DETERMINATION OF THE EFFECT OF pH ON MICROALAGAL GROWTH AND PROTEIN CONTENT IN LOCALLY ISOLATED *TETRASELMIS SUECICA* AND *SCENEDESMUS PARVUS*

YEONG KAH CHUEN

UNIVERSITI SAINS MALAYSIA

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UNIVERSITI SAINS MALAYSIA

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Nama penyelia: DR. MOHD ASYRAF KASSIM

Bahagian: TEKNOLOGI BIOPROSES

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By

YEONG KAH CHUEN

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Univerisiti Sains Malaysia

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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.

YEONG KAH CHUEN

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LIST OF SYMBOLS AND ABBREVIATIONS

Symbol	Caption
%	Percentage
±	Plus minus
<	Smaller than
>	Larger than
˚C	Degree Celsius
H_2O	Distilled Water
CO_2	Carbon dioxide
US$	American dollar
$NaNO_3$	Sodium Nitrate
$MgSO_4 \cdot 7H_2O$	Magnesium sulphate
NaCl	Sodium Chloride
K_2HPO_4	di-Potassium hydrogen Orthophosphate
KH_2PO_4	Potassium dihydrogen Orthophosphate
$CaCl_2 \cdot 2H_2O$	Calcium chloride
$ZnSO_4 \cdot 7H_2O$	Zinc sulphate
$MnCl_2 \cdot 4H_2O$	Manganese chloride
$CuSO_4 \cdot 5H_2O$	Cupric Sulphate
$Na_2MoO_4 \cdot 6H_2O$	Sodium molybdate
KOH	Potassium Hydroxide
$FeSO_4 \cdot 7H_2O$	Ferrous sulphate
H_2SO_4	Sulphuric acid
$ZnSO_4 \cdot 7H_2O$	Zinc sulphate
$MnCl_2 \cdot 4H_2O$	Manganese chloride

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KOH	Potassium Hydroxide
$FeSO_4 \cdot 7H_2O$	Ferrous sulphate
H_2SO_4	Sulphuric acid

LIST OF ABBREVIATION

Abbreviation	Caption
UN	United Nation
kg	Kilogram
g	Gram
mg	Milligram
L	Litre
mL	Millilitre
m	Meter
nm	Nanometer
h	Hours
min	Minutes
s	Second
SCP	Single Cell Protein
w/w	Weight/weight
v/v	Volume/volume
rpm	Rotation per minutes
FAO	Food and Agriculture Organization
BBM	Bold Basal Medium
OD	Optical Density

PENGARUH pH TERHADAP PERTUMBUHAN MIKROALGA DAN KANDUNGAN PROTEIN DALAM *TETRASELMIS SUECICA* DAN *SCENEDESMUS PARVUS*

ABSTRAK

Pengkulturan mikroalga spesis yang kaya dengan protein dianggap sebagai satu penyelesaian untuk mengurangkan jurang protein yang diakibatkan oleh peningkatan populasi global. Walaubagaimanapun, produktiviti protein dan pertumbuhan mikroalga akan dipengaruhi oleh keadaan kultivasi. Oleh itu, projek ini dirangka untuk meneroka potensi mikroalga tempatan yang diperincilkan sebagai sumber protein sel tunggal di mana *Tetraselmis suecica* dan *Scenedesmus parvus* dihidupkan dalam media dengan menggunakan pH awal yang berbeza iaitu pH 3.00 hingga pH 9.00. Profil kinetik pertumbuhan kedua-dua mikroalga tersebut telah dikenalpastikan selama 13 hari. Kandungan dan produktiviti protein biojisim mikroalga ditentukan melalui kaedah Kjeldahl. Akhir sekali, model kinetik yang bersesuaian untuk pertumbuhan kedua-dua mikroalga dalam media pH yang berbeza turut dikenalpasti menggunakan model Logistic, model Gompertz dan model Baranyi-Roberts. Maksimum biojisim bagi *T. suecica* diperolehi pada pH 5.00 dengan kepekatan 157.842 ± 4.507 mg L^{-1} manakala maksimum biojisim bagi *S. parvus* diperolehi pada pH 7.00 dengan kepekatan 154.447 ± 3.030 mg L^{-1}. Produktiviti biojisim tertinggi bagi *T. suecica* diperolehi pada pH 5.00 dan *S. parvus* diperolehi pada pH 7.00 masing-masing adalah 9.767 ± 0.003 mg $L^{-1}d^{-1}$ dan 10.132 ± 0239 mg $L^{-1}d^{-1}$. Selain itu, kandungan protein serta produktiviti protein tertinggi bagi *T. suecica* diperolehi pada pH 5.00 adalah 44.704 ± 0.785 % dan 4.366 ± 0077 mg $L^{-1}d^{-1}$ manakala kandungan protein serta produktiviti protein tertinggi bagi *S. parvus* diperolehi pada pH 7.00 adalah 36.93 ± 1.039 % dan 3.742 ± 0.105 mg $L^{-1}d^{-1}$. Selain itu, analisis model kinetik untuk pertumbuhan *T. suecica* dan *S. parvus* pada media

nilai pH yang berbeza menunjukkan pemadanan yang tinggi bagi model Logistic masing-masing dengan nilai R^2 0.976 dan 0.982.

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ABSTRACT

Mass production of certain protein rich microalgae as single cell protein was considered as a possibility to minimise the protein gap due to increasing of global population. However, the protein productivity and the growth of the microalgae will be affected by the cultivation condition during the mass production. Thus, this project is to explore the possibility of the locally isolated microalgae as a single cell protein source where both microalgae *Tetraselmis suecica* and *Scenedesmus parvus* were cultivated in different initial pH cultivation medium (pH 3.00 to pH 9.00). The growth kinetic and growth profile of the microalgae over 13 day's cultivation period were determined. The protein content as well as the protein productivity of the microalgae biomass were determined using Kjeldahl method. Lastly, suitable kinetic growth model for both microalgae under different pH medium was also determined among Logistic model, Gompertz model and Baranyi-Roberts model. The maximum biomass concentration and highest biomass productivity for *T. suecica* was obtain at pH 5.00 with 157.842 ± 4.507 mg L^{-1} and 9.767 ± 0.003 mg $L^{-1}d^{-1}$ respectively while maximum biomass concentration and highest biomass productivity for *S. parvus* was obtain at pH 7.00 with 154.447 ± 3.030 mg L^{-1} and 10.132 ± 0239 mg $L^{-1}d^{-1}$ respectively. The maximum protein content and highest protein productivity of *T. suecica* was obtained at pH 5.00 with 44.704 ± 0.785 % and 4.366 ± 0077 mg $L^{-1}d^{-1}$ while maximum protein content and highest protein productivity of *S. parvus* were obtained at pH 7.00 with 36.93 ± 1.039 % and 3.742 ± 0.105 mg $L^{-1}d^{-1}$respectively. The results of the kinetic model analysis of both microalgae strain growth at different

initial pH medium fitted well to the Logistic model with average R^2 value of 0.9759 and 0.9842, respectively.