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ABBREVIATIONS AND SYMBOLS

%	percent
/	per
<	less than
±	deviation
°C	degree Celsius
µg	microgram
µL	microliter
µm	micrometer
ADP	adenosine diphosphate
ANOVA	analysis of variance
Ara	arabinose
ATP	adenosine triphosphate
BBD	Box-Behnken design
CCD	central composite design
CFU	colony forming unit
cm	centimeter
CO ₂	carbon dioxide
CRC	cellulose-rich corncob
Da	Dalton
DEAE	diethylaminoethyl
DNS	dinitrosalicylic acid
DP	degree of polymerization
e.g.	exempli gratia
EDTA	ethylenediaminetetraacetic acid
EMP pathway	the Embden-Meyerhof-Parnas pathway
etc.	et cetera

<i>F</i>	Fisher's
g	gram
GH	glycoside hydrolase
h	hour
H	hydrogen
HPLC	high performance liquid chromatography
k	kilo
K_m	Michaelis constant
L	liter
LAB	lactic acid bacteria
LCM	lignocellulosic material
m	meter, milli
M	molarity
mA	milliampere
mg	milligram
min	minute
mL	milliliter
mm	millimeter
mM	millimolar
Mpa	megapascal
MW	molecular weight
NCBI	The National Center for Biotechnology Information
ND	not determined
<i>o</i> -	ortho-
OD ₆₀₀	optical density at 600 nm
-OH	hydroxyl group
<i>p</i> -	para-
pH	power of hydrogen
pI	isoelectric point
ppm	part per million
<i>p</i> -value	probability value
R^2	coefficient of determination

rpm	round per minute
RSM	response surface methodology
SDS	sodium dodecyl sulfate
SDS-PAGE	sodium dodecyl sulfate polyacrylamide gel electrophoresis
SEM	scanning electron microscope
SHF	separate hydrolysis and fermentation
SSF	simultaneous saccharification and fermentation
TAPPI	Technical Association of the Pulp and Paper Industry
TIM-barrel	triosephosphate isomerase-barrel
TISTR	Thailand Institute of Scientific and Technological Research
TLC	thin layer chromatography
U	unit
v/v	volume by volume
V_{\max}	limiting reaction rate
w/v	weight by volume
w/w	weight by weight
X1	xylose
X2	xylobiose
X3	xylotriose
X4	xylotetraose
X5	xylopentaose
XO	xylooligosaccharide
Y	response value
Y	yield
α	alpha
β	beta
γ	gamma

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ข้อความแห่งการริเริ่ม

- 1) วิทยานิพนธ์นี้แสดงกระบวนการทางเอนไซม์ที่มีประสิทธิภาพเพื่อเปลี่ยนซังข้าวโพดให้เป็นผลิตภัณฑ์ที่มีมูลค่าสูง คือ ไชโลโอลลีโกแซกคาไรด์และไบโอเอทานอล
- 2) เพื่อเพิ่มประสิทธิภาพของกระบวนการผลิตไชโลโอลลีโกแซกคาไรด์ จึงทำการหาสภาวะที่เหมาะสมต่อการผลิตไชโลโอลลีโกแซกคาไรด์จากซังข้าวโพดที่ผ่านการแปรสภาพด้วยโพแทสเซียมไฮดรอกไซด์ โดยใช้เอนไซม์เอนโคไซลานีสทนร้อนที่ผลิตได้เองจากเชื้อ *Streptomyces thermovulgaris* TISTR1948 โดยใช้การออกแบบทางสถิติ ตลอดจนทดสอบคุณสมบัติความเป็นฟรีไบโอติกส์ของไชโลโอลลีโกแซกคาไรด์จากซังข้าวโพดที่ผลิตได้
- 3) เพื่อประเมินประสิทธิภาพของเอนไซม์ดังกล่าวในการผลิตไชโลโอลลีโกแซกคาไรด์ที่มีความบริสุทธิ์สูง จึงทำเอนไซม์ให้บริสุทธิ์และศึกษาคุณลักษณะของเอนไซม์ จากนั้นจึงประยุกต์ใช้เอนไซม์ที่ผ่านการทำให้บริสุทธิ์แล้วในการผลิตไชโลโอลลีโกแซกคาไรด์จากซังข้าวโพด และประเมินคุณสมบัติความเป็นฟรีไบโอติกส์ของไชโลโอลลีโกแซกคาไรด์ที่มีความบริสุทธิ์สูงที่ผลิตได้ ในระดับหลอดทดลอง
- 4) เพื่อนำซังข้าวโพดที่อุดมไปด้วยเซลลูโลสซึ่งเป็นของเหลือทิ้งจากกระบวนการผลิตไชโลโอลลีโกแซกคาไรด์ไปใช้ประโยชน์ จึงนำมาใช้เป็นสารตั้งต้นในการผลิตไบโอเอทานอลด้วยกระบวนการย่อยและการหมักที่เกิดขึ้นพร้อมกัน โดยใช้ยีสต์ทนร้อนสายพันธุ์ใหม่ที่แยกได้ *Candida glabrata* KY618709 ซึ่งสามารถช่วยลดระยะเวลาในการหมักให้สั้นลง
- 5) เพื่อศึกษากระบวนการผลิตไชโลโอลลีโกแซกคาไรด์และไบโอเอทานอลแบบบูรณาการ จึงทำการขยายขนาดการผลิตไชโลโอลลีโกแซกคาไรด์ต่อเนื่องด้วยการผลิตไบโอเอทานอลในถังปฏิกรณ์ชีวภาพโดยกระบวนการแบบบูรณาการ ซึ่งรายละเอียดต่าง ๆ เหล่านี้ได้นำเสนอไว้ในวิทยานิพนธ์ฉบับนี้

STATEMENTS OF ORIGINALITY

- 1) This thesis demonstrates an effective enzymatic process to convert corncob into the high-value products of xylooligosaccharides and bioethanol.
- 2) In order to enhance the efficacy of xylooligosaccharide production process, the optimization of xylooligosaccharide production from KOH-treated corncob using an in-house thermostable endo-xylanase from *Streptomyces thermovulgaris* TISTR1948 via statistical design has been investigated. Moreover, the prebiotic property of corncob-xylooligosaccharides has also been tested.
- 3) To evaluate the performance of this xylanase on producing of high-purity xylooligosaccharides, the purification, characterization, as well as application of this purified enzyme on production of corncob-xylooligosaccharides have been investigated. A prebiotics property of these high-purity xylooligosaccharides have been assessed by *in vitro* evaluation.
- 4) In order to valorize a cellulose-rich corncob, a waste from xylooligosaccharide production process, so it has been used as a substrate for bioethanol production. The bioethanol production via simultaneous saccharification and fermentation (SSF) employing by a new isolated thermotolerant yeast *Candida glabrata* KY618709 can minimize the fermentation time.
- 5) In order to study the integrated process for xylooligosaccharide and bioethanol productions, the scaling up of the consecutive integrated process of xylooligosaccharide and bioethanol production has been investigated in a bioreactor, as the providing details in this thesis.