INFLUENCE OF NITROGEN SOURCES ON GROWTH PROFILE AND THEIR KINETIC STUDIES IN NEWLY ISOLATED ACIDOPHILIC MICROALGAE, *COCCOMYXA DISPAR* AND *SCENEDESMUS PARVUS*

LEE ZI XIN

UNIVERSITI SAINS MALAYSIA

JULY 2020

PUSAT PENGAJIAN TEKNOLOGI
INDUSTRI UNIVERSITI SAINS
MALAYSIA

BORANG PENYERAHAN DISERTASI
MUTAKHIR SATU (1) NASKAH

Nama penyelia: DR. MOHD ASYRAF KASSIM

Bahagian: TEKNOLOGI BIOPROSES

Saya telah menyemak semua pembetulan/pindaan yang dilaksanakan oleh Encik/Puan/Cik LEE ZI XIN mengenai disertasinya sebagaimana yang dipersetujui oleh Panel Pemeriksa di Viva Vocenya.

2. Saya ingin mengesahkan bahawa saya berpuashati dengan pembetulan/pindaan yang dilaksanakan oleh calon.

Sekian, terima kasih.

_____ 19/7/2020

(Tandatangan dan cop) (Tarikh)

INFLUENCE OF NITROGEN SOURCES ON GROWTH PROFILE AND THEIR KINETIC STUDIES IN NEWLY ISOLATED ACIDOPHILIC MICROALGAE, *COCCOMYXA DISPAR* AND *SCENEDESMUS PARVUS*

by

LEE ZI XIN

A dissertation submitted in the partial fulfillment of the requirements for the degree of
Bachelor of Technology (B.Tech) in the field of Food Technology
School of Industrial Technology
Universiti Sains Malaysia

JULY 2020

DECLARATION BY AUTHOR

This dissertation is composed of my original work, and contains no material previously published or written by another person except where due reference has been made in the text. The content of my dissertation is the result of work I have carried out since the commencement of my research project and does not include a substantial part of work that has been submitted to qualify for the award of any other degree or diploma in any university or other tertiary institution.

zixin

LEE ZI XIN

JULY 2020

ACKNOWLEDGEMENT

The completion of this thesis could not have been possible without the participation and assistance of so many people whose names may not all be enumerated. First of all, I would like to take this opportunity to express my utmost gratitude to my supervisor, Dr. Mohd Asyraf Kassim who guided me throughout my research project in both practical and writing. Thousand thanks to his patience, support and encouragement throughout this year which are my biggest force to complete this thesis. I would also like to extend my sincere thanks to Tan Kean Meng and Ramizah Kamaludin who constantly guided me and gave me so many helpful tips to make my project runs smoothly.

Apart from that, my thanks also go to all staff in School of Industrial Technology especially Mr. Azmaizan bin Yaakub and Madam Najmah binti Hamid for their assistance by providing me all the necessary things that I need in the laboratory. I also appreciate all the lecturers who taught me throughout my four years of degree and provided me useful knowledge.

In addition, I would like to thank my family members who constantly giving me enough of care and support so that I can finish my project. Not to forget all my course-mates who supported me and lent their helping hands when I needed them. Last but not least, I would like to express my deepest thanks to all the rest that I did not mention for their willingness to help me during my project. Their contributions are sincerely appreciated and gratefully acknowledged.

zixin

LEE ZI XIN

JULY 2020

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS AND ABBREVIATIONS

Symbol	Caption
+	plus
-	minus
±	plus-minus
=	equal
%	percent
<	less than
^{o}C	degree Celsius
e.g.	for example
H_2O	water
HCl	Hydrochloric acid
CO_2	carbon dioxide
O_2	oxygen
Mg^{2+}	magnesium ion
Ca^{2+}	calcium ion
K^{+}	potassium ion
$(NH_2)_2CO$	urea
H_2CO_3	carbonic acid
NH_3	ammonia
NH_4^{+}	ammonium
NO_3^{-}	nitrate
NO_2^{-}	nitrite

Abbreviation	Caption
cm	centimetre
day $^{-1}$	per day
DNA	deoxyribonucleic acid
EC	Enzyme commission number
g	gram
g L^{-1} day^{-1}	gram per litre per day
h	hour
L min^{-1}	litre per minute
Lux	luminious flux per unit area
mg L^{-1}	milligram per litre
mL	millilitre
mM	millimolar
nm	nanometre
OD_{680}	optical density at wavelength 680 nanometre
pKa	ion dissociation constant
R^2	correlation coefficient
RNA	ribonucleic acid
rpm	revolutions per minute
sp.	species
SD	standard deviation
USD	United States Dollar
µmol photons m^{-2} s^{-1}	micro mol photons per metre square per second
v/v	volume per volume
w/v	weight per volume

KESAN NITROGEN TERHADAP PROFIL PERTUMBUHAN DAN KAJIAN KINETIK DUA MIKROALGA ASIDOFILIK, *COCCOMYXA DISPAR* DAN *SCENEDESMUS PARVUS*

ABSTRAK

Biojisim mikroalga merupakan bahan mentah yang diperbaharui sesuai sebagai tenaga baharu pada masa depan. Walaubagaimanapun, penghasilan biojisim yang rendah tetap menjadi cabaran yang harus dikuasai dan beberapa faktor telah dikenalpasti untuk meningkatkan penghasilan biojisim. Nitrogen yang merupakan makronutrien menjadi unsur yang penting untuk dikaji kerana nitrogen yang sesuai dapat mengubah tapak jalan metabolik mikroalga dan seterusnya meningkatkan penghasilan biojisim. Walaupun banyak kajian tentang kesan nitrogen terhadap spesies mikroalga yang berbeza telah dijalankan, namun maklumat tentang kesan nitrogen terhadap spesies mikroalga *Coccomyxa dispar* dan *Scenedesmus parvus* masih kurang. Kajian ini telah dijalankan untuk mengkaji kesan nitrogen dengan mengkulturkan *Coccomyxa dispar* dan *Scenedesmus parvus* dalam Medium Bold Basal yang kekurangan nitrogen tetapi digantikan dengan amonium sulfate, sodium nitrat dan urea dalam kepekatan 0.1 peratus berat isipadu. Data kinetik pertumbuhan juga dibandingkan dengan menggunakan tiga model pertumbuhan (Logistik, Gompertz dan Baranyi-Roberts). Keputusan menunjuk bahawa kesan nitrogen terhadap penghasilan biojisim kedua-dua mikroalga adalah berbeza ketara. Sodium nitrat merupakan nitrogen yang terbaik untuk meningkatkan penghasilan biojisim bagi *Coccomyxa diapar* dan *Scenedesmus parvus* dengan menghasilkan produktivti biojisim masing-masing sebanyak 0.080 g L^{-1} $hari^{-1}$ and 0.037 g L^{-1} $hari^{-1}$. Keputusan juga menunjukkan model Logistik paling sesuai kepada *Coccomyxa diapar* (R^2 0.9954) dan model Baranyi-Roberts paling sesuai kepada *Scenedesmus parvus* (R^2 0.9972) untuk meramalkan profil kadar pertumbuhan mikroalga.

INFLUENCE OF NITROGEN SOURCES ON GROWTH PROFILE AND THEIR KINETIC STUDIES IN NEWLY ISOLATED ACIDOPHILIC MICROALGAE, *COCCOMYXA DISPAR* AND *SCENEDESMUS PARVUS*

ABSTRACT

Microalgae are potential candidates to be sustainably developed in the future as a new energy resource. However, low biomass production remains a big challenge to be tackled. Several factors had been tested to increase biomass production including abiotic and biotic factors. Nitrogen is the macronutrient in which uptake is of particular importance. This is because by supplying suitable nitrogen sources, metabolic pathways can be manipulated thus expand the production capabilities of microalgae. Despite many studies conducted on effect of nitrogen sources in different microalgae species, there is still limited information on *Coccomyxa dispar* and *Scenedesmus parvus.* Thus, this research is conducted to determine the influence of nitrogen sources on two acidophilic microalgae strains, *Coccomyxa dispar* and *Scenedesmus parvus* through cultivating them in nitrogen-deficient Bold Basal Medium (BBM) supplemented with 0.1% w/v ammonium sulphate, sodium nitrate and urea. The growth data were fitted into three mathematical models (Logistic, Gompertz and Baranyi-Roberts) to analyse the cell growth profile. Results indicated that both microalgae strains were significantly influenced by the type of nitrogen sources. With the best nitrogen source (0.1% w/v sodium nitrate), the biomass productivity achieved by *C. dispar* (0.080 g L^{-1} day $^{-1}$) was almost double compared to *S. parvus* (0.037 g L^{-1} day $^{-1}$). Besides, Logistic model model was the most suitable kinetic growth model for *Coccomyxa dispar* with R^2 of 0.9954 and standard error of estimate of 0.0251 while Baranyi-Roberts model was the most suitable kinetic growth model for *Scenedesmus parvus* with R^2 of 0.9972 and standard error of estimate of 0.0098, to predict the growth profile when cultivated in 0.1% w/v sodium nitrate.