

## CHAPTER 1

### INTRODUCTION

#### 1.1 Background

Agar wood or Gaharu is a resinous wood that sometimes occurs in trees belong to the *Aquilaria* genus, *Thymelaeaceae* family. Agar wood producing species are found from India eastwards throughout Southeast Asia (Indonesia, Thailand, Cambodia, Laos, Vietnam, and Malaysia). *Aquilaria* is a fast-growing, archaic tropical forest tree. There are different names for agar wood such as ch'en hsiang, eagle wood, jin-koh, oud and others. There are 15 species of *Aquilaria*. In Malaysia, there are five species of *Aquilaria* which are *Aquilaria Malaccensis*, *Aquilaria Microcorpa*, *Aquilaria Hirta*, *Aquilaria Rostrata* and *Aquilaria Becanana*. Agar wood contains more than 12 chemical components that can be extracted. The resinous wood or oil extracted from the inside of *Aquilaria sp.* trees is extremely valuable for the use of religion cultural activities as well as an important ingredient in many traditional medicines and also used as perfume component. Agar wood extracts bring high prices range from a few dollars per kilo for the lowest quality to over 3000 US dollars for top quality oil and resinous wood (Cheksum *et al.*, 2002).

The main extract of the *Aquilaria* wood contained sesquiterpene namely alfa-agarofuran, (-)-10 epi-gama-eudesmol and oxo-agarospinol that produce the aromatic smell of the *Aquilaria* incense wood (Cheksum *et al.*, 2002). In order to facilitate its extraction from seeds, it is necessary to degrade the cell walls to increase the permeability for oil (Olsen, 1988). Oil extraction can also be favoured upon partial hydrolysis of the cell walls by means of appropriate enzymes (Domínguez *et al.*,

1996a). Enzyme treatment with carbohydrases and proteases was reported to enhance the oil extractability of seeds (Lanzani *et al.*, 1975; Fullbrook, 1983; Domínguez *et al.*, 1994). The oil extraction yields can be improved if an enzymatic treatment is applied during the mixing step (Fullbrook, 1983; Marek *et al.*, 1990; Tano-Debrah and Ohta, 1995a,b; Sengupta and Battacharyya, 1996; Tano-Debrah *et al.*, 1996). The cell wall degradation caused by the enzymes increases the permeability to the oil through the seed membranes. The use of several enzymes as cellulases, hemicellulases, pectinases, amylases, proteases has been reported (Lanzani *et al.*, 1975; Bhatnagar and Johari, 1987; Badr and Sitohy, 1992), and it is believed that the multiple activity complexes and enzyme mixtures being especially effective, due to their synergistic action on the demolition of cell walls (Düsterhöft *et al.*, 1993).

## 1.2 Problem Statement

The traditional way to extract the gaharu oil by soaking the gaharu powder in pure water takes months in order to extract the oil from the gaharu and the percentage of the yield is low. These are the reasons why this research is carried out in order to speed up the extraction of the gaharu oil. To overcome the low percentage of yield and long period to extract the oil, enzymatic hydrolysis, a pre-treatment process, is apply before the gaharu is being distillate. The results from the previous research shows that the yield of extraction gaharu oil using enzyme as pre-treatment (enzymatic hydrolysis) give the highest results compared with extraction without enzyme pre-treatment. Enzymatic hydrolysis need mild operational conditions (pH 4.8 & temperature 45 - 50°C) favour production of high quality products such as oil that need no further refining and detoxified meal (Lanzani *et al.*, 1991; Ohlson, 1992). Enzymatic hydrolysis produces better yields than acid-catalyzed hydrolysis (Pan *et al.*, 2005). Domínguez *et al.*, (1994) indicated enzymatic hydrolysis to be a promising field in today's biotechnological applications which has potential to enhance oil recovery from the oilseeds in shorter time with increased capacity of the equipments. This research will be carried out in order to extract the highest yield of essential oil at optimum conditions of enzymatic hydrolysis which are duration time and enzyme loading. Increasing the dosage of cellulases in the process, to a certain

extent, can enhance the yield and rate of the hydrolysis, but would significantly increase the cost of the process (Bhatnagar, 1987). At the same time, the enzyme's characteristic also will be affected by pH, temperature and substrate concentration (Cantwell *et al.*, 1988; Durand *et al.*, 1988; Orpin, 1988). By studying the effects of the enzymatic pre-treatment, the yield of oil extracted will be greatly enhanced and the optimum condition for the hydrolysis process will be determined.

### **1.3 Scope of Research Work**

In order to enhance the production of gaharu oil, two sequential steps processes are involved that are enzymatic hydrolysis followed by extraction using hydro distillation. In this research, effect of time during enzymatic pretreatment and enzyme loading are studied. Other factors that affect the enzymatic hydrolysis include substrate concentration, enzyme activity and reaction conditions (temperature, pH, shaking rate and others) were maintained at specific conditions.

### **1.4 Objectives**

The objectives of this study are:

- i. To study the effect of duration time (hour) on gaharu essential oil extraction with enzymatic hydrolysis.
- ii. To study the effect of enzyme loading (ml enzyme/ g gaharu) on gaharu essential oil extraction with enzymatic hydrolysis.