

# CURRENT RESEARCH AND DEVELOPMENT IN BIOTECHNOLOGY ENGINEERING AT IIUM

VOLUME III

Editors:

Md. Zahangir Alam  
Ahmed Tariq Jameel  
Azura Amid



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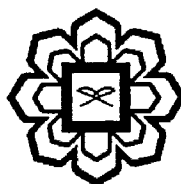
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**Department of Biotechnology Engineering  
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## CONTENTS

PREFACE		i
CHAPTER 1	OPTIMIZATION OF EXTRACTION PROCESS PARAMETERS FOR ANTI-CANCER AGENT FROM <i>Solanum lycopersicum</i> <i>Azura Amid, Abdul Aziz Ahmad and Raha Ahmad Raus</i>	1
CHAPTER 2	OPTIMIZATION OF THE EXTRACTION PROCESS PARAMETER FOR KENAF SEEDS OIL TO OBTAIN HIGH OIL YIELD <i>Azura Amid, Parveen Jamal, Nurul Elyani Mohamad and Engku Hasmah Engku Abdullah</i>	11
CHAPTER 3	OPTIMIZATION OF THE EXTRACTION PROCESS PARAMETER TO OBTAIN HIGHEST ANTI-CANCER ACTIVITY FROM KENAF SEEDS <i>Azura Amid, Parveen Jamal, Nurul Elyani Mohamad and Engku Hasmah Engku Abdullah</i>	17
CHAPTER 4	OPTIMIZATION OF HEAT STERILIZATION ON MANGO FRUIT ( <i>Mangifera indica</i> ) PUREE AND EFFECTS TOWARDS CANCER TREATMENT <i>Azura Amid, Irwandi Jaswir and Muhd. Ezza Faiez Othman</i>	25
CHAPTER 5	DETERMINATION OF OPTIMAL RANGE OF POST-INDUCTION TEMPERATURE FOR PRODUCTION OF SOLUBLE RECOMBINANT BROMELAIN IN <i>Escherichia coli</i> USING ONE-FACTOR-AT-A-TIME (OFAT) APPROACH <i>Azura Amid and Jamil Jamaluddin</i>	33
CHAPTER 6	AEROBIC BIODEGRADATION OF OIL AND GREASE IN PALM OIL MILL EFFLUENT USING CONSORTIUM OF MICROORGANISMS <i>Ahmad Tariq Jameel and Alade Abass Olanrewaju</i>	43
CHAPTER 7	WASTEWATER TREATMENT BY IMMOBILISED CELL SYSTEMS <i>Ahmad Tariq Jameel and Alade Abass Olanrewaju</i>	53
CHAPTER 8	BATCH FERMENTATION OF RECOMBINANT <i>Escherichia coli</i> PRODUCING $\beta$ -GLUCURONIDASE USING DIFFERENT CONTROL CONDITION <i>Mohd Ismail Abdul Karim, Hamzah Mohd Salleh and Maizirwan Mel</i>	61
CHAPTER 9	OPTIMIZATION OF PROCESS CONDITION FOR <i>E. coli</i> FERMENTATION PRODUCING NUCLEOCAPSID PROTEIN-AVIAN INFLUENZA VIRUS (NP-AIV) <i>Maizirwan Mel, Md Rashid Shamsuddin, Hamadah Mohd Nur Lubis, Syarifah Syed Hasan and Suriani Mohd Noor</i>	73

CHAPTER 10	CELL DISRUPTION IMPROVEMENT OF <i>E. coli</i> PRODUCING NP-AIV USING HIGH PRESSURE HOMOGENIZER <i>Maizirwan Mel, Mohd Rashid Shamsuddin, Hamadah Mohd Nur Lubis, Sharifah Syed Hasan and Suriani Mohd Noor</i>	79
CHAPTER 11	SEEDS' OIL AS BIOLUBRICANT <i>Mohamed E. S. Mirghani, I. A. Ahmed, N. A. Kabbashi, S. A. Muyibi, J. I. Daoud and M. A. Mikail</i>	85
CHAPTER 12	SPECIAL OIL FROM DATE PALM KERNEL <i>Mohamed Elwathig Saeed Mirghani, Nasereldin A. Kabbashi and Nur Ellyana Mohd Noor</i>	93
CHAPTER 13	GUM ARABIC: A NARRATIVE EMULSIFYING AGENT <i>Mohamed Elwathig Saeed Mirghani, Maizirwan Mel and Fatimah Misran</i>	105
CHAPTER 14	INVESTIGATIONS ON SPIDER HOUSE FOR ANTI MICROBIAL ACTIVITY <i>Mohamed Elwathig Saeed Mirghani and Mohamad Zul Fahmi Zulkifli</i>	117
CHAPTER 15	EVALUATION ON QUALITY OF HEAT RESISTANCE CHOCOLATE <i>Mohamed Elwathig Saeed Mirghani and Maan Fahmi Al- Khatib</i>	129
CHAPTER 16	ANTIMICROBIAL PROPERTY OF DATE SEED EXTRACT <i>Mohamed E. S. Mirghani, M. A. Mikail, I. A. Ahmed, M. I. Abdul Karim and J. I. Daoud</i>	139
CHAPTER 17	PROCESS IMPROVEMENT OF CONVENTIONAL PALM OIL MILLING: CONTINUOUS COOKER <i>Azlin Azmi, Mageswari Somasundaram and Dzun Jimat</i>	146
CHAPTER 18	FOWL CHOLERA VACCINE PRODUCTION: SCREENING AND OPTIMIZATION OF MEDIA IN SHAKE FLASK CULTURE <i>Maizirwan Mel, Mohd Ismail Abdul Karim, Nor Jannah Yob, Intan Zahrah Samsury, Sharifah Syed Hassan and Akma Nghah Hamid</i>	155
CHAPTER 19	FOWL CHOLERA VACCINE PRODUCTION: PROCESS OPTIMIZATION IN LABORATORY SCALE FERMENTER <i>Maizirwan Mel, Mohd Ismail Abdul Karim, Nor Jannah Yob, Intan Zahrah Samsury, Sharifah Syed Hassan and Akma Nghah</i>	163



CHAPTER 20	PROCESS IMPROVEMENT OF CONVENTIONAL PALM OIL MILLING: DEPULPER <i>Azlin Azmi, Mageswari Somasundaram and Dzun Jimat</i>	169
CHAPTER 21	DIFFUSION-REACTION OF NUTRIENT IN IMMOBILIZED SLAB BIOCATALYST FOR FIRST AND ZERO ORDER REACTIONS <i>Ahmad Tariq Jameel and RM Syibli Milasi</i>	175
CHAPTER 22	DIFFUSION-REACTION OF SUBSTRATE IN CYLINDRICAL IMMOBILIZED BIO-CATALYST <i>Ahmad Tariq Jameel and RM Syibli Milasi</i>	183
CHAPTER 23	DIFFUSION-REACTION OF SUBSTRATE IN IMMOBILIZED SLAB BIOCATALYST FOR MICHAELIS-MENTEN KINETICS <i>Ahmad Tariq Jameel and RM Syibli Milasi</i>	189
CHAPTER 24	FERMENTATION OF BIOETHANOL FROM SAGO STARCH <i>Mohamed Ismail Abdul Karim and Husna Muhammad Nadzri</i>	197
CHAPTER 25	KINETIC STUDY ON VINEGAR PRODUCTION USING STAR FRUIT JUICE <i>Mohamed Ismail Abdul Karim and Noor Izzaida Kamaruddin</i>	203
CHAPTER 26	FERMENTATION OF VINEGAR FROM STAR FRUIT ( <i>Averrhoa carambola</i> ) <i>Mohamed Ismail Abdul Karim, Farah Izora Jasni and Parveen Jamal</i>	207
CHAPTER 27	DESIGN AND DEVELOPMENT OF A LAB SCALE BIOREACTOR FOR HEAT INDUCIBLE ENZYME EXPRESSION SYSTEM <i>Daud Adam, Ahmad Faris Ismail and Hamzah Mohd. Salleh</i>	211
CHAPTER 28	OPTIMIZATION OF PHYTOCHEMICAL ANTIOXIDANTS IN RBD PALM OLEIN DURING FRYING PROCESS <i>Irwandi Jaswir and Mohd Syakirin Sudin</i>	219
CHAPTER 29	OPTIMIZATION OF PROCESS PARAMETERS FOR EXTRACTION OF XANTHINE OXIDASE INHIBITOR (XOI) FROM <i>Lycopersicon esculentum</i> <i>Parveen Jamal, Azura Amid, Rasidi Bahardin and Saiful Mohammad Nizam Azmi</i>	226
CHAPTER 30	PROCESS OPTIMIZATION OF HYDROCOLLOID PRODUCTION FROM SEaweEDS <i>Irwandi Jaswir, Mohd Razi Kodin and Parveen Jamal</i>	237
CHAPTER 31	IMPROVEMENT OF CONVENTIONAL MILLING PROCESS IN PALM OIL PROCESSING: ROTARY FILTER PRESS	245

CHAPTER 32	SCREENING OF FUNGI ON SOLID STATE BIOCONVERSION OF OIL PALM EMPTY FRUIT BUNCH FOR PRODUCTION OF CELLULASE <i>Mohamed Ismail Abdul Karim, Manisya Zauri A. Hamid, Faridah Yusof and Md Zahangir Alam</i>	251
CHAPTER 33	SINGLE STAGE STIRRED TANK BIOREACTOR PRODUCTION OF STAR FRUIT ( <i>Averrhoa carambola</i> ) VINEGAR <i>Mohamed Ismail Abdul Karim, Parveen Jamal and Mohd Nasir Jamaluddin Ab Rahaman</i>	259
CHAPTER 34	TREATMENT OF PALM OIL MILL EFFLUENT USING MICROORGANISMS <i>Mohamed Ismail Abdul Karim, Nurul Aima Daud and Md Zahangir Alam</i>	269
CHAPTER 35	COMPARATIVE STUDY OF BIOREACTORS USED FOR PALM OIL MILL EFFLUENT TREATMENT BASED ON CHEMICAL OXYGEN REMOVAL EFFICIENCIES <i>Ahmad T. Jameel, Suleyman A. Muyibi and Alade A. Olanrewaju</i>	277
CHAPTER 36	EFFECT OF HOMOGENIZATION IN BREAKING PROTEIN-CAROTENOID COMPLEXES FOR RELEASING ACTIVE COMPOUNDS <i>Parveen Jamal, Irwandi Jaswir, Nurhasri Mulyadi Hashim and Saiful Mohammad Nizam Azmi</i>	285
CHAPTER 37	THE USE OF MODIFIED POLYMERIC POLYHIPE AS AN IMMOBILIZED CELL MATRIX <i>Dzun Jimat and Azlin Azmi</i>	297
INDEX		306

### KINETIC STUDY ON VINEGAR PRODUCTION USING STAR FRUIT JUICE

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#### ABSTRACT

A study was undertaken to produce Star fruit vinegar (*Averrhoa carambola*) juice through double stage fermentation with the use of microorganisms namely *Saccharomyces cerevisiae* and *Acetobacter aceti*. The star fruit juice with optimum glucose concentration (20%) was used and growth kinetic study of the cultures to optimize operational conditions (agitation speed and inoculum size) in 2L bioreactor for production of star fruit vinegar was conducted. An experimental design using the Central Composite Design by Design Expert software, where the main factors impeller speed (rpm) and inoculum sizes (% inoculum) were optimized affecting the production of acetic acid in fruit juice during fermentation. Sampling of the were done every 12 hours during 4 days of fermentation time to analyze cell concentration (OD 600 nm), Total Cell Number, cell dry weight, reducing sugar, ethanol and acetic acid production. On the different combination of factors for all 9 runs of experiment conducted, it was found optimum production of acetic acid was achieved with agitation speed of 250 rpm and 5 % inoculum sizes where highest ethanol production of 17.8% or 150.34 g/L. and 2.76% acetic acid (TA) was obtained. This combination of parameters produces the highest specific growth rate,  $\mu$  and highest yield which are 0.859 and 0.342 g/g of the culture was obtained.

**Keywords:** Star Fruit Vinegar, Fermented Vinegar, Vinegar Kinetics.

#### INTRODUCTION

Many types of commercial fruit vinegar are being manufactured and among them are apple cider, persimmon vinegar, banana vinegar, wine (grape) vinegar, balsamic (crush grape) vinegar and others. Recently our researches had shown some interest on the production of star fruit (*Averrhoa carambola*) juice vinegar. however, kinetic study on factors affecting the vinegar production in bioreactor using yeast and acetic bacteria is lacking. Fruit vinegar has wide health benefits and is widely used as a condiment, health drink and used in many cooking dishes. Many researchers (Prescott *et al.*, 1999; Wood, 1998; Neto *et al.*, 2001; Simoons, 2000) has describe in detail the production of vinegar in open batch system, however, not much work is being done on kinetic study of vinegar using bioreactor. It is critical in to evaluate factors such as pH, aeration, inoculum size, and temperature and substrate concentration affecting production of the vinegar. A research was conducted to find the aeration rate and inoculum size affecting production of ethanol and acetic acid in star fruit juice vinegar.