

UNIVERSITI TEKNOLOGI MARA

**PERFORMANCE OF THE FAR
INFRARED AND CONVENTIONAL
OVEN DRYING METHODS IN
EXTRACTION OF
ACETAMINOPHEN FROM
AQUILARIA SPP DRIED LEAVES**

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ABSTRACT

The growing of *Aquilaria* plantation in Malaysia has become an interest among researchers to explore additional benefits while waiting for the tree to produce a good quality resin, which requires 10 years and above. The traditional use of the leaves as tea in lowering high body temperature has been an idea for the exploration of the antipyretic properties of the leaves. The removal of moisture content by different drying techniques offers numerous advantages, which improve stability, as well as prevent microbial growth and biochemical modifications that could alter the characteristics of agricultural products. Current conventional drying methods, such as sun drying, conventional oven drying, hot air drying, and freeze-drying have disadvantages due to longer drying time, deterioration of nutrients, and physical appearance. Infrared drying is one of the latest techniques with unique characteristics, in which the heat penetrates directly into the product without losses to the surrounding. In this study, a series of experiments were conducted at various temperatures using a fabricated far-infrared (FIR) dryer and compared with a conventional oven in the drying of *Aquilaria* spp. leaves: *Aquilaria subintegra* and *Aquilaria malaccensis*. The drying characteristics, mathematical models, and physicochemical evaluations, especially antipyretic compounds of the dried leaves, were investigated. The findings show that the use of FIR drying shortens the drying duration by one-third over the conventional oven. The leaves dried at 50 °C took only 60 min to dry compared to 180 min for the conventional oven. At this condition, the effective diffusivity coefficient of the leaves is 1.4522×10^{-11} m²/s for FIR drying and 2.0745×10^{-12} m²/s for oven drying. The results showed that slow moisture diffusivity occurred in the conventional oven, resulting in a longer duration for the leaves to dry. The *Midilli* model fitted well the drying in the FIR dryer with 0.0001458×10^{-6} and 0.0021 of the sum of squared error and RMSE, respectively. For the colour changes, the ΔE of 7.90 ± 3.86 for FIR drying is lower than 9.07 ± 1.01 in the conventional oven, showing that the colours are well preserved. The existence of compounds, such as α -pinene, hexadecanoic acid, and octadecatrienoic acid, as well as the antipyretic source from the *Aquilaria* leaves indicates that the antipyretic compounds exist and are preserved. The conformation of the preservation of antipyretic compounds using acetaminophen was validated by the high-performance liquid chromatography analysis, with the amount of acetaminophen extracted of 1.0317 ± 0.15 μ g/mL for *A. malaccensis* and 0.7828 ± 0.16 μ g/mL for *A. subintegra* dried leaf extracts. In conclusion, the use of IR drying has been proven to be a good alternative for drying herbs, which provides a shorter drying time and preserves the physiochemical of *Aquilaria* spp. leaves. Further research needs to be done to enhance the valorisation of *Aquilaria* spp. leaves and other agricultural products for medicinal benefits by using the FIR technique.

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CHAPTER ONE

INTRODUCTION

1.1 Introduction

This chapter outlines the background of the research in the area of the topic. The problem statement, research objectives, and scope of the study are presented. This gives a general view regarding the study.

1.2 Background of Study

Malaysia is amongst countries that have more than 500,000 species of plants that grow and survive within the country forest. Herbal plants have a long history of non-conventional medicine use. The studies, quality control, and developments in clinical research have advanced, showing the value of herbal medicine in the treatment and prevention of disease. In this modern age, demand for medicinal plants is growing due to the development of scientific proof that confirms the health benefits of plant-separated extracts and phytochemicals. The biologically active phytoconstituents found in herbal plants, including alkaloids, flavonoids, tannins, and phenolic compounds, are known to have potential medicinal benefits. Hence, research has centred on these traditional medical plants nowadays.

Herbal trees are very highly demanded products in the market due to their immense value. They have been used widely in various ways, such as pharmaceuticals, incense in ritual ceremonies of some religions, foods, perfumes, and many more. Each part of the plant has its own benefits and uses. Most herbal trees have been proven by various studies to have many beneficial properties to humans, such as antioxidant, antidiabetic, anti-inflammatory, analgesic, antipyretic, and many more. Among herbal plants that are being used as natural remedies *are mas cotek, tongkat ali, kacip fatimah, tunjuk langit, belalai gajah, and gaharu*. Traditionally, people have been drinking herbal tea from herbal plants after drying the leaves to relieve the inner body temperature. The increase in body temperature is related to fever, in which the body temperature increases to above 37.5 °C. Synthetic analgesic, anti-inflammatory, and antipyretic drugs have been widely used for medication. These drugs might have an