IMMOBILISATION OF XYLANASE FOR XYLOOLIGOSACCHARIDES PRODUCTION FROM MERANTI WOOD SAWDUST

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Doctor of Philosophy

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SUPERVISOR'S DECLARATION

We hereby declare that we have checked this thesis and in our opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Doctor of Philosophy.

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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LIST OF SYMBOLS

%	Percentage
% (w/v)	Percentage weight per volume
% (w/w)	Percentage weight per weight
µL	Microliter
µm	Micrometer
µmol	Micromole
Å	Angstrom (a unit of length)
cm^{-1}	Reciprocal centimeters
D-values	Decimal reduction time
E_a	Activation enery
E_d	Activation energy for denaturation
g/g	Gram per gram
g/L	Gram per liter
g/mol	Gram per mole
h	Planck constant (11.04 x 10^{-36} J min)
$J \cdot mol^{-1}\ K^{-1}$	Joule per mole times Kelvin
K	Kelvin
k_B	Boltzman constant (1.38 x 10^{-23} $J \cdot K^{-1}$)
k_d	Thermal inactivation rate constant
k_d	Deactivation rate constant (min^{-1})
kDa	Kilodalton
$kJ \cdot mol^{-1}$	Kilojoule per mole
K_m	Michaelis-Menten constant
M	Molar concentration
mg/g	Miligram per gram
mg/mL	Milligram per mililiter
mg/mL·min	Milligram per mililiter times minutes
min^{-1}	Reciprocal minutes
mL	Mililiter
mL/min	Mililiter per minutes
°C	Degree celcius
R	Gas constant (8.314 $J \cdot mol^{-1}\ K^{-1}$)
R^2	Coefficient of determination
Rpm	Rotations per minute
S	Substrate concentration
$t_{1/2}$	Half-life
U	Units of enzyme activity
U/min	Units of enzyme activity per minutes
V_{max}	Maximum reaction rate
V_o	Initial reaction rate
V	Reaction rate
z-values	The temperature increase needed for 90% of decrease in the *D*-values
ΔG°	Gibbs free energy
ΔH°	Enthalpy
ΔS°	Entropy

LIST OF ABBREVIATIONS

3D	Three Dimensional
ANOVA	Analysis of Variance
CCD	Central Composite Design
CLEAs	Crosslinked Enzyme Aggregates
CLECs	Crosslinked Enzyme Crystals
CLEs	Crosslinked Enzyme
CX	Commercial Xylan
DNS	Dinitrosalycyclic acid
DOE	Design of Experiment
DP	Degree of Polymerisation
FFD	Fractional Factorial Design
FOS	Fructooligosaccharides
FOSHU	Foods for Specified Health Uses
FTIR	Fourier Transform Infrared
FX	Free Xylanase
HMF	Hydroxymethylfurfural
HPLC	High Performance Liquid Chromatography
IX	Immobilised Xylanase
IY	Immobilisation Yield
LAB	Lactic Acid Bacteria
LCM	Lignocellulose Materials
LOF	Lack of Fit
MWS	Meranti Wood Sawdust
MX	MWS Xylan
NA	Not Available
NDOS	Nondigestible Oligosaccharides
NREL	National Renewable Energy Laboratory
OD	Optical Density
OFAT	One-Factor-at-a-Time
OPF	Oil Palm Fronds
RID	Refractive Index Detector
RSM	Response Surface Methodology
SD	Standard Deviation
SEM	Scanning Electron Microscope
TAPPI	Technical Association of Pulp and Paper Industry
TS	Tobacco Stalk
X1	Xylose
X2	Xylobiose
X3	Xylotriose
X4	Xylotetraose
X5	Xylopentaose
XOS	Xylooligosaccharides
NM	Not Mentioned