

TABLE OF CONTENT

	Page
Acknowledgments	iii
Abstract (in English)	iv
(in Thai)	vi
Table of content	viii
List of tables	xi
List of illustrations	xii
CHAPTER 1 INTRODUCTION AND LITERATURE REVIEWS	1
1.1 Introduction	1
1.2 Types of Xylanases	3
1.2.1 Endo- β -1,4-xylanase	3
1.2.2 β -Xylosidase	3
1.2.3 α -L arabinofuranosidase	3
1.2.4 α -Glucuronidase	4
1.2.5 Acetyl xylan esterase	4
1.2.6 Ferulic and p -coumeric acid esterase	4
1.3 Applications of Xylanolytic Enzymes	5
1.4 General Problems Associated with Microbial Xylanases	6
1.5 Properties of Cellulase-Free Xylanases in Application of Pulp Bleaching Processes	14
1.6 Cellulase-Free Xylanase Production from Agricultural Waste	15
1.7 Optimization by Statistical Method	16
1.8 Objectives	16
CHAPTER 2 MATERIALS AND METHODS	20
2.1 Media and Chemical Reagents	20
2.2 Equipments	21
2.3 Media	22
2.4 Methods	23
2.4.1 Microorganism	23
2.4.2 Culture Media	23
2.4.3 Inoculum Preparation	23
2.4.4 Experimental Design Setup	24

	Page
2.4.5 Enzyme Production	25
2.4.6 Enzyme Activity Measurement	25
2.4.7 Quadratic Model Analysis	26
2.4.8 Test for the Accuracy and Precision of the Model	26
2.4.9 Characterization of Crude Xylanases from <i>Streptomyces</i> sp. Ab106.3.	27
2.4.9.1 Temperature Profile	27
2.4.9.2 pH Profile	27
2.4.9.3 Stability of Xylanases	27
2.4.9.4 Effect of Bleaching Reagent on Xylanase Stability	27
2.4.9.5 Enzyme Kinetic Studies	28
2.4.10 Prebleaching and Bleaching of Kraft Pulp	28
2.4.10.1 Biobleaching Pulp with Xylanases	28
2.4.10.2 Hydrogen Peroxide Bleaching of Enzyme Pretreated Pulp	29
2.4.10.3 Enzyme Bleaching of Hydrogen Peroxide Pretreated Pulp	29
CHAPTER 3 RESULTS AND DISCUSSION	30
3.1 Estimation of the Coefficients in Mathematical Model and Model Setup	30
3.2 Model Analysis	31
3.3 Optimization of pH and Temperature for Xylanase Production	32
3.4 Test for the Accuracy of the Model	33
3.5 Some Properties of Xylanases	35
3.5.1 Optimum Temperature and pH of Crude Xylanases	35
3.5.2 Thermal Stabilities of Crude Xylanases	37
3.5.3 Effect of Bleaching Reagent on Xylanase Stability	40
3.6 Enzyme Kinetics	43
3.7 Prebleaching and Bleaching of Kraft Pulp	48
3.7.1 Biobleaching Pulp with Xylanases	48
3.7.2 Hydrogen Peroxide Bleaching of Enzyme Pretreated Pulp	53
3.7.3 Enzyme Bleaching of Hydrogen Peroxide Pretreated Pulp	54
3.8 Conclusions	59
3.9 Suggestions	60

REFERENCES

Page

APPENDICES

61

75



ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่

Copyright© by Chiang Mai University

All rights reserved

LIST OF TABLES

Tables	Page
1.1 Characteristics of Xylanases from Fungi	9
1.2 Characteristics of Xylanases from Bacteria	10
1.3 Characteristics of Xylanase from Actinomycetes and Yeast	12
1.4 Cellulase-free Xylanase Producers and Their Xylanase Properties	13
2.1 Maximum and Minimum Levels of Temperature and pH Used in the Central Composite Experimental Design	24
2.2 The Central Composite Design for the Two Independent Variables, Factors 1 and 2	24
3.1 Least Squares Linear Regression Analysis for Xylanase Production (quadratic model)	31
3.2 Comparison of Cellulase-Free Xylanase Production and Properties of <i>Streptomyces</i> sp.Ab106.3 to other Mesophilic and Thermophilic Actinomycetes	39
3.3 Comparison of Xylanase Kinetic Constants of <i>Streptomyces</i> sp.Ab106.3 to other Actinomycete Xylanases	45
3.4 Comparison of Xylanase Kinetic Constants of <i>Streptomyces</i> sp.Ab106.3 for Mixed-Inhibition to Non-inhibition	46
3.5 Summary of Some Properties of Xylanases Obtained from <i>Streptomyces</i> sp. Ab106.3	59
3.6 Summary of Kinetic Constants of Xylanases Obtained from <i>Streptomyces</i> sp. Ab106.3	60

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่

Copyright© by Chiang Mai University

All rights reserved

LIST OF ILLUSTRATIONS

Figures	Page
1.1 Lignin Associated Hemicellulose Fraction Removal from Pulp Structure by Action of Cellulase-free Xylanase	2
1.2 General of a Central Composite Design for two factors	17
3.1 Xylanase Productions From Conditions Simulated by Central Composite Design.	30
3.2 3-D Graphics for Quadratic Response Surface Optimization for Xylanase Production	32
3.3 Xylanase Production at Optimized Condition, 50 °C , pH 7.2. (a) Xylanase activity (IU/ml) ; (b) Total soluble protein (mg/ml)	34
3.4 Optimum Temperature and pH of Crude Xylanases Obtained from <i>Streptomyces</i> sp. Ab106.3 (a) Temperature profile at pH 7 (b) pH profile at 60 °C	36
3.5 Stability Profiles of Xylanases under Various Temperature and pH Values. (a) ; 55 °C , (b) ; 65 °C and (c) ; 75 °C	38
3.6 Stability Profiles of Xylanases Under Various Temperature and Hydrogen Peroxide Concentrations. (a) ; 45 °C , (b) ; 55 °C and (c) ; 65 °C	41
3.7 Stability Profiles of Xylanases Under Various Temperature and Sodium Hypochlorite Concentrations. (a) ; 45 °C , (b) ; 55 °C and (c) ; 65 °C	42
3.8 Enzymatic Hydrolysis of Oat Spelt Xylan (1 – 20 g/l) with Constant Concentration of Xylanases (5 IU/ml), at 65 °C.	43
3.9 Lineweaver –Burk Plot of the Enzymatic Hydrolysis of 1 – 20 g/l Oat Spelt Xylan with Constant Concentration of Xylanase (5 IU/ml) at 65 °C	44
3.10 Effect of Hydrogen Peroxide on Initial Rates of Xylanase Activity	47
3.11 Inhibition Kinetic analysis of Xylanase by Hydrogen Peroxide Using Soluble Oat Spelt Xylan as Substrate	47
3.12 Release of Reducing Sugar from Enzymatic Pretreatment of Kraft Pulp with Different Xylanase Doses at 55 °C, pH 7.0.	50
3.13 Release of Lignin from Enzymatic Pretreatment of Kraft Pulp with Different Xylanase Doses at 55 °C, pH 7.0	51

Figures	Page
3.14 Effect of Various Xylanase Doses on the Kraft Pulp Brightness at Different Incubation Times	52
3.15 Effect of Hydrogen Peroxide Bleaching on Brightness of the Pretreated Kraft Pulp with Various Xylanase Doses	54
3.16 Release of Reducing Sugar from Enzymatic Treatment of Kraft Pulp with Different Xylanase Doses After Hydrogen Peroxide Bleaching	56
3.17 Release of Lignin from Enzymatic Treatment of Kraft Pulp with Different Xylanase Doses After Hydrogen Peroxide Bleaching	57
3.18 Effect of Xylanase Doses on Brightness of the Pretreated Kraft Pulp with Hydrogen Peroxide	58

ABBREVIATION AND SYMBOLS

α	Alpha
β	Beta
μ	Micro
Δ	Delta
*	Star
/	Per
\pm	Deviation
>	More than
°	Degree
C	Celsius
g	Gram
h	Hour
IU	International unit
L	Liter
min	Minute
m	Meter
M	Molar
n	Nano
N	Normal
rpm	Round per minute
t_d	Half life
v	Volume
w	Weight

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่
 Copyright© by Chiang Mai University
 All rights reserved