Chapter 1 Introduction

1.1 Background

The major plantations of commercial crops including rubber, oil palm, cocoa and pineapple are the strength of agricultural production in Malaysia which engages almost all of the arable land. Of the commercial plantation crops, oil palm industry is the important contributor to Malaysian economy with more than 5.00 million hectares of planted areas in 2011; grow by 3% against 4.85 million hectares in 2010. Because of the rapid development of oil palm production in Malaysia, oil palm industry produced highest quantity of biomass for around 80 million dry tones in 2010. The different types of biomass from oil palm industry included empty fruit bunch (EFBs), palm oil mill effluent, fiber, shell, wet shell, palm kernel, fronds and trunks (A. Noraishah., 2012). In 2009, approximately 15.2 and 17.5 million tons (wet weight) of OPT and OPEFB were produced in Malaysia. In spite of this, the most abundant biomass from oil palm plantation is not OPEFB or OPT. The most produced oil palm biomass is oil palm frond (OPF), which amounted to 83 million tons (wet weight) every year and have been found to be a highly favorable source (MPOC, 2010). OPF is obtained in the middle of pruning for harvesting fresh fruit bunch (FFB) that is why it is obtainable daily. OPF is now under-utilized as the plantation owners believe that all the OPF is required for nutrient recycling and soil conservation (Hassan et al., 1994; Wan Zahari et al., 2002). Therefore; pruned fronds are simply left in the plantation. However, the study shows that OPF does not contain high metal contents as widely thought, but contain high carbohydrates in the form of simple sugars. Therefore, part of the OPF can be utilized for other purpose without scarifying the nutrient recycling process (M. Zahari, M. Zakaria, H. Ariffin et al., 2012).

1.2 Problem statement

An excessive amount of oil palm frond (OPF) from oil palm industry will not just caused the improper disposal problem, but also generally caused environmental pollution when the waste are left to go rotten on the grounds or burnt on the plantation sites (K. Lim, Z. Zainal, G. Quadir et al., 2000; N. Mohd Nor., 2008). In spite of this, the large numbers of oil palm fronds (OPF) containing lignocellulosic materials were potentially to be utilized as renewable material. Consumption of all these materials is not going to only fix the sufficient disposal, but as well as contribute side income for farmers and generate more job (O. Akpinor, K. Erdogan, S. Bostanci., 2009; R. Howard, E. Abotsi et al., 2003).

1.3 Research objective

This work aims to study the factors that affect the production of renewable sugar from fiber pressed oil palm frond (FPOPF) through enzyme hydrolysis using Design Expert Software.
1.4 Research scope
The scopes in this research are functioning as a guideline to achieve objective. The scopes are:

- To identify the effect of the pH (4 – 5.6), temperature (35 - 65°C), enzyme concentration (1.5 - 6%), reaction time (3 – 72 hours) and agitation speed (50 – 200 rpm) towards the enzymatic hydrolysis.
- To quantify glucose yield by applying DNS method.
- To analysed the experimental data by using Design Expert Software.

1.5 Rationale and significance
Based on the research scopes mentioned above, the following rationale and significance that we could get have been outlined.

i. It shall reduce the huge production of biomass residue.
ii. It shall reduce deforestation and environmental problem.
iii. Alternative way to produce valuable product from oil palm biomass residue.
iv. New substitute of raw material for renewable sugar production.
v. It shall reduce factory’s waste disposal costs.
vi. It shall reduce termites’ problem in plantation because of Zero Burning Policy.

1.6 Organization of thesis
A review of literature is presented in Chapter 2. This chapter review about the biomass which is oil palm frond. Chapters 3 describe the experimental work carried out in the thesis where focuses on the alkaline pretreatment and different parameters that affect the enzymatic hydrolysis.

The remaining chapters cover a number of additional investigations carried out as a part of this study:

- Chapter 4 contains result and discussion about the alkaline pretreatment and enzymatic hydrolysis. The results were analysed using Design Expert Software.
- Chapter 5 is the conclusion of the study.
Chapter 2 Literature Review

2.1 Lignocellulose Biomass

Lignocellulose is a common term for describing the major components practically in most plants, which are cellulose, hemicelluloses, and lignin. Lignocellulose is a complex matrix, composed of a variety of polysaccharides, phenolic polymers and proteins. Cellulose is the main component of cell walls of land plants. Lignocellulosic biomass comprises of various materials with distinctive physical and chemical characteristics. It is the non-starch based fibrous part of plant material.

First-generation lignocellulose source is primarily from food crops such as grains, sugar beet and oil seeds. Their sustainable production is under scanner, as is the possibility of creating unnecessary competition for land and water used for food and fiber production, thus encroaching on fragile ecosystems like wetlands, forests, and shallow hills.

The cumulative effects of these issues have increased the interest in utilizing non-food biomass and agricultural residues. Feedstock from lignocellulose materials includes corn stover, cereal straw, bagasse, forest residues, and purpose-grown crops such as vegetative grasses and short rotation forests. These second-generation lignocellulosic could prevent many of the concerns facing first-generation lignocellulosic and potentially offer better cost reduction potential in the longer term. Importantly, lignocellulosic feedstock does not interfere with food security (Salman Zafar, 2014). Figure 2.1 shows the first and second generations of lignocellulosic sources.

Figure 2.1: The first and second generations of lignocellulosic sources