CURRENT RESEARCH
AND DEVELOPMENT IN
BIOTECHNOLOGY
ENGINEERING
AT IIUM

VOLUME III

Editors:
Md. Zahangir Alam
Ahmed Tariq Jameel
Azura Amid

IIUM PRESS
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
CURRENT RESEARCH AND DEVELOPMENT IN BIOTECHNOLOGY ENGINEERING AT IIUM

(VOLUME III)

Editors:
Md. Zahangir Alam
Ahmed Tariq Jameel
Azura Amid

Department of Biotechnology Engineering
Faculty of Engineering
International Islamic University Malaysia

IIUM Press
CONTENTS

PREFACE i

CHAPTER 1 OPTIMIZATION OF EXTRACTION PROCESS PARAMETERS FOR ANTI-CANCER AGENT FROM Solanum lycopersicum Azura Amid, Abdul Aziz Ahmad and Raha Ahmad Raus 1

CHAPTER 2 OPTIMIZATION OF THE EXTRACTION PROCESS PARAMETER FOR KENAF SEEDS OIL TO OBTAIN HIGH OIL YIELD Azura Amid, Parveen Jamal, Nurul Elyani Mohamad and Engku Hasmah Engku Abdullah 11

CHAPTER 3 OPTIMIZATION OF THE EXTRACTION PROCESS PARAMETER TO OBTAIN HIGHEST ANTI-CANCER ACTIVITY FROM KENAF SEEDS Azura Amid, Parveen Jamal, Nurul Elyani Mohamad and Engku Hasmah Engku Abdullah 17

CHAPTER 4 OPTIMIZATION OF HEAT STERILIZATION ON MANGO FRUIT (Mangifera indica) PURÉE AND EFFECTS TOWARDS CANCER TREATMENT Azura Amid, Irwandi Jaswir and Muhd. Ezza Faiez Othman 25

CHAPTER 5 DETERMINATION OF OPTIMAL RANGE OF POST-INDUCTION TEMPERATURE FOR PRODUCTION OF SOLUBLE RECOMBINANT BROMELAIN IN Escherichia coli USING ONE-FACTOR-AT-A-TIME (OFAT) APPROACH Azura Amid and Jamil Jamaluddin 33

CHAPTER 6 AEROBIC BIODEGRADATION OF OIL AND GREASE IN PALM OIL MILL EFFLUENT USING CONSORTIUM OF MICROORGANISMS Ahmad Tariq Jameel and Alade Abass Olanrewaju 43

CHAPTER 7 WASTEWATER TREATMENT BY IMMOBILISED CELL SYSTEMS Ahmad Tariq Jameel and Alade Abass Olanrewaju 53

CHAPTER 8 BATCH FERMENTATION OF RECOMBINANT Escherichia coli PRODUCING ß-GLUCURONIDASE USING DIFFERENT CONTROL CONDITION Mohd Ismail Abdul Karim, Hamzah Mohd Salleh and Matzirwan Mel 61

CHAPTER 9 OPTIMIZATION OF PROCESS CONDITION FOR E. coli FERMENTATION PRODUCING NUCLEOCAPSID PROTEIN-AVIAN INFLUENZA VIRUS (NP-AIV) Matzirwan Mel, Md Rashid Shamsuddin, Hamadah Mohd Nur Lubis, Syarifah Syed Hasan and Suriani Mohd Noor 73
CHAPTER 10  CELL DISRUPTION IMPROVEMENT OF E. coli PRODUCING NP-AIV USING HIGH PRESSURE HOMOGENIZER
Maizirwan Mel, Mohd Rashid Shamsuddin, Hamadah Mohd Nur Lubis, Sharifah Syed Hasan and Suriani Mohd Noor

CHAPTER 11  SEEDS’ OIL AS BIOLUBRICANT
Mohamed E. S. Mirghani, I. A. Ahmed, N. A. Kabbashi, S. A. Muyibi, J. I. Daoud and M. A. Mikail

CHAPTER 12  SPECIAL OIL FROM DATE PALM KERNEL
Mohamed Elwathig Saeed Mirghani, Nasereldin A. Kabbashi and Nur Ellyana Mohd Noor

CHAPTER 13  GUM ARABIC: A NARRATIVE EMULSIFYING AGENT
Mohamed Elwathig Saeed Mirghani, Maizirwan Mel and Fatimah Misran

CHAPTER 14  INVESTIGATIONS ON SPIDER HOUSE FOR ANTI MICROBIAL ACTIVITY
Mohamed Elwathig Saeed Mirghani and Mohamad Zul Fahmi Zulkifli

CHAPTER 15  EVALUATION ON QUALITY OF HEAT RESISTANCE CHOCOLATE
Mohamed Elwathig Saeed Mirghani and Maan Fahmi Al-Khatib

CHAPTER 16  ANTIMICROBIAL PROPERTY OF DATE SEED EXTRACT
Mohamed E. S. Mirghani, M. A. Mikail, I. A. Ahmed, M. I. Abdul Karim and J. I. Daoud

CHAPTER 17  PROCESS IMPROVEMENT OF CONVENTIONAL PALM OIL MILLING: CONTINUOUS COOKER
Azlin Azmi, Mageswari Somasundaram and Dzun Jimat

CHAPTER 18  FOWL CHOLERA VACCINE PRODUCTION: SCREENING AND OPTIMIZATION OF MEDIA IN SHAKE FLASK CULTURE
Maizirwan Mel, Mohd Ismail Abdul Karim, Nor Jannah Yob, Intan Zahrah Samsury, Sharifah Syed Hassan and Akma Ngah Hamid

CHAPTER 19  FOWL CHOLERA VACCINE PRODUCTION: PROCESS OPTIMIZATION IN LABORATORY SCALE FERMENTER
Maizirwan Mel, Mohd Ismail Abdul Karim, Nor Jannah Yob, Intan Zahrah Samsury, Sharifah Syed Hassan and Akma Ngah
CHAPTER 20  PROCESS IMPROVEMENT OF CONVENTIONAL PALM OIL MILLING: DEPULPER
 Azlin Azmi, Mageswari Somasundaram and Dzun Jimat

CHAPTER 21  DIFFUSION-REACTION OF NUTRIENT IN IMMOBILIZED SLAB BIOCATALYST FOR FIRST AND ZERO ORDER REACTIONS
 Ahmad Tariq Jameel and RM Syibli Milasi

CHAPTER 22  DIFFUSION-REACTION OF SUBSTRATE IN CYLINDRICAL IMMOBILIZED BIO-CATALYST
 Ahmad Tariq Jameel and RM Syibli Milasi

CHAPTER 23  DIFFUSION-REACTION OF SUBSTRATE IN IMMOBILIZED SLAB BIOCATALYST FOR MICHAELIS-MENTEN KINETICS
 Ahmad Tariq Jameel and RM Syibli Milasi

CHAPTER 24  FERMENTATION OF BIOETHANOL FROM SAGO STARCH
 Mohamed Ismail Abdul Karim and Husna Muhammad Nadzri

CHAPTER 25  KINETIC STUDY ON VINEGAR PRODUCTION USING STAR FRUIT JUICE
 Mohamed Ismail Abdul Karim and Noor Izzaida Kamaruddin

CHAPTER 26  FERMENTATION OF VINEGAR FROM STAR FRUIT (Averrhoa carambola)
 Mohamed Ismail Abdul Karim, Farah Izora Jasni and Parveen Jamal

CHAPTER 27  DESIGN AND DEVELOPMENT OF A LAB SCALE BIOREACTOR FOR HEAT INDUCIBLE ENZYME EXPRESSION SYSTEM
 Daud Adam, Ahmad Faris Ismail and Hamzah Mohd. Salleh

CHAPTER 28  OPTIMIZATION OF PHYTOCHEMICAL ANTIOXIDANTS IN RBD PALM OLEIN DURING FRYING PROCESS
 Irwandi Jaswir and Mohd Syakirin Sudin

CHAPTER 29  OPTIMIZATION OF PROCESS PARAMETERS FOR EXTRACTION OF XANTHINE OXIDASE INHIBITOR (XOI) FROM Lycopersicon esculentum
 Parveen Jamal, Azura Amid, Rasidi Bahardin and Saiful Mohammad Nizam Azmi

CHAPTER 30  PROCESS OPTIMIZATION OF HYDROCOLLOID PRODUCTION FROM SEAWEEDS
 Irwandi Jaswir, Mohd Razi Kodin and Parveen Jamal

CHAPTER 31  IMPROVEMENT OF CONVENTIONAL MILLING PROCESS IN PALM OIL PROCESSING: ROTARY FILTER PRESS

iv
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>Screening of Fungi on Solid State Bioconversion of Oil Palm Empty Fruit Bunch for Production of Cellulase</td>
<td>251</td>
</tr>
<tr>
<td></td>
<td>Mohamed Ismail Abdul Karim, Manisya Zauri A. Hamid, Faridah Yusof and Md Zahangir Alam</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>Single Stage Stirred Tank Bioreactor Production of Star Fruit (<em>Averrhoa carambola</em>) Vinegar</td>
<td>259</td>
</tr>
<tr>
<td></td>
<td>Mohamed Ismail Abdul Karim, Parveen Jamal and Mohd Nasir Jamaliuddin Ab Rahaman</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>Treatment of Palm Oil Mill Effluent Using Microorganisms</td>
<td>269</td>
</tr>
<tr>
<td></td>
<td>Mohamed Ismail Abdul Karim, Nurul Aima Daud and Md Zahangir Alam</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>Comparative Study of Bioreactors Used for Palm Oil Mill Effluent Treatment Based on Chemical Oxygen Removal Efficiencies</td>
<td>277</td>
</tr>
<tr>
<td></td>
<td>Ahmad T. Jameel, Suleyman A. Muyibi and Alade A. Olanrewaju</td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>Effect of Homogenization in Breaking Protein-Carotenoid Complexes for Releasing Active Compounds</td>
<td>285</td>
</tr>
<tr>
<td></td>
<td>Parveen Jamal, Irwandi Jasvir, Nurhasri Mulyadi Hashim and Saiful Mohammad Nizam Azmi</td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>The Use of Modified Polymeric Polyhippe as an Immobilized Cell Matrix</td>
<td>297</td>
</tr>
<tr>
<td></td>
<td>Dzun Jimat and Azlin Azmi</td>
<td></td>
</tr>
<tr>
<td>INDEX</td>
<td></td>
<td>306</td>
</tr>
</tbody>
</table>
CHAPTER 3

THE USE OF MODIFIED POLYMERIC POLYHIPE AS AN IMMOBILIZED CELL MATRIX

Dzun Jimat and Azlin Azmi

Department of Biotechnology Engineering, Faculty of Engineering, International Islamic University Malaysia, P.O. Box 10, 50728 Kuala Lumpur, Malaysia

ABSTRACT

Utilization of modified-polyHIPE polymer matrix in the immobilization cell system is probably can substitute conventional cell matrix. The confined microenvironment was designed to promote the bacterium growth and its metabolic activity. The applied forced-flow seeding technique yielded a more uniform distribution of cells within the polymeric support, which also helps to improve nutrient transport. This also prevents significant growth of cells around the outer surface of matrix. The microstructure of the matrix with respect to its physico-chemical characteristics, which include appropriate pore and interconnect sizes as well as surface chemistry (i.e. hydrophobic, hydrophilic), are very important with respect to the flow of nutrients and waste material and also for cell migration. As a result, the developed immobilized matrix can be performed effectively and essential in the area of bioprocess development specifically for microbial fermentations.

Keywords: polyHIPE polymer matrix, immobilization cell, microenvironment, forced-flow seeding, physico-chemical characteristics

INTRODUCTION

The immobilization of the diverse types of microbial species in various bioprocesses that they are currently applied to (e.g. wastewater treatment, production of enzymes and solvents etc) has shown that this cultivation system offers a number of advantages over conventional free cells (planktonic) cultures. The advantages of this system include high cell concentrations and high productivity for metabolites and proteins, the maintenance of plasmid stability, the ease of biomass removal from the bulk liquid and a reduction in cell washout associated with high dilution rates. The careful selection of immobilization technique, as well as the matrix material used, is essential for ensuring the efficiency of the system and the minimalization of problems such as cell leakage and restricted substrate diffusion.

Cell immobilization can be defined as the physical confinement or localization of viable microbial cells to a defined region of space in such a way as to exhibit hydrodynamic characteristics which differ from those of the surrounding environment (Karel et al., 1985a). There are three components that can be differentiated in the immobilized cell systems,