UNIVERSITI TEKNOLOGI MARA

PRODUCTION OF XYLOOLIGOSACCHARIDES FROM OIL PALM FRONDS HEMICELLULOSE BY *TRICHODERMA LONGIBRACHIATUM* XYLANASE AND ULTRAFILTRATION

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Oil palm fronds (OPF) are cheap, widespread and largely available throughout the year. OPF contains rich hemicellulose which can be hydrolysed by enzyme for production of xylooligosaccharides (XOs). The aim of this study was to produce high yield of XOs from OPF hemicellulose. XOs production was performed by enzymatic hydrolysis of hemicellulose which was obtained by alkaline extraction from the OPF. OPF hemicellulose was hydrolysed using an endo-xylanse from *Trichoderma longibrachiatum* and the effects of different pH, temperature, enzyme and substrate concentration and hydrolysis time on the XOs yield were investigated. The hydrolysate containing XOs was then fractionated by ultrafiltration using 10 kDa, 3 kDa and 1 kDa molecular weight cut off (MWCO) membrane to purify the crude of XOs. The maximum yield of XOs (46%) was obtained at pH 4.6, temperature of 4°C, enzyme concentration of 2 U/ml and substrate concentration of 2% for 8 hours hydrolysis time with a considerable amount of xylose (12.55%). The percent recoveries of XOs in the final permeate of 3 kDa and 1 kDa MWCO membrane were 78.32% and 76.18%, respectively. The results showed that 3 kDa MWCO membrane fractionated XOs better than 1 kDa MWCO membrane with low amount of monosaccharides and high yield of xylobiose (X2) and xylotriose (X3). The results indicated the potential utilization of OPF for the production of XOs by enzymatic hydrolysis, which could be further extended as functional food ingredients.

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CHAPTER ONE
INTRODUCTION

1.1 BACKGROUND OF STUDY AND PROBLEM STATEMENT

The oil palm trees (*Elaeis guineensis*) which was introduced in Malaysia in 1870 as an ornamental tree, was originated from the tropical rain forests of West Africa (WanRosli et al. 2007; Ibrahim & Chandak, 2012). It was commercially exploited as an oil crop only from 1911, when the first commercial planting was done on Tenammaran Estate, Kuala Selangor (Mohd Nor, 2008). Due to the rapid growth of palm oil industry since 1990s, it has caused increasing output of biomass from oil palm trees including empty fruit bunch (EFB), oil palm trunk (OPT), and oil palm frond (OPF) which consist of lignocellulosic materials. The OPF is available daily throughout the year when the palms are pruned during the harvesting of bunches of fresh fruit (Noor Haliza et al. 2006; Namoolnoy et al. 2011). Oil palm fronds were the most abundant agricultural wastes of oil palm plantation in Malaysia which generated approximately 83 million tons (dry weight) annually (Mohd Zahari et al. 2012). Therefore, OPF was used as raw material in the present study.

Lignocellulosic materials such as tobacco stalk, wheat straw, oil palm trunk, cotton stalk, paddy straw and OPF are composed of hemicellulose which is tightly bound together with cellulose and lignin. Hemicellulose can be easily hydrolyzed by xylanase to produce value added products including xylooligosaccharides. Xylooligosaccharides (XOs) are oligomers of xylose structure and the degree of polymerization (DP, chain length) of XOs ranges from 2 to 10. Additionally, XOs present advantages in numerous field of applications, including food, feed, pharmaceutical, cosmetics and agro-chemistry industries.

In recent years, there has been growing interest in the isolation of hemicellulose and is reflected in the different techniques developed for the isolation of hemicellulose from diferent agricultural wastes. Alkaline extraction performed at low temperature and pressure has been employed in this study to extract hemicellulose from the OPF. The alkaline extraction showed the best performance in exposing hemicellulose to the action of endoxylanases, thus resulting in high yield of XOs