UNIVERSITI PUTRA MALAYSIA

COMPARISON OF MICROWAVE EXTRACTION TECHNIQUE AND CONVENTIONAL EXTRACTION TECHNIQUE FOR EXTRACTING ESSENTIAL OILS FROM LEMONGRASS, TUMERIC AND GINGER

NOR AZILA BINTI ABD AZIZ

FS 2012 8

COMPARISON OF MICROWAVE EXTRACTION TECHNIQUE AND CONVENTIONAL EXTRACTION TECHNIQUE FOR EXTRACTING ESSENTIAL OILS FROM LEMONGRASS, TUMERIC AND GINGER

By

NOR AZILA BINTI ABD AZIZ

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

June 2012

DEDICATION

Specially dedicated to:

My Father,
My Mother,
My Brothers,
My Sisters,
My Friends,
My Lecturers,

for their encouragement and support.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

COMPARISON OF MICROWAVE EXTRACTION TECHNIQUE AND CONVENTIONAL EXTRACTION TECHNIQUE FOR EXTRACTING ESSENTIAL OILS FROM LEMONGRASS, TUMERIC AND GINGER

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Chairman : Assoc. Prof. Jumiah Hassan, PhD

Faculty : Science

The purpose of this research is to compare the performance between two techniques of extraction which are Microwave Extraction Technique (MET) and Conventional Extraction Technique (CET) in extracting essential oils from Lemongrass, Ginger and Turmeric by using wet distillation (WD), dry distillation (DD) and hydro distillation (HD) methods in term of efficiency, rapidity, the yield of oil and the quality or composition of oil. The important parameters in the extraction process such as time, temperature and microwave power output were controlled to obtain high yield essential oils. The MET is performed at 450 W of irradiation power and temperature about 100°C for 1 hour using WD and DD. The CET is performed using HD at 450 W of extraction power and temperature 100°C for 4 hours. The absorbed power of microwave irradiation for WD and DD are also estimated to determine the method with higher value of absorbed power. A higher absorbed power means it is more efficient. The MET provides a rapid extraction 4 times faster compared to CET. After 1 hour of extraction using

MET, the total yield of essential oils is about the same with 4 hours extraction using CET. During WD, it requires only 8 to 12 minutes to achieve the boiling point of water (100.00±1.00˚C) whereas DD requires 8 to 15 minutes. However, HD requires 15 to 17 minutes to achieve the boiling point of water. From the 300.000 ± 0.001g actual weight of Lemongrass, the highest yield of essential oils per second is using the DD method which gives $10.4 \times 10^{-5}\%$ compared to WD with $8.97 \times 10^{-5}\%$ and DD with $2.09 \times 10^{-5}\%$. It is different with Ginger and Turmeric, the WD method gives them the highest yield of essential oil per second. For Ginger, the total yield of essential oil per second using WD is $3.85 \times 10^{-5}\%$, higher than DD $\left(1.06 \times 10^{-5}\%\right)$ and HD $\left(0.96 \times 10^{-5}\%\right)$. For Turmeric, the total yield per second using WD is $19.79 \times 10^{-5}\%$, which is very high compared to DD with $4.17 \times 10^{-5}\%$ and HD with $3.65 \times 10^{-5}\%$. The absorbed power of fresh sample mixture, $(PA/Vol)_{mfs}$ during DD is estimated to be higher than WD and this implies that DD is the more efficient method for the heating process. Another parameter is number of days to soak the samples. Generally, the longer time taken to soak the sample will produce more yields but this depends on the type of sample. Lemongrass and Turmeric gave the highest yield (0.49% and 0.69%) after 3 days of soaking. However it is vice versa for ginger. Ginger gives the highest yield of essential oils (0.14%) without soaking. The chemical component of the samples was identified using GC-MS. From the results, it was found that MET produced good quality of essential oils compared to CET where the oxygenated compound dominated in all the samples used. From the three samples used, Lemongrass is of better quality of essential oil followed by Turmeric and Ginger with oxygenated fraction of 94.73%, 90.56% and 46.69%.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi syarat keperluan untuk Ijazah Master Sains

PERBANDINGAN PENGEKSTRAKAN TEKNIK MIKROGELOMBANG DAN TEKNIK PENGEKSTRAKAN KONVENSIONAL UNTUK MENGEKSTRAK MINYAK PATI DARI SERAI, KUNYIT DAN HALIA

Oleh

NOR AZILA BINTI ABD AZIZ

Jun 2012

Pengerusi : Prof. Madya Jumiah Hassan, PhD

Fakulti : Sains

Tujuan penyelidikan ini adalah untuk membandingkan prestasi antara dua teknik pengekstrakan iaitu Teknik Pengekstrakan Mikro Gelombang (MET) dan Teknik Pengekstrakan Biasa (CET) dalam mengekstrak minyak pati daripada Serai, Halia dan Kunyit menggunakan kaedah penyulingan basah (WD), penyulingan kering (DD) dan penyulingan hidro (HD) dari segi kecekapan, kepantasan, penghasilan minyak dan kualitinya atau kandungan minyak. Parameter-parameter penting dalam proses pengekstrakan seperti masa, suhu dan kuasa output gelombang mikro dikawal untuk menghasilkan minyak pati pada kuantiti yang tinggi. MET beroperasi pada kuasa sinaran 450 W dan suhu sekitar 100˚C selama 1 jam menggunakan WD dan DD. CET menggunakan kaedah HD beroperasi pada kuasa sinaran 450 W dan suhu 100˚C selama 4 jam. Kuasa penyerapan sinaran gelombang mikro semasa WD dan DD dikira untuk menentukan kaedah yang memberikan nilai kuasa serapan tertinggi. Kuasa penyerapan yang lebih tinggi bermakna ia lebih cekap. MET menyediakan pengekstrakkan yang pantas iaitu 4 kali lebih cepat berbanding CET. Selepas 1 jam pengekstrakan

menggunakan MET, jumlah hasil minyak pati adalah hampir sama dengan 4 jam pengekstrakan menggunakan CET. Semasa WD, ia memerlukan hanya 8 hingga 12 minit mencapai takat didih air (100.00 ± 1.00˚C) manakala DD memerlukan 8 hingga 15 minit. Walau bagaimanapun, HD memerlukan 15 hingga 17 minit untuk mencapai takat didih air. Dari berat 300.000 ± 0.001g sebenar Serai, ia memberikan hasil minyak pati dalam sesaat yang tinggi menggunakan kaedah DD iaitu sebanyak $10.4 \times 10^{-5}\%$ berbanding WD dengan $8.97 \times 10^{-5}\%$ dan DD dengan $2.09 \times 10^{-5}\%$. Berbeza dengan Halia dan Kunyit, kaedah WD memberikan pulangan minyak pati yang tinggi dalam tempoh sesaat masa pengekstrakan. Jumlah hasil minyak pati dalam sesaat untuk Halia menggunakan WD adalah $3.85 \times 10^{-5}\%$, tinggi daripada DD $\left(1.06 \times 10^{-5}\%\right)$dan HD $\left(0.96 \times 10^{-5}\%\right)$. Jumlah hasil dalam sesaat untuk Kunyit menggunakan WD adalah $19.79 \times 10^{-5}\%$, sangat tinggi berbanding dengan DD dengan $4.17 \times 10^{-5}\%$ dan HD dengan $3.65 \times 10^{-5}\%$. Penyerapan kuasa campuran sampel segar, semasa DD dianggarkan lebih tinggi daripada WD dan ini menunjukkan bahawa DD adalah kaedah yang lebih cekap untuk proses pemanasan. Parameter lain ialah masa merendam sampel. Pada amnya, masa rendaman yang panjang akan menghasilkan lebih minyak tetapi ia bergantung kepada jenis sampel. Serai dan Kunyit memberikan hasil yang paling tinggi (0.49% and 0.69%) selepas 3 hari rendaman. Walau bagaimanapun, ia berlainan bagi Halia. Halia memberikan hasil minyak pati yang tinggi (0.14%) tanpa direndam. Komponen kimia sampel telah dikenal pasti menggunakan GC-MS. Daripada keputusan, di dapati bahawa MET menghasilkan kualiti minyak pati yang baik berbanding CET di mana sebatian oksigen didominasi dalam semua jenis sampel yang digunakan. Daripada tiga jenis sampel yang digunakan, Serai menunjukkan kualiti yang lebih baik diikuti oleh

Kunyit dan Halia dan masing-masing mempunyai pecahan sebatian oksigen 94.73%, 90.56% dan 46.69%.

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I certify that a Thesis Examination has met on **28 JUNE 2012** to conduct the final examination of **NOR AZILA BINTI ABD AZIZ** on her thesis entitled **"A COMPARATIVE STUDY OF ESSENTIAL OIL EXTRACTION FROM LEMONGRASS, GINGER AND TURMERIC"** in accordance with the Univerties and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U. (A) 106] 15 March 1998. The commitee recommends that the student be a awarded the relevant degree.

Member of the Thesis Examination Comittee were as follows:

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of **Master of Science**. The members of the Supervisory Committee were as follows:

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

NOR AZILA BINTI ABD AZIZ

Date: 28 JUNE 2012

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