MICROBIAL PRODUCTION OF POLYHYDROXYBUTYRATE (PHB) BY *Burkholderia Cepacia* BPT1213 FROM DIFFERENT CARBON SOURCES AND ITS FERMENTATION KINETICS

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by

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

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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.

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LIST OF SYMBOLS

Symbol	Definition
°C	Degree Celsius
±	Plus Minus
+	Plus
×	Multiply
-	Minus
/	Divide
%	Percentage
>	Greater than
<	Less than
$CoSO_4$	Cobalt sulphate
$FeSO_4$	Iron sulphate
$MnCl_2$	Manganese chloride
$CaCl_2$	Calcium chloride
$ZnSO_4$	Zinc sulphate
$CuCl_2$	Copper (II) chloride
NaCl	Sodium chloride
$(NH_4)_2SO_4$	Ammonium sulphate
KBr	Potassium bromide
X_t	Biomass concentration at specific time
X_0	Biomass concentration at t = 0

LIST OF ABBREVIATIONS

Abbreviation	Definition
et al.	And others
PHA	Polyhydroxyalkanoate
TCS	Type of carbon sources
VA	Valeric acid
SV	Sodium valerate
CDW	Cell dry weight
P(3HB-co-3HV)	Poly(3-hydroxybutyrate-co-3-hydroxyvalerate)
P(3HB)	Poly-3-hydroxybutyrate
mg	Milligram
mL	Millilitre
g	Gram
L	Litre
BTJ	Banana Trunk Juices
OPF	Oil Palm Frond
OPFJ	Oil Palm Frond Juices
rpm	Revolutions per minute
h	Hour
Min	Minutes
H_2O	Water
OD	Optical density
NR	Nutrient rich
MSM	Mineral salt medium
t_d	Doubling time
μ	Specific growth rate
P	Maximum product concentration
P_0	Initial product concentration

PENGHASILAN POLYHYDROXYBUTYRATE (PHB) OLEH *Burkholderia Cepacia* BPT1213 DARIPADA SUMBER KARBOM BERBEZA DAN KINETIK FERMENTASINYA

ABSTRAK

Isu-isu pencemaran plastik telah menjadi ancaman besar bagi ekologi global disebabkan oleh ciri-cirinya yang tidak boleh degradasi. Oleh sebab itu, polimer bio-degradable seperti Polihidroksi alkanoats (PHA), boleh diaggap sebagai pengganti yang sesuai untuk polimer berasaskan petroleum konvensional kerana ia bersifat serupa dengan polimer sintetik dan degradasi secara lengkap. Walau bagaimanapun, homopolimer PHA, poly-3-hydroxybutyrate (P(3HB)) telah dikaji secara meluas. Dalam kajian ini, biosintesis polimer P(3HB) yang dihasilkan oleh *Burkholderia cepacia* BPT1213 dengan menggunakan sumber karbon yang berbeza seperti jus batang pisang, molases dan jus pelepah kelapa sawit telah dijalankan. Selain itu, kandungan gula (sukrosa, glukosa dan fruktosa) dalam sumber-sumber karbon ini telah dianalisiskan. Molasses mempunyai kandungan sukrosa, glukosa dan fruktosa tertinggi (8.41 ± 0.50 mg/mL, 35.34 ± 0.01 mg/mL and 33.88 ± 0.06 mg/mL masing-masing).Seterusnya, kajian kinetik untuk *B. cepacia* BPT1213 seperti kadar pertumbuhan spesifik, masa penggandaan, biomas dan produktiviti PHA ditentukan untuk pemahaman yang lebih baik. Di antara sumber karbon ini, molases adalah sumber karbon yang paling sesuai untuk menghasilkan PHA daripada *B. cepacia* BPT1213 yang dicatatkan pada 1.4442 ± 0.46 g/L dan produktiviti PHA dicatat pada 0.030 ± 0.0056 gL-1 h-1. Di samping itu, masa penggandaan dan produktiviti biojisim yang diperoleh oleh *B. cepacia* BPT1213 ketika menggunakan molases sebagai sumber karbon adalah 35.78 ± 1.65 h and 0.004 ± 0.0001 gL^{-1} h^{-1} masing-masing. Oleh itu, molases dan kepekatan prekursor yang berbeza (asid valerat dan natrium valerat)

digunakan untuk pengeluaran kopolimer P (3HB-co-3HV) oleh *B. cepacia* BPT1213. Walau bagaimanapun, Walau bagaimanapun, kandungan kopolimer P (3HB-co-3HV) tidak dapat dikesan, kecuali menggunakan 0.50 % natrium valerat sebagai pendahulu. Kesimpulannya, molases adalah sumber karbon yang paling sesuai untuk pengeluaran P(3HB) oleh *B. cepacia* BPT1213, sedangkan kopolimer tidak dapat dihasilkan oleh *B. cepacia* BPT1213 menggunakan asid valerat dan natrium valerat sebagai prekursor.

MICROBIAL PRODUCTION OF POLYHYDROXYBUTYRATE (PHB) BY *Burkholderia Cepacia* BPT1213 FROM DIFFERENT CARBON SOURCES AND ITS FERMENTATION KINETICS

ABSTRACT

The issue of plastic pollution has become a major threat to global ecology due to plastic's resilience against degradation and its proliferation in industry. As a result, the biodegradable polymer such as polyhydroxyalkanoate (PHA) is considered as a good substitute to the conventional petroleum-based polymers because of their similar material properties to synthetic polymers and complete biodegradability after disposal. However, PHA homopolymer, poly-3-hydroxybutyrate (P(3HB)) is the most common and widely studied PHA compounds. In this study, the biosynthesis of P(3HB) polymer produced by *Burkholderia cepacia* BPT1213 using different carbon source such as banana trunk juices, molasses and oil palm frond juices was studied. Besides, the sugar contents (sucrose, glucose and fructose) of these carbon sources were analysed. Molasses has the highest sucrose, glucose and fructose content (8.41 ± 0.50 mg/mL, 35.34 ± 0.01 mg/mL and 33.88 ± 0.06 mg/mL respectively). Next, kinetic study of *B. cepacia* BPT1213 such as specific growth rate, doubling time, biomass and PHA productivity were investigated for greater understanding of the fermentation efficiency. Among these carbon sources, molasses was the most suitable carbon source for PHA production by *B. cepacia* BPT1213 in which the PHA concentration recorded at 1.4442 ± 0.46 g/L and PHA productivity recorded at 0.030 ± 0.0056 gL^{-1} h^{-1}. The doubling time and biomass productivity obtained by *B. cepacia* BPT1213 when using molasses as carbon source were 35.78 ± 1.65 h and 0.004 ± 0.0001 gL^{-1} h^{-1} respectively. Thus, molasses and different concentration of precursors (valeric acid and sodium valerate) were used for P(3HB-co-3HV) copolymer production by *B. cepacia* BPT1213. However, the P(3HB-co-3HV) copolymer content cannot be detected,

except when using 0.50 % sodium valerate as precursor. In conclusion, molasses was the most suitable carbon source for P(3HB) production by *B. cepacia* BPT1213 whereas the copolymer cannot be produced by *B. cepacia* BPT1213 using valeric acid and sodium valerate as precursors.