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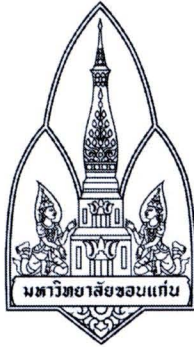
PRODUCTION OF CELLULOSIC ETHANOL FROM DURIAN
AND PINEAPPLE PEEL BY *Saccharomyces cerevisiae*
VIA BATCH FERMENTATION

MR. PATIWAT CHAIYAMATE

A THESIS FOR THE DEGREE OF MASTER OF SCIENCE
KHON KAEN UNIVERSITY

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**A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE
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IN ANALYTICAL CHEMISTRY

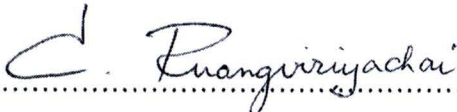
Thesis Title: Production of cellulosic ethanol from durian and pineapple peel
by *Saccharomyces cerevisiae* via batch fermentation


Author: Mr. Patiwat Chaiyamate


Thesis Examination Committee:

Assist. Prof. Dr. Pakawadee Kaewkannetra	Chairperson
Assoc. Prof. Dr. Saksit Chanthai	Member
Assist. Prof. Dr. Sayant Seangsuwan	Member
Assoc. Prof. Dr. Chalerm Ruangviriyachai	Member

Thesis Advisor:


.....
(Assoc. Prof. Dr. Chalerm Ruangviriyachai) Advisor


.....
(Assoc. Prof. Dr. Lampang Manmart)
Dean, Graduate School


.....
(Assist. Prof. Dr. Kiat Sangaroon)
Dean, Faculty of Science

ปฎิวัติ ไชยมาตร. 2554. การผลิตเซลลูโลสจากเอทานอลจากเปลือกทุเรียนและเปลือกสับปะรด โดย *Saccharomyces cerevisiae* ด้วยการหมักแบบกะ. วิทยานิพนธ์ปริญญาวิทยาศาสตรมหาบัณฑิต สาขาวิชาเคมีวิเคราะห์ บัณฑิตวิทยาลัย มหาวิทยาลัยขอนแก่น.
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บทคัดย่อ

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เซลลูโลสจากเอทานอลสามารถเป็นแหล่งพลังงานทางเลือกใหม่ในอนาคต โดยผลิตได้จากพืชเศรษฐกิจ ได้แก่ ข้าวโพด มันสำปะหลัง และอ้อย ปัจจุบันพืชเศรษฐกิจเหล่านี้มีจำนวนลดลง จึงทำให้พืชเหล่านี้มีราคาสูงขึ้นอย่างต่อเนื่อง อย่างไรก็ตาม เซลลูโลสจากเอทานอลก็สามารถผลิตได้จากวัสดุเหลือทิ้งทางเกษตรที่อุดมไปด้วยลิกโนเซลลูโลส เช่น ลำต้นมันสำปะหลัง ฟางข้าว ชานอ้อย เปลือกทุเรียนและเปลือกสับปะรด เป็นต้น ในงานวิจัยนี้ สารละลายที่ผ่านการไฮโดรไลซิสด้วยกรดเจือจางของเปลือกทุเรียนและเปลือกสับปะรด จะถูกเปลี่ยนไปเป็นเซลลูโลสจากเอทานอลโดยการหมักแบบกะ นอกจากนี้การเตรียมและศึกษาลักษณะทางหมู่ฟังก์ชันของเซลลูโลสที่ได้จากเทคนิค Technical Association of Pulp and Paper Industrial T203 test method หรือ TAPPI T203 ร่วมกับเทคนิค FTIR เพื่อการผลิตเซลลูโลสจากเอทานอลให้มีปริมาณเพิ่มขึ้น จากผลการทดลองพบว่าสเปกตรัมของ ลิกนินและเฮมิเซลลูโลสที่ถูกกำจัดออกไปจากเปลือกทุเรียนและเปลือกสับปะรดไม่ปรากฏที่เลขคลื่น 1580 cm^{-1} , 1465 cm^{-1} , 1270 cm^{-1} , 1184 cm^{-1} และ 1590 cm^{-1} , 1475 cm^{-1} , 1250 cm^{-1} , 1164 cm^{-1} ตามลำดับ ร้อยละขององค์ประกอบหลักในเปลือกทุเรียนและเปลือกสับปะรด ได้แก่ เซลลูโลส ลิกนินและเฮมิเซลลูโลส เท่ากับ 35.16, 32.88, 1.21 และ 20.44, 41.21, 9.43 ตามลำดับ ซึ่งให้ร้อยละสูงสุดของน้ำตาลรีดิวซ์ทั้งหมดที่ได้จากการไฮโดรไลซิส คือ 80.21 และ 80.20 ตามลำดับ ปริมาณของเซลลูโลสจากเอทานอลในการหมักแบบกะถูกทำให้เพิ่มขึ้นด้วยกระบวนการกำจัดองค์ประกอบหลักที่ไม่จำเป็นต่อการหมักออกไปจากเปลือกทุเรียนและเปลือกสับปะรด ร้อยละสูงสุดของเซลลูโลสจากเอทานอลที่ได้จากการหมักแบบกะ คือ 66.34 และ 65.27 ตามลำดับ และ ผลผลิตได้สูงสุดของ เซลลูโลสจากเอทานอล คือ 0.663 กรัม/กรัม และ 0.653 กรัม/กรัม ในกรณีของเปลือกทุเรียนและเปลือกสับปะรด

Patiwat Chaiyamate. 2011. **Production of Cellulosic Ethanol from Durian and Pineapple Peel by *Saccharomyces cerevisiae* via Batch Fermentation.** Master of Science Thesis in Analytical Chemistry, Graduate School, Khon Kaen University.

Thesis Advisor: Assoc. Prof. Dr. Chalerm Ruangviriyachai

ABSTRACT

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Cellulosic ethanol can be an alternative energy source in the future. It was produced from high economical plants such as corn, cassava and sugarcane. Currently, these economical plants are being reduced which cause their initial cost still increases. However, the cellulosic ethanol production can alternatively be done from lignocellulosic agricultural wastes such as cassava stem, rice straw, durian and pineapple peel. In this research work aims to use cellulosic materials of durian and pineapple peel in form of hydrolyzed solution for production of cellulosic ethanol via batch fermentation. The preparation and characterization of the cellulose which obtained from Technical Association of Pulp and Paper Industrial T203 test method (TAPPI T203) couple with FTIR technique for the enhancement of the cellulosic ethanol production was investigated. The results showed that the FTIR spectra of their removable lignin and hemicelluloses from durian and pineapple peel disappeared at 1580 cm^{-1} , 1465 cm^{-1} , 1270 cm^{-1} , 1184 cm^{-1} and 1590 cm^{-1} , 1475 cm^{-1} and 1250 cm^{-1} , 1164 cm^{-1} , respectively. The percentage of cellulose was 35.16 and 20.44, respectively and the others in durian and pineapple peel such as lignin and hemicelluloses were 32.88, 1.21 and 41.21, 9.43, respectively. The maximum total reducing sugars found in the hydrolyzed durian and pineapple peel solution were 80.21 and 80.20, respectively. The percentage of cellulosic ethanol was enhanced when treatment process was used. The fermented broth gave the highest percentage of cellulosic ethanol at 66.34 and 65.27. In addition, the highest cellulosic ethanol yield obtained was 0.663 g/g and 0.653 g/g in case of raw durian peel and pineapple peel.

**The good aspects of the present thesis are dedicated
to my parents and entire teaching staffs**

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LIST OF ABBREVIATIONS

Abs	Absorbance
AU	Absorbance unit
cm ⁻¹	Per centimetre
DI	Deionized
DNS	3,5-Dinitrosalicylic acid
E-M	Embden-Meyerhof
ENO	Enolase
FBPA	Fructose bisphosphate aldolase
GAPDH	Glyceraldehydes-3-phosphate dehydrogenase
GC	Gas Chromatography
HK	Hexokinase
hr	Hour
FFVs	Flexible Fuel Vehicles
FID	Flame Ionization Detector
g/g	Gram per gram
g	Gram
GRAS	Generally recognized as safe
HPLC	High performance liquid chromatography
kg	Kilogram
LOD	Limit of detection
LOQ	Limit of quantitation
M	Molar
m	Metre
mg L ⁻¹	Milligram per litre
min	Minute
mL	Millilitre
mol	Mole
OCC	Old corrugated cardboard
OPEC	Organization of Petroleum Exporting Countries

LIST OF ABBREVIATIONS (Cont.)

PDC	Pyruvate decarboxylase
PFK	Phosphofructokinase
PGI	Phosphoglucoisomerase
PGK	Phosphoglyceratekinase
PGM	Phosphoglyceromutase
pH	Power of hydrogen ion
PYK	Pyruvatekinase
RSD	Relative standard deviation
psi	Pound per second inch
r^2	R square
rpm	Round per minute
SD	Standard deviation
SHF	Separate hydrolysis and fermentation
SSF	Simultaneous saccharification and fermentation
TAPPI	Technical Association of the Pulp and Paper Industry
t_R	Retention time
TPI	Triose phosphate isomerase
UV	Ultraviolet
v/v	Volume by volume
VGH	Very high gravity
Vis	Visible
w/v	Weight by volume
μL	Microlitre