KINETIC MODEL FOR GROWTH AND INFLUENCE OF pH ON THE GROWTH OF *HALOCHLORELLA RUBESCENS* IN A FABRICATED PHOTOBIOREACTOR

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By

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A dissertation submitted in partial fulfillment of the requirements for the degree of Bachelor of Technology (B. Tech) in the field of

Bioprocess Technology

School of Industrial Technology

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DECLARATION BY AUTHOR

I am hereby declaring that this dissertation is my original work and contains no published materials, except any acknowledged materials that have been cited and listed under the references. I also declare that the content of this thesis is the result of work that has been done solely by myself and has not been submitted for the award of any other degree of diploma in any university or other tertiary institution.

NUR IZATUL ANIS BINTI MUHAMMAD JAIS

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LIST OF SYMBOLS AND ABBREVIATIONS

SYMBOLS

°	Degree
%	Percentage
±	Plus, minus

ABBREVIATIONS

C	Celsius
cm	Centimeter
CO_2	Carbon dioxide
dH_2O	Distilled water
DW	Dry weight
g/L	Gram per Liter
HCL	Hydrochloric acid
L	Liter
L/ha	Liter per hectar
LED	Light-emitting diodes
m	Meter
mg/L	Milligram per liter
mL	Milliliter
MLA	Modified algae
NaOH	Sodium Hydroxide

nm	Nanometer
PBR	Photobioreactor
TAGs	Triacylglycerides
vvm	volume of liquid per minute

ABSTRAK

Selama bertahun, *Chlorella sp.* telah terbukti sebagai salah satu calon dalam menghasilkan biomas yang banyak. Dalam projek ini, sebuah reaktor baru telah dibuat dan keupayaan *Halochlorella rubescens*, spesies mikroalgae daripada genus *Chlorella sp.* untuk menghasilkan jisim sel yang tinggi akan dinilai. Profil sel pengaktifan oleh mikroalga dalam tiga jenis isi padu (500 mL, 1 L dan 5 L) dalam mod pertumbuhan normal dan kesan pH terhadap tumbesaran kinetik algae dalam 15-L photobioreaktor akan dikaji. Kepekatan sel dan produktiviti biomas tertinggi, 2.493 g/L dan 0.183 g DW L^{-1} d^{-1} dapat dilihat pada medium 500 mL. Pencairan jaringan sel dan umur inokulum dilihat memberi kesan terhadap pertumbuhan mikroalga. Kepekatan biomas dan produktiviti biomas tertinggi , 1.689 g/L dan 0.1043 g DW L^{-1} d^{-1} direkodkan apabila mikroalga dibesarkan di dalam medium pH 10.5 dan alkaliniti medium yang tinggi dilihat memberi kesan terhadap kepekatan sel yang dihasilkan oleh mikroalga. Dua model pertumbuhan, Logistik dan Gompertz diguna dalam projek ini bagi mendapatkan model tumbuhan untuk mikroalga dalam reaktor yang baru dibuat. R^2 yang diperoleh untuk pH 8.5,10.5 dan 13.5 daripada model Logistik dan Gompertz adalah 0.9634, 0.9482, 0.7225 dan 0.9626, 0.9474, 0.7249. Ini menunjukkan bahawa mikroalga paling sesuai dengan model Logistik dan pertumbuhan kinetik *Halochlorella rubescens* boleh ditentukan menggunakan model ini.

ABSTRACT

For years, *Chlorella sp,* have been proven to be one of the candidates in producing abundant amounts of algal biomass. In this study, the fabrication of a new reactor was done and performance of *Halochlorella rubescens*, microalgae under genus *Chlorella sp.* in producing high cell mass was studied. Microalgae cell activation profile in three different cultivation volumes (500 mL, 1 L and 5 L) at normal cultivation mode and effect of pH towards the algae growth kinetic in a fabricated 15-L photobioreactor was investigated. 500 mL culture recorded highest biomass concentration and biomass productivity of 2.493 g/L and 0.183 g DW L^{-1} d^{-1}. Dilution of cell lines and inoculum age are found to have notable effects towards microalgae growth. Highest biomass concentration and biomass productivity,1.689 g/L and 0.1043 g DW L^{-1} d^{-1} was recorded when the microalgae cultivated in pH 10.5 culture and high alkalinity medium showed remarkable effects towards the microalgae productivity. Two growth models, Logistic and Gompertz tested in this study to determine the growth model for microalgae in fabricated reactor. R^2 values obtained for pH 8.5, 10.5 and 13.5 from both Logistic and Gompertz are 0.9634, 0.9482, 0.7225 and 0.9626, 0.9474, 0.7249 respectively. This shows that this microalgae best-fitted with Logistic model and growth kinetics of *Halochlorella rubescens* can be determined by using this model.