



**UNIVERSITI PUTRA MALAYSIA**

**PRODUCTION OF POLYHYDROXYBUTYRATE BY *Cupriavidus necator*  
CCGUG 52238 USING ORGANIC ACIDS RECOVERED FROM  
FERMENTED KITCHEN WASTE**

**FARAH NADIA OMAR**

**FBSB 2011 21**

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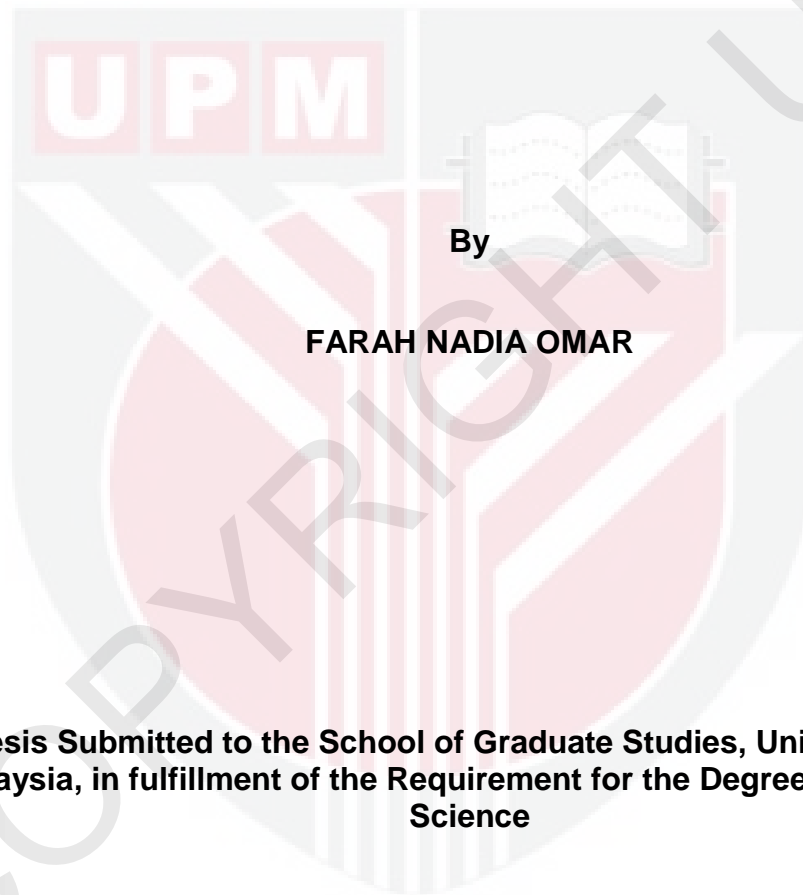
**FARAH NADIA OMAR**

**MASTER OF SCIENCE**

**UNIVERSITI PUTRA MALAYSIA**

**2011**

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CCGUG 52238 USING ORGANIC ACIDS RECOVERED FROM FERMENTED  
KITCHEN WASTE**



By

**FARAH NADIA OMAR**

**Thesis Submitted to the School of Graduate Studies, Universiti Putra  
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Science**

**JULY 2011**

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the Degree of Master of Science

**PRODUCTION OF POLYHYDROXYBUTYRATE BY *Cupriavidusnecator* CCGUG 52238 USING ORGANIC ACIDS RECOVERED FROM FERMENTED KITCHEN WASTE**

By

**FARAH NADIA OMAR**

**July 2011**

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**Faculty : Faculty of Biotechnology and Biomolecular Sciences**

The amount of solid waste generated was gradually increased and currently in Malaysia, all the waste is disposed in the municipal landfill. Solid wastes generated are mainly characterized by high concentration of organic matter primarily from kitchen waste. In this study, the organic acids recovered from naturally fermented kitchen waste was utilized as a sole carbon source for the production of polyhydroxybutyrate (PHB). PHB production was achieved through two stage processes: organic acids recovered from naturally fermented kitchen wastes followed by PHB production utilizing the recovered organic acids by

*Cupriavidus necator* CCGUG 52238 in batch and fed-batch mode of fermentation. Kitchen waste was fermented using 50 L bioreactor at 37°C with agitation of 150 - 200 rev/min. The initial pH of fermentation was adjusted to pH 7. After seven days of kitchen waste fermentation, about 60 g/L of total organic acids could be produced where it comprised lactic acid (98%), acetic acid (1.8%) and formic acid (0.2%). Organic acids were recovered after undergo few treatment processes which were freezing and thawing, centrifugation, filtration and evaporation methods. The effect of the treatments on the organic acids concentration, nitrogen content as well as total suspended solids (TSS) removal was also investigated. As a result, about 223.9 g/L of organic acids had been successfully recovered and concentrated from initial 25.7 g/L of total organic acids produced, 93% of TSS had been removed after filtration process and about 98% of total nitrogen content had reduced. This indicates that the stepwise recovery process was able to recover high concentration of organic acids as well as removes the suspended solids.

The recovered organic acids from kitchen wastes were then utilized for PHB production by *C. necator* CCGUG 52238 in series of batch and fed batch experiments. In batch culture, fermentation was carried out in 2 L bioreactor and the pH and temperature was controlled at 7 and 30°C, respectively. The dissolve oxygen level (DO) was maintained at 30%, via agitation 300-700 r/min. The maximum PHB content produced from kitchen wastes organic acids was 52.79% (w/w) with dry cell weight of 4.62 g/L. The PHB yield and

productivity were obtained at 0.382 g/g and 0.1091 g/L/h, respectively. In fed batch culture, experiment was conducted in 7 L of bioreactor with condition was set up as same as in batch fermentation. About five times increment in PHB production was achieved by applying feeding strategy for every 10 hours. The PHB yield and productivity obtained were 0.79 g/g and 0.49 g/L/h, respectively. Therefore, organic acids derived from kitchen waste have a potential to be used as one of a favorable substrate for PHB production by *C.necator* CCGUG 52238.



Abstraktesis yang dikemukakan kepada Senat Universiti Putra Malaysia  
sebagaimemenuhikeperluan untukijazah Master Sains

**PENGHASILAN ASID POLIHIDROKSIBUTIRIKOLEH *Cupriavidus necator*  
CCGUG 52238 MENGGUNAKAN ASID ORGANIK YANG DIPEROLEHI  
DARIPADA FERMENTASI SISA BUANGAN DAPUR**

Oleh

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Jumlah sisa buangan pepejal yang dihasilkan di Malaysia  
semakin meningkat dan kesemua sisa buangan tersebut dilupuskan di  
tempat pelupusan sampah perbandaran. Sisa pepejal yang  
dihasilkan dikategorikan sebagai organik dan kebanyakannya terdiridaripada sisa bu-  
angandapur. Di dalam kajian ini, asid organik yang  
diperoleh dari pada sisa buangandapur telah digunakan sebagai sumber karbon tungsu-  
al untuk menghasilkan asid polihidroksibutirik (PHB). Penghasilan PHB  
melalui dua fasa iaitu: pemerolehan asid organik daripada fermentasi semulajadi sis

buangandapurdiikutidenganpenghasilan PHB menggunakanasid organic oleh*Cupriavidusnecator* CCGUG 52238dengankaedahfermentasisesekelompokdansuapansesekelompok. Fermentasisisabuangandapurdilakukandenganmenggunakan 50 L tangkiberpengadukpadasuhu37°Cdengankelajuanmengadukantara 150 – 200 rev/min. pH permulaanfermentasidilaraskankepada pH 7. Selepastujuhharifermentasi, kira-kira 60 g/L asidorganikyangdihasilkanderidiripadaasidlaktik (98%), asidasetik (1.8%) danasidformik (0.2%).Pemerolehanasidorganikmelaluibeberapapra-rawataniaitupenyejukbekuandanpencairan, pengemparan, penapisandanpemekatan.Kesanrawatan-rawatanituterhadapkepekatanasidorganik, kandungan nitrogen danpepejal yang terampaiturutdikaji.Sebanyak 223.9 g/L asidorganikberjayadipekatkandandiperolehidaripada 25.7 g/L jumlahasidorganik yang dihasilkanpadapermulaannya, sebanyak 93% pepejalterampaiberjayadibuangdansebanyak 98% kandungan nitrogen berjayadikurangkan. Inimenunjukkankajian proses pemerolehanasidsecaraberturutandapatdilakukanuntukmemperolehiasidorganik berkepakatantinggi disampingdapatmembuangpepejalterampai.

Asidorganik yang diperoleh dari pdsisabuangandapur tadikemudiannyadigunakan untuk penghasilan PHB oleh *C. necator* CCGUG 52238



menggunakan kaedah fermentasi sesekelompok dan suapan sesekelompok. Dalam suapan sesekelompok, fermentasi dilakukan di dalam tangki berpengaduk 2L dengan pH dan suhu pada masing-masing 7 dan 30°C. Level oksigen terlarut dilaraskan kepada 30% menggunakan pengaduk berkelajuan 300 – 700 r/min. Penghasilan PHB maksimum yang dihasilkan dari asid organik tersebut adalah 52.79% dengan berat sel kering ialah 4.62 g/L. Penghasilan dan produktiviti PHB yang didapati masing-masing sebanyak 0.382 g/g dan 0.1091 g/L/h. Dalam fermentasi suapan sesekelompok, eksperimen dilakukan di dalam tangki pengaduk 7 L dengan keadaan seperti dalam fermentasi sesekelompok. PHB telah dihasilkan hampir lima kali ganda peningkatan dengan menggunakan strategi suapan berkala setiap 10 jam. Penghasilan dan produktiviti PHB yang dihasilkan masing-masing adalah 0.79 g/g dan 0.49 g/L/h. Kesimpulannya, asid organik yang diperolehi dari pada sisa buangan dapur berpotensi sebagai substrat yang sesuai untuk penghasilan PHB oleh *C. necator* CCGUG 52238.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment for the requirement for the degree of Master of Science. The members of Supervisory Committee were as follows:

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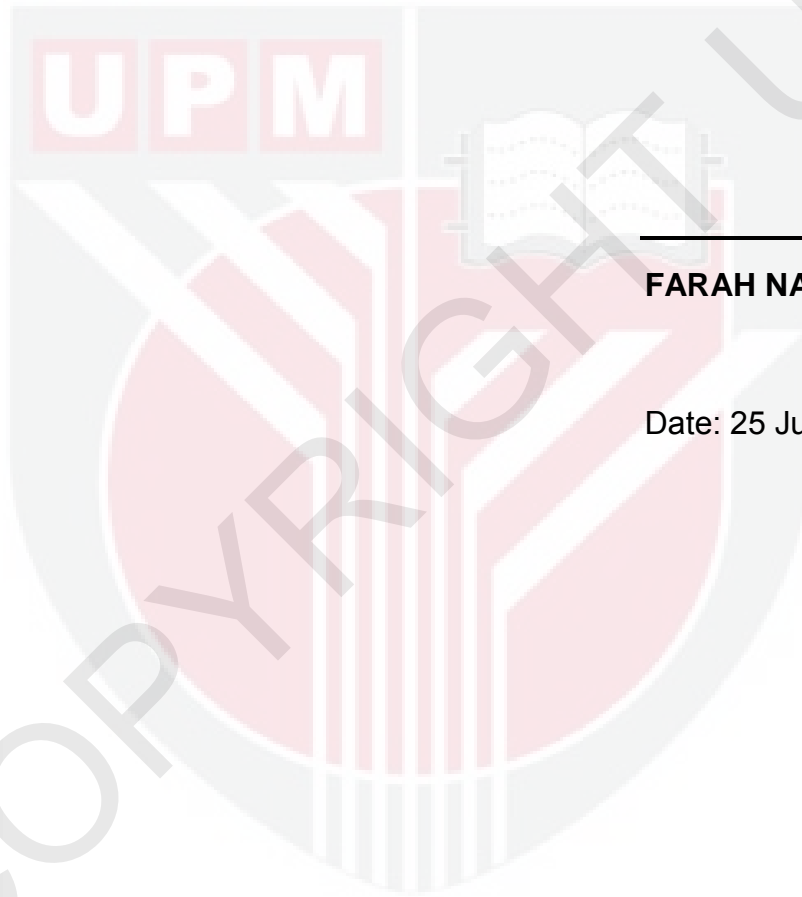
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Date:

## DECLARATION

I declare that the thesis is my original work except for quotations and citation which have been duly acknowledged. I also declare that it has not been previously and is not concurrently, submitted for any other degree at UniversitiPutra Malaysia or other institutions.



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**FARAH NADIA OMAR**

Date: 25 July 2011

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