UNIVERSITI TEKNOLOGI MARA

SYNERGISTIC EFFECT OF ENZYMATIC PRE-TREATMENT AND MICROWAVE-ASSISTED HYDRODISTILLATION IN AGARWOOD OIL EXTRACTION

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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 results 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

The primary technique to extract agarwood essential oil is through hydrodistillation (HD) technique which is a common practice in the agarwood commercial industries especially here in Malaysia. Agarwood chip is mixed with water in a still pot soaked for a period of time and then heated up until it boils, and once condensed the essential oil is collected. This conventional technique consumes longer soaking and extraction time which may result in a lower oil yield. Therefore, this thesis focused on the effect of adding enzymatic pre-treatment steps and an alternative extraction technique of microwave-assisted hydrodistillation to overcome the drawbacks. The chip is soaked in different enzyme concentration of 1%, 3% and 5% in different soaking period of 3, 6 and 14 days. The conventional method of hydrodistillation was carried out using the Clevenger-type apparatus in obtaining the extracted essential oil and the compounds of the extract were identified using GC-MS. To support the observation, Scanning Electron Microscope (SEM) were done to identify the effect of soaking to agarwood chips' morphology. The SEM results of enzymatic pretreated sample showed a disrupted cell morphology as compared with non-pretreated sample. The highest oil yield achieved from a sample treated with 3% enzyme concentration was 0.123% as compared to samples without any pre-treatment with 0.068% oil yield. The GC-MS analysis showed that similar compounds were found in both samples soaked for 6 days with or without enzyme treatment such as Caryophyllene, Gurjunene and Alloaromadendrene which contributes to the unique odor of agarwood oil. Microwave-assisted hydrodistillation (MAHD) technique was applied with different microwave power of 300, 400, 600, and 800 Watt (W) for irradiation time of 5 hours to extract agarwood oil. The highest oil yield obtained from the MAHD was 0.130% with a power of 600 W in 5-hour in which similar oil yield was obtained by using hydrodistillation for a longer period of time of 7-hour. Two main compounds were identified in MAHD extracted oil which are Alloaromadendrene and γ-Gurjunene. Energy consumption and CO_2 rejection into the atmosphere was the highest from hydrodistillation with 4.2 kWh and 2969 g of CO_2 as compared to MAHD14C with 3 kWh and 2121 g of CO_2. The synergistic effect of enzymatic pre-treatment coupled with microwave-assisted hydrodistillation (MAHDEP) was investigated by using 6 days soaking time, 3% enzyme concentration and microwave power of 600 W. The highest yield obtained from MAHD6EP3 was 0.128% as compared to enzymatic pre-treatment with conventional hydrodistillation (HDEP) with 0.123% of oil yield with additional 2-hour of extraction time. This showed that MAHD6EP3, with reduced soaking and extraction time could obtained a similar yield with 0.135 % from the hydrodistillation technique soaked for 14 days. Thus, it can be concluded that the synergistic combination can be achieved with a comparable oil yield of 0.128% as compared to MAHD and HD only with 0.130% and 0.135% respectively.

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TABLE OF CONTENTS