

PRETREATMENT OF COCOA WASTE USING IONIC LIQUID FOR
BIOETHANOL PRODUCTION

AHMAD IDI

A thesis submitted in partial fulfilment of the requirements for the award of the
degree of Masters of Science (Biotechnology)

Faculty of Bioscience and Bioengineering
Universiti Teknologi Malaysia

JANUARY, 2012

DEDICATION

This work is dedicated to my beloved sister Hasiya. May Allah (SWA) grant her Jannatul Firdaus, Ameen

AKNOWLEDGMENT

First of all I will like to thank Allah (SWA) for been the source of my everything. Peace and blessings of Allah be on our beloved prophet (SAW). This work will never be a success without the support and assistance of my supervisor Dr Shaza Eva Mohamad. Words are not enough to say how grateful I am. Thank you for your guidance, patience and advice

I will be ungrateful if I fail acknowledge the support and assistance of all the students in the special equipment laboratory. Special thanks to Summaiya for her support and assistance. Finally to my family, friends and colleagues for been there for me during this challenging time.

ABSTRACT

Bioethanol is a fuel derived from renewable sources of feedstock typically plants and agricultural waste such as cocoa waste. It has improved 'Lifecycle CO₂' performance because the plants used as feedstock take CO₂ from the atmosphere as they grow. This means that almost all the CO₂ produced by burning the fuel is balanced by CO₂ taken from the air. The reduced CO₂ emissions indicate that bioethanol is good for the environment. But unfortunately most of the chemicals used in the pretreatment processes for bioethanol production are not environmentally benign. In this study we employed the use of ionic liquid which is environmentally friendly in the pretreatment of cocoa waste, so that the whole process will be "green" (environmentally benign). To determine how effective ionic liquid pretreatment is, it was compared to the untreated cocoa waste, sulphuric acid pretreatment and sodium hydroxide pretreatment. Ionic liquid pretreatment was found to show minimal biomass destruction of 30.77% after pretreatment while H₂SO₄ showed 61.18% and NaOH 78.89% of biomass destruction after pretreatment. The untreated biomass has 10.23% amount of cellulose but pretreatment with ionic liquid exposed this amount up to 47.30%, H₂SO₄ to 49.13% and NaOH reduced this amount to 7.150%. Two types of yeast were also isolated from Tapai Ubi to do the fermentation. Using DNS method for determining reducing sugar, ionic liquid pretreatment produced 6.3×10^{-2} g/L of reducing sugar and untreated, H₂SO₄ pretreatment NaOH pretreatment produced 2.87×10^{-2} g/L, 7.4×10^{-2} g/L and 3.37×10^{-2} g/L respectively at the end of 24 hours of incubation. Bioethanol produced during the fermentation was analysed using gas chromatography. Ionic liquid produced a total of 7.885g/L, H₂SO₄ produced 7.911g/L NaOH produced 6.824g/L and untreated cocoa waste produced 5.116g/L of ethanol at the end of 24 hours.

ABSTRAK

Bioethanol adalah bahan api yang diperolehi daripada sumber yang boleh diperbaharui seperti bahan mentah biasanya tumbuh-tumbuhan dan bahan buangan pertanian seperti sisa koko. Ia telah meningkatkan prestasi 'Kitaran Hayat CO₂' kerana tumbuh-tumbuhan yang digunakan sebagai bahan mentah mengambil CO₂ dari atmosfera semasa mereka bertumbuh. Ini bermakna bahawa hampir semua CO₂ yang dihasilkan dengan membakar bahan api adalah seimbang oleh CO₂ yang diambil dari udara. Penghasilan CO₂ yang kurang menunjukkan bahawa bioethanol adalah baik untuk alam sekitar. Tetapi malangnya, kebanyakan bahan kimia yang digunakan dalam proses prarawatan untuk penghasilan bioethanol tidak mesra alam. Dalam kajian ini, kami menggunakan cecair ionik yang mesra alam dalam prarawatan coca sisa, supaya keseluruhan proses akan menjadi "hijau" (mesra alam). Untuk menentukan keberkesanan prarawatan cecair ionik, ia dibandingkan dengan sisa koko yang tidak dirawat, prarawatan dengan asid sulfurik dan natrium hidroksida. sisa koko yang tidak dirawat, prarawatan cecair ionik menunjukkan kemusnahan biomass yang minimum (30.77%) selepas prarawatan. Manakala H₂SO₄ menunjukkan 61.18% dan NaOH 78.89% daripada kemusnahan biomass selepas prarawatan. Biomass yang tidak dirawat mempunyai jumlah 10.23% selulosa tetapi sisa koko dengan prarawatan cecair ionik mempunyai jumlah 47.30% selulosa, H₂SO₄ prarawatan mempunyai 49.13% selulosa dan NaOH prarawatan mempunyai 7.150% selulosa. Dua jenis yis telah diisolasi daripada Tapai Ubi penapaian. Menggunakan kaedah DNS untuk menentukan gula sisa kok yang penurum, prarawatan cecair ionik yang menghasilkan 6.3×10^{-2} g/L gula penurum dan tidak dirawat, prarawatan dengan H₂SO₄, dan NaOH prarawatan menghasilkan 2.87×10^{-2} g/L, 7.4×10^{-2} g/L dan 3.3×10^2 g/L masing-masing pada akhir 24 jam penggeraman. Bioethanol yang dihasilkan semasa penapaian disulkat menggunakan kromatografi

gas. Cecair ionik telah menghasilkan sejumlah 7.885g/L, H₂SO₄ menghasilkan 7.911g/L NaOH menghasilkan 6.824g/L dan biomass yang tidak dirawat menghasilkan 5.116g / L ethanol akhir 24 jam.

TABLE OF CONTENT

CHAPTER	TITLE	PAGE
	DECLARATION	ii
	DEDICATION	iii
	ACKNOWLEDGMENT	iv
	ABSTRACT	v
	ABSTRAK	vi
	TABLE OF CONTENTS	vii
	LIST OF TABLES	xi
	LIST OF FIGURES	xii
	LIST OF ABBREVIATIONS	xiv
	LIST OF APPENDICES	xv
I	INTRODUCTION	
	1.1 Background of the study	1
	1.2 Aim of the study	4
	1.3 Scope of the study	4
	1.4 Significant of the study	5
II	LITERATURE REVIEW	
	Literature review	6