UNIVERSITI TEKNOLOGI MARA

EFFECT OF ATMOSPHERIC POLLUTANTS AND ACID PRECIPITATION ON THE ALGAL DENSITY OF EPIPHYTIC TERRESTRIAL MICROALGAE

NORDIANA BAKTI BT MOHD YUSOFF

Dissertation submitted in partial fulfillment
of the requirements for the degree of
Master of Science

Faculty of Applied Science

April 2017

ABSTRACT

Epiphytic terrestrial algae are plant-like protists with lack of plant characteristics, usually found on other plants. Carbon monoxide, nitrogen oxide and sulphur dioxide are the main contributors of atmospheric pollutants that could enhance or limit algal density. This study set out with the aim of assessing algal density and species composition of the epiphytic terrestrial microalgae from polluted (Banting) and less polluted area (Kuala Selangor). Another objective is to determine the effect of atmospheric pollutants in precipitation on algal density, species composition, size of cells and chlorophyll content of epiphytic terrestrial algae inhabiting Taman Botani Negara Shah Alam (TBNSA) using simulated acid rain. The finding shows that density in polluted areas is significantly higher with 118 ±8.06 $x10^7$ cells/cm^2 compared to the control site with only 71 ±6.55 $x10^7$ cells/cm^2. The bark pH in polluted area is more acidic 5.17^* ± 0.12 compared to 5.90^{**} ±0.24 in less polluted area. After simulation of atmospheric deposition in TBNSA, it is found that density of algae has increased significantly in all treatment, with highest recorded by carbon dioxide 142.9%, followed by nitrogen oxides 129.1%, control 104.4%, and the least was in sulphur dioxide 62.8%. Bark pH of the tree hosting the algae was found to increase from 4.19^*±0.14 to 4.36^{**}±0.13, 4.69^{**}±0.14, 4.82^{**}±0.18 and 4.87^{**}±0.16 after exposure to the pollutants in precipitation. On the contrary, chlorophyll content is highest in sulphur dioxide with a total of 563.81 ±220.36 and carbon dioxide as the least with 348.77 ±147.14. In conclusion, several parameters have been measured to quantify the effects of atmospheric pollutants in epiphytic terrestrial algae and some recommendations have been identified for future research.

Keywords: algal density, precipitation, sulphur dioxide, chlorophyll content, atmospheric pollutants.

ACKNOWLEDGEMENT

First and foremost, all praises, adorations and glorifications are due to ALLAH, the Most Exalted and may His boundless blessings continue to shower on our Prophet (S.A.W). All praises and thanks be to Allah (S.W.T), who has guided us to this, never could we have found guidance, were it not that ALLAH had guided us (Q7:43).

Words cannot express my gratitude and appreciation towards my supervisor, Dr Asmida Ismail and Co-Supervisor Dr Harinder Rai Singh for their patience, supervision and advice I received from them in the course of this dissertation. May the sky be your limits in all your future endeavours and may Jannatul-firdaus be your abode in the hereafter.

Also I would like to heartily thank my parents, Mr. Mohd Yusoff Omar and Mdm Shahriza Osman for their everlasting support, prayers and provisions in finishing my thesis. To my siblings Mohd Sofie & wife Suhana, Nor Azlillie and husband Syed Aizat, and Razieman who are my inspiration to complete this dissertation.

I believe help come in all forms, thus I am indebted my sincere thanks to my dearest auntie Hasinah Othman and uncle Shahrom for their assistance, encouragement and love. Not to forget, staffs of Taman Botani Negara Shah Alam and Faculty Applied Science (Pn NurHidayah, En Mad, En Johari, En Zul, Pn Azimah) for their generous duty.

Finally, my acknowledgment will be complete with the remembrance of my friends, Farhana, Syafikah, Atiqah, Marshitah, Mastini, Emir, UPMKB former colleagues and classmates of AS730 that has kept me going. Last but not least, special thanks to my research team for their cooperation (Sarah Diyana, Ihsan, Amyrul, Aisyah) and all colleagues from Universiti Teknologi MARA for their prayers and support. I wish everyone the very best in life.

TABLE OF CONTENTS

CHAPTER ONE
INTRODUCTION

1.1 BACKGROUND STUDY

Algae, composing of simple tissues, are considered to be aquatic, oxygen evolving photosynthetic autotrophs, and can either be unicellular or colonial constructed of filaments (Guiry, 2012). Similarly, epiphytic terrestrial algae are plant-like protists lacking few plant characteristics that grow on another plant on land. They react to pollutant faster and easier because algae are simple organism, have short life cycle and rapid growth, and are also suitable as biological indicators. Algae react differently to different pollutants and even small changes in the environment will affect algal density and its species composition.

Lower plants such as microalgae are small microscopic photosynthetic plants that do not have roots, stems or leaves (Wolkers, Barbosa, Kleinegris, Bosma, & Wijffels, 2011) which make them very sensitive to any concentration changes of atmospheric pollutants. An increasing trend of atmospheric pollutants was found for the past two decades for NO_3^- from 0.41 to 3.32ppm and SO_4^{2-} 0.39 to 3.26 ppm (Khoon, Issabayeva, & Lee, 2011). On top of that, it is also stated that NO_3^- is the major anions in rainwater followed by SO_4^{2-}. Further investigation by Rahman et al. (2015) proclaim that CO_2 and NO_2 were the major sources of outdoor air pollution in the Klang valley followed by $PM_{10}$and O_3.

Emission of primarily three atmospheric gasses namely, sulphur dioxide, nitrogen oxides and carbon dioxide in the atmosphere will form acid precipitation with pH lower than 5.6 (Behera, Mallick, Rautray, Tiwari, & Mishra, 2014). Increasing abundance of carbon dioxide in the environment is acclaimed as the prime factor of global warming but by some means, higher concentration of CO_2 in the atmosphere can induce growth and productivity of algae (Salih, 2011). Dissolved carbon dioxide controls the pH of normal rainwater. It is greatly influenced by inclusion of acidic components namely sulphur dioxide and nitrogen oxides which are