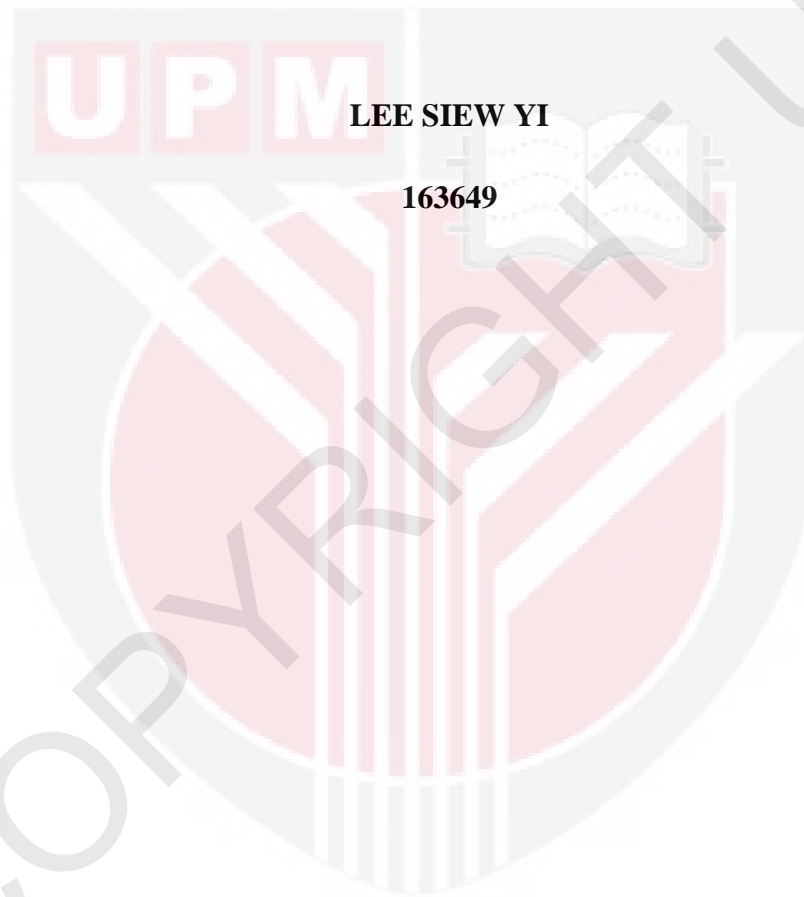
***Ipomoea aquatica* Forssk AS POTENTIAL PHENOL PHYTOREMEDIATOR**

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**Dissertation submitted in partial fulfillment of the requirement for the course  
BMY 4999 Project in the Department of Microbiology  
Universiti Putra Malaysia  
JUNE 2015**

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## PENGESAHAN

Dengan ini adalah disahkan bahawa projek yang bertajuk “*Ipomoea aquatica* Forssk as Potential Phenol Phytoremediator” telah disiapkan serta dikemukakan kepada Jabatan Mikrobiologi oleh Lee Siew Yi (163649) sebagai syarat untuk kursus BMY 4999 projek.

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## ABSTRACT

Despite widespread applications of phenol in industries such as pesticides and oil refineries, leaking of phenol into aquatic environment remained a common issue. It causes water pollution and can lead to acute and chronic damages to plants, animals and human upon contact or consumption. There are many technologies currently practised to remediate phenol pollution. For examples, soil removal, chemical treatments and biological degradation using fungi. However, each of the current technology has some limitations and weakness. Hence, phytoremediation was proposed to be an alternative phenol remediator. In the present study, *Ipomoea aquatica* Forssk (water spinach) was treated with different concentration of phenol to test its ability to biodegrade phenol. *I. aquatica* Forssk was chosen for this project because it is highly tolerant to pollutants, cheap and fast growing. The plants were grown in containers with 4 Litre of phenol spiked water for duration of 14 days. Data such as length of plant structures and remaining phenol concentrations were taken every day. Remaining phenol concentrations were assayed using 4-Aminoantipyrine (4-AAP) method. Then, all data were analysed statistically. In 0.10 g/L phenol, *I. aquatica* Forssk was least damaged with induced roots growth. Results also show that *I. aquatica* Forssk is capable of survive and biodegrades phenol up to 0.30 g/L despite morphological damages such as scars on stems, nodal root growth inhibition and yellowish leaves. Phenol concentration higher than 0.30 g/L will be fatal to the *I. aquatica* Forssk. Highest rate of phenol degradation was 0.021 g/L per day upon exposure to 0.30 g/L phenol.

## **ABSTRAK**

Walaupun aplikasi meluas fenol dalam industri seperti racun perosak dan kilang-kilang penapis minyak, kebocoran fenol ke dalam alam sekitar akuatik kekal menjadi isu semasa. Ia menyebabkan pencemaran air dan boleh menyebabkan kerosakan akut dan kronik kepada tumbuh-tumbuhan, haiwan dan manusia melalui sentuhan atau penggunaan. Terdapat banyak teknologi kini diamalkan untuk mengatasinya pencemaran fenol. Sebagai contoh, pembuangan tanah, rawatan kimia dan biologi degradasi menggunakan kulat. Walau bagaimanapun, setiap teknologi kini mempunyai beberapa batasan dan kelemahan. Oleh itu, Fitopemulihan telah dicadangkan untuk menjadi fenol remediator alternatif. Dalam kajian ini, *Ipomoea aquatica* Forssk (kangkung) telah dirawat dengan beberapa kepekatan fenol untuk menguji keupayaan biodegradasi fenol tersebut. *I. aquatica* Forssk telah dipilih untuk projek ini kerana ia adalah sangat toleran kepada pencemaran, murah dan cepat tumbuh. Tumbuh-tumbuhan telah ditanam di dalam bekas dengan 4 Liter air yang mengandungi fenol untuk tempoh 14 hari. Data seperti panjang struktur tumbuh-tumbuhan dan kepekatan fenol baki diambil setiap hari. Kepekatan fenol baki telah dicerakin menggunakan kaedah 4-Aminoantipyrine (4-AAP). Kemudian, semua data dianalisis secara statistik. Dalam 0.10 g/L fenol, *I. aquatica* Forssk paling kurang dirosak dengan pertumbuhan akar teraruh. Keputusan juga menunjukkan bahawa *I. aquatica* Forssk mampu bertahan dan biodegradasi sehingga 0.30 g / L fenol walaupun keadaan kerosakan morfologi seperti parut pada batang, perencatan pertumbuhan akar pada nod dan kekuningan daun. Kepekatan fenol lagi tinggi daripada 0.30 g/L akan membawa maut kepada *I. aquatica* Forssk. Kadar tertinggi degradasi fenol adalah 0.021 g / L sehari apabila terdedah kepada 0.30 g / L fenol.

## ACKNOWLEDGEMENT

First and foremost, I would like to express my most sincere gratitude and deep appreciation to my supervisor and advising lecturer, Dr. Janna Ong Abdullah and Dr. Siti Aqlima Ahmad for their never ending guidance, encouragement and support until the completion of this project. Their supervisions and inspiration have helped me a lot in the progression and smoothness of this project. Without them, this study will not be able to materialize within given time period. I am very grateful to have such wonderful lecturer and supervisor who passionately teach me and correct me whenever I made a mistake.

Also, special thanks to postgraduate seniors, Abang Ijan, Abang Rahim and Kak Sabrina from Biochemistry Laboratory 115 for teaching and helping me in my lab works. Thank you for teaching and sharing all the basic knowledge and previous experiences as well as providing laboratory materials for this project. Last but not least, I would like to thank my beloved family, friends and fellow course mates for their never ending physical and emotional support throughout the project.

## TABLE OF CONTENTS

PENGESAHAN	i
ABSTRACT	ii
ABSTRAK	iii
ACKNOWLEDGEMENT	iv
LIST OF TABLES	vi
LIST OF FIGURES	vii
LIST OF ABBREVIATION	viii
CHAPTER 1	1
INTRODUCTION	1
CHAPTER 2	3
LITERATURE REVIEW	3
2.1 Phenol contamination	3
2.2 Current phenol remediating technologies and researches	4
2.3 Phytoremediation	6
2.4 Water spinach ( <i>Ipomoea aquatica</i> Forssk)	7
2.5 Phenol degradation	9
2.5.1 Phenol degradation by microorganisms	10
2.5.2 Phenol degradation by plants	11
CHAPTER 3	13
MATERIALS AND METHODS	13
3.1 Equipment and materials	13
3.2 Plant material	14
3.3 Phenol removal by plants	14
3.4 Phenol assay: 4-aminoantipyrine (AAP) assay	15
3.5 Phenol standard curve	16
3.6 Statistical analysis	16
CHAPTER 4	17
RESULTS AND DISCUSSION	17
4.1 Standard graph of AAP phenol assay	17
4.2 Plant growth	18
4.2.1 Plant growth control	18
4.2.2 Growth curve of primary roots, stems, leaves and petioles	19
4.2.3 Other morphological effects on plant growth	23
4.3 Phenol degradation by plants	26
4.3.1 Absorbed phenol in plants	29
CHAPTER 5	30
CONCLUSION AND RECOMMENDATIONS	30
REFERENCES	31
APPENDICES	36



## LIST OF TABLES

Table		Page
1	Equipment used and its manufacturer.	13
2	Materials used and its manufacturer.	13
3	Total amount of <i>Ipomoea aquatica</i> Forssk survived and forming plant structures.	25
4	Internal phenol concentration after complete absorption of phenol.	34
5	Result of ANOVA.	38

## LIST OF FIGURES

Figure		Page
1	Pathway of phenol phytodegradation.	12
2	Standard graph of 4-aminoantipyrine phenol assay.	17
3	Growth of plant control in distilled water.	19
4	Growth of <i>Ipomoea aquatica</i> Forssk in different phenol concentration.	22
5	Appearance of scars on <i>Ipomoea aquatica</i> Forssk stems and petioles.	23
6	Morphologies of <i>Ipomoea aquatica</i> Forssk exposed to different phenol concentrations.	24
7	Deaths of germinated seedlings exposed to 0.40 g/L phenol.	26
8	Daily analysis of phenol remaining in the water.	27
9	Phenol uptake rate by <i>Ipomoea aquatica</i> Forssk.	28
10	<i>Ipomoea aquatica</i> Forssk extract after centrifugation.	29
11	Growth curve of <i>Ipomoea aquatica</i> Forssk and daily analysis of remaining phenol concentration.	33

## LIST OF ABBREVIATIONS

%	Percentage
4- AAP, C <sub>11</sub> H <sub>13</sub> N <sub>3</sub> O	4-Aminoantipyrine
acetyl-CoA	Acetyl- coenzyme A
ANOVA	Analysis of variance
cm	Centimeter
g	Gram
H <sub>2</sub> O <sub>2</sub>	Hydrogen peroxide
K <sub>3</sub> Fe(CN) <sub>6</sub>	Potassium ferricyanide
L	Litre
mg	Miligram
ml	Mililitre
mm	Milimeter
NADH <sub>2</sub>	Reduced pyridine nucleotide
NH <sub>4</sub> Cl	Ammonium chloride
nm	Nanometer
PEG	Polyethylene glycol
RM	Ringgit Malaysia
UPM	Universiti Putra Malaysia
USA	United States of America
× g	Multiples of gravitational force

## CHAPTER 1

### INTRODUCTION

Phenol, also known as hydroxybenzene, carboic acid or benzenol, is a volatile mono-substituted aromatic hydrocarbon with sweet and tarry odour. Pure phenol is colourless or white crystalline solid. Although it is not strongly acidic, exposure of high concentration to skin will cause chemical burns. Due to its poor biodegradability and high water affinity, it brings greater risk when contaminating water. Long term contamination may even cause chronic damages such as mutagenicity and carcinogenicity.

Despite availability of many other methods to remove phenols from aquatic environment, interests rises on phytoremediation as potential solution to phenol pollution. Phytoremediation is a remediation method using plants. It is considerably cost-effective, environment friendly and easy to manage. Besides remediation of phenol, phytoremediation can be used to remove many other pollutants such as heavy metal or excess nutrients such as nitrogen. Phytoremediation can occur solely by the plant using its metabolism pathways and transpiration mechanisms or cooperatively by the microbial ecosystem formed at rhizosphere involving the roots and microorganisms such as fungi, bacteria and actinomycetes.

*Ipomoea aquatica* Forssk is the plant chosen in this project to study its ability to remediate phenol spiked water. It is widely distributed in tropical and subtropical countries and has its own local common names in all these countries. In Malaysia, it is known as “kangkung”, “ong choy” or hollow-stem vegetable. Propagation of *I. aquatica* Forssk is commonly carried out through seeds or cuttings from matured

plants as roots are growing from each nodes of the stem. Germination of *I. aquatica* Forssk from seeds takes only around one to two days and matured plants can grow around 4 inches per day. It can be grown on both soil and water.

Objectives of this project are to investigate the ability of *I. aquatica* Forssk to remove phenol from phenol spiked water and to study the effects of phenol concentration on growth rate of *I. aquatica* Forssk.

It is hypothesised that *I. aquatica* Forssk will be able to remove phenol from contaminated water and their growth will be affected by different phenol concentrations.

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