UNIVERSITI PUTRA MALAYSIA

OPTIMIZATION OF MICROBIAL PROCESS FOR THE CONVERSION OF KITCHEN WASTE INTO ORGANIC ACIDS USING RESPONSE SURFACE METHODOLOGY

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MASTER OF SCIENCE

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By

HALIMATUN SAADIAH HAFID

Thesis submitted to the School of Graduate Studies, Universiti Putra Malaysia, in fulfillment of the requirements for the Degree of Master of Science

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Abstract of a thesis to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

OPTIMIZATION OF MICROBIAL PROCESS FOR THE CONVERSION OF KITCHEN WASTE INTO ORGANIC ACIDS USING RESPONSE SURFACE METHODOLOGY

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May 2011

Chairman: Nor 'Aini Abdul Rahman, PhD

Faculty: Biotechnology and Biomolecular Sciences

Model kitchen waste was formulated in this study to overcome the problem of kitchen waste variation composition. The performance of organic acids production was compared between the model kitchen waste and actual kitchen waste. Both substrates were subjected to anaerobic treatment by indigenous mixed microflora from fermented kitchen waste in a 250 mL shake flask. The parameters conditions used were agitation at 200 rpm, adjusted pH 5 and 7 and temperature of 30°C, 37°C and 40°C. The highest organic acid produced in real kitchen waste and model kitchen waste were 48.64 g/L and 37.49 g/L, respectively after 6 days of incubation at pH 5 and 37°C. For both

kitchen waste fermentation, lactic acid was dominant (76.2%) followed by acetic acid (17.7%) and butyric acid (6.1%).

Organic acids production from model kitchen waste fermentation was further improved by optimization of fermentation procedures using response surface methodology (RSM). Central composite design (CCD) was employed to determine the maximum organic acids production for several parameter variables which include temperature, pH adjusted intermittently and inoculum size. The source of inoculum was originated from kitchen waste being used after 15 days of fermentation. The optimum temperature, pH and inoculums size for the acidogenic fermentation of organic acids from kitchen waste were 35°C, adjusted pH 6.0 and 20%, respectively. The predicted value for the final organic acids produced in this optimal fermentation was 78.20 g/L. The verification study has been carried out and the maximum organic acid produced was 77.28 g/L. Organic acids production was significantly affected by pH and temperature and the interaction between them. Lactic acid showed the main organic acids detected in the kitchen waste fermentation (more than 80%) followed by acetic acid and butyric acid. The organic acids produced have potential to be used as substrate for the production of biopolymer.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

PENGOPTIMUMAN PROSES MIKROORGANISMA BAGI PENGHASILAN ASID ORGANIK DARIPADA SISA MAKANAN MENGGUNAKAN KAEDAH PERMUKAAN TINDAK BALAS

Oleh

HALIMATUN SAADIAH HAFID

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Model sisa makanan untuk penghasilan asid organik telah diformulasi bagi mengatasi masalah variasi komposisi sisa makanan. Prestasi penghasilan asid organik bagi kedua-dua substrat sisa makanan sebenar dan model sisa makanan telah dibandingkan. Rawatan anaerobik bagi kedua-dua substrat oleh mikroflora semulajadi daripada sisa makanan telah diuji di dalam kelalang kon 250 mL dengan kelajuan mengaduk 200 rpm. Keadaan parameter bagi rawatan anaerobik adalah kelajuan campuran pada 200 rpm, pH terlaras masing-masing kepada pH 5 dan 7 dengan suhu 30°C, 37°C and 40°C. Penghasilan asid organik paling tinggi bagi kedua-dua substrat ialah masing-masing

48.64 g/L dan 37.49 g/L, pada pH 5 dan suhu 37°C. Asid laktik dihasilkan paling banyak dalam kedua-dua substrat iaitu 37 g/L (76.2%) diikuti oleh asid asetik (17.7%) dan asid butirik (6.1%).

Penghasilan asid organik daripada model sisa makanan ditingkatkan lagi melalui prosedur pengoptimuman fermentasi menggunakan kaedah permukaan tindak balas (RSM). Rekabentuk komposit pusat (CCD) digunakan untuk menentukan penghasilan asid organik maksimum untuk parameter suhu, pH kawalan dan saiz inokulum. Inokulum yang digunakan diperolehi dari sisa makanan yang difermentasikan selama 15 hari. Suhu, pH terlaras dan saiz inokulum yang paling sesuai untuk penghasilan asid organik dalam fermentasi asid ialah masing-masing pada suhu 35°C dan kawalan pH 6 menggunakan sejumlah 20% inokulum. Nilai anggaran asid organik yang dihasilkan ialah sebanyak 78.20 g/L. Kajian untuk menentukan kesahihan keputusan telah dijalankan dan jumlah asid organik paling tinggi dihasilkan ialah 77.28 g/L. Penghasilan asid organik sangat dipengaruhi oleh faktor pH, suhu dan interaksi antara kedua-duanya. Asid laktik ialah asid yang paling banyak dihasilkan melalui fermentasi sisa makanan iaitu merangkumi 80% dari jumlah keseluruhan asid berbanding dengan asid asetik dan asid butirik. Asid organik yang dihasilkan berpotensi untuk digunakan sebagai substrat bagi penghasilan biopolimer.

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I certify that a Thesis Examination Committee has met on 18th May 2011 to conduct the final examination of Halimatun Saadiah hafid on her thesis entitled "Optimization of microbial process for the conversion of kitchen waste into organic acids using Response Surface Methology" in accordance with the Universiti Putra Malaysia [P.U (A) 106] 15 March 1998. The committee recommends that the student be awarded the Master of Science.

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DECLARATION

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

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HALIMATUN SAADIAH HAFID

Date: 18 May 2011

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