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EXTRACTION OF ESSENTIAL OIL FROM CANANGA (*Cananga odorata*) USING SOLVENT-FREE MICROWAVE EXTRACTION: A PRELIMINARY STUDY

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ABSTRACT
Today the production of cananga (*Cananga odorata*) oil still has the potential to be developed in Indonesia. But the extraction of essential oil from cananga flowers are still using conventional methods such as hydrodistillation, steam-hydrodistillation and steam distillation which takes a long time to produce oil with good quality. In this research the extraction of cananga oil is done using solvent-free microwave extraction (SFME) method. The optimum yield in the extraction of cananga oil using SFME method is 2.304%. The optimum yield is obtained on the operating conditions: microwave power of 380 W, feed to distiller (F/D) ratio of 0.05 g/mL and flower size of ±0.5 cm. Based on the results of the GC-MS analysis showed that the main components of cananga oil produced by SFME method were β-caryophyllene (16.855%), benzyl benzoate (14.326%), caryophyllene oxide (13.484%) and germacrene (10.692%). Additionally, from GC-MS analysis can be said that the cananga oil that has been extracted using SFME method offers the possibility for better reproduction of the natural aroma of the flower essential oil than that obtained using the conventional method.
Keywords: *Cananga odorata*, cananga oil, solvent-free microwave extraction.

INTRODUCTION

Essential oil is one of an agro-industry export commodity that is potential to be a mainstay for Indonesia to earn foreign exchange. The statistical data of world export-import show that the average growth of essential oils and derivatives consumption is 5-10% per year. This increase was mainly driven by growing needs for food flavoring industry, cosmetics industry, and fragrances. Essential oils which have been widely extracted in Indonesia, among others, patchouli, clove, nutmeg, lemongrass, vetiver, eucalyptus oil, and others. While there are some essential oils that are still potential to be developed such as cananga, basil, cardamom, cinnamon, and others.

Cananga (*Cananga odorata*) is known for its flowers have a fragrant smell. In Java and Bali, cananga traded by local residents as potpourri and sow flowers used in religious ceremonies. In addition, cananga is also known as a medicinal plant, the leaves as a remedy for itch[1], dried flowers for malaria drugs[2], fresh flowers for aroma therapy, as well as the bark as a remedy for ulceration. Essential oils contained in cananga flowers is used as a fragrance ingredient. Cananga oil has quite high economic value in the world market. In addition to economic value, cananga trees also have ecological value, where this trees can be used for slope stability due to the type of roots are strong.

But today generally extraction process of essential oils from dried cananga flowers is still done using conventional methods such as hydrodistillation, steam-hydrodistillation and steam distillation. The length of time and still small yield obtained from conventional methods led to the need for the development of the methods of essential oils extraction. One of the methods that have the potential to be used for extraction of cananga oil is microwave-assisted extraction (MAE) methods.[3] MAE methods which now widely used, among others, microwave-assisted hydrodistillation (MAHD), microwave steam distillation (MSD), microwave steam diffusion (MSDf), and microwave hydro diffusion and gravity (MHG).[4,5] The advanced development of MAE method is solvent-free microwave extraction (SFME) method.[6] This method has the

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advantages compared with previously mentioned methods such as having faster extraction rate, yield, and also higher purity of extract because it does not require solvent so that does not contact with chemicals. Therefore, in this research, the essential oil from dried cananga flowers extracted using SFME method. The extraction using these methods is expected to obtain optimum yield and quality of cananga oil that can be accepted in the market.

EXPERIMENTAL

Plant Material

Fresh cananga (*Cananga odorata*) flowers were collected from Pasuruan, East Java, Indonesia. The flowers then were dried and stored at room temperature until required.

Solvent-Free Microwave Extraction (SFME) of Cananga Oil

In employing SFME, we used a domestic microwave oven (EMM-2007X, Electrolux, 20 L, maximum delivered power of 800 W) with a wave frequency of 2450 MHz. In a typical SFME procedure performed at atmospheric pressure, flower size of ± 0.5, ± 2.5 and ± 5.0 cm and feed to distiller (F/D) ratio of 0.05 g mL^{-1} were wetted before extraction by soaking in a certain proportion of distilled water for 30 min, and then removal the excess distilled water. The wetted material was placed in a 1 L flask. The microwave oven was operated at a power level of 100, 240 and 380 W for a period of 1 h. To remove water, the extracted cananga oil were then dried over anhydrous sodium sulfate, weighed and stored in amber vials at 4 ^{o}C until they were used for analysis. The yield of cananga oil was calculated as follows:

$$\text{Cananga oil yield (\%, w/w)} = \frac{\text{Mass of extracted cananga oil}}{\text{Mass of dried cananga flowers x } (1 - \text{water content})} \text{x100}$$

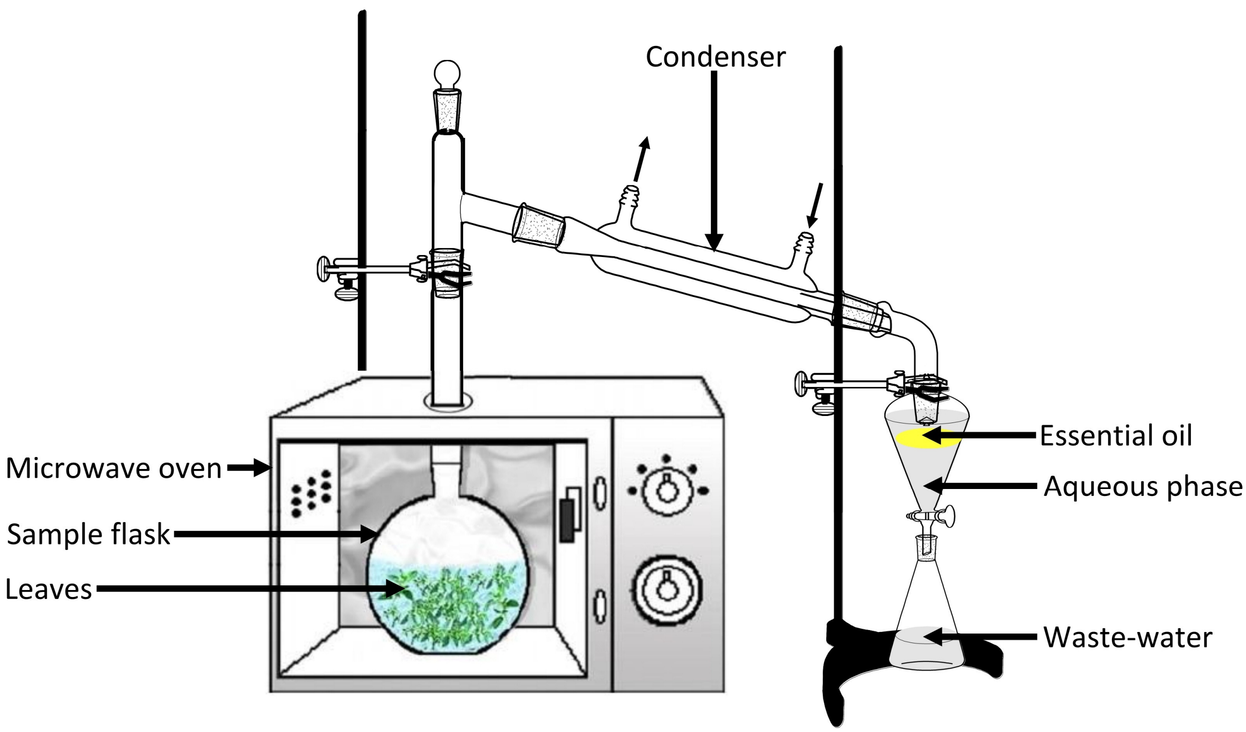

Fig.-1: Schematic representation of solvent-free microwave extraction (SFME) method for extraction of cananga oil

Chemical Analysis of Essential Oil Components

Essential oils components were determined on the basis of gas chromatography (GC) retention time on fused silica capillary column, by comparison of their mass fragmentation pattern with literature reports and by computer matching with standard spectra.

RESULTS AND DISCUSSION

The Extraction of Cananga Oil using Solvent-Free Microwave Extraction (SFME) Method

In the extraction process of cananga oil, the determination of the optimal microwave power for the extraction process is very important because microwave power also affects the temperature during the extraction process. Figure 2 shows the effect of various microwave power to temperature. The high microwave power was used so that the polar molecules in the material rotate faster when exposed to microwave radiation (motion oscillation and collide each other) and generate heat energy which is detected by the increase in temperature. The higher the microwave power used, the higher the generated energy will be. This can be described using the following equation:

$$P = \frac{E}{t}, \quad \text{where} \quad E = Q = m.Cp.\Delta T$$

So, it can be seen that P ≈ E ≈ ΔT (power is proportional to the energy and the increase of temperature).[3] In order to better understand this, the temperature profile for various microwave power that is used in the extraction process of cananga oil can be seen in Figure-2.

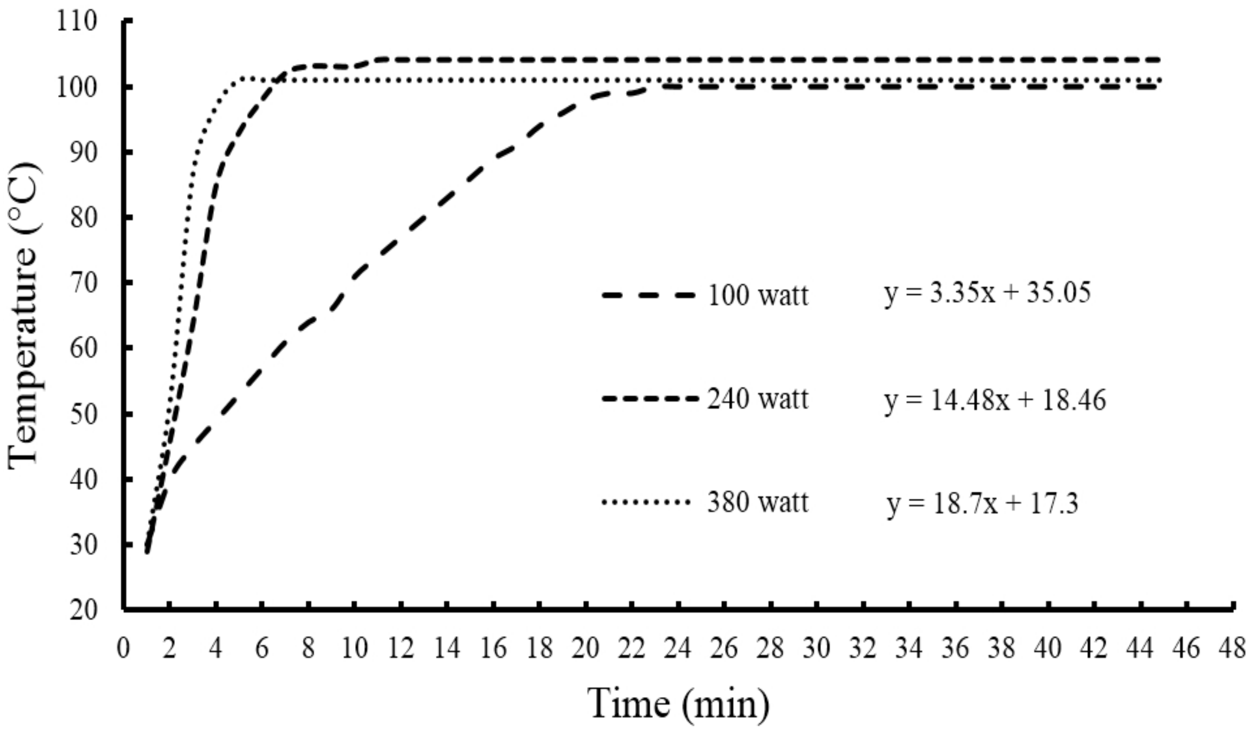

Fig.-2: Temperature profile for various microwave power that is used in the extraction of cananga oil using solvent-free microwave extraction (SFME) method

The rate of the temperature rise for each of the microwave power can be measured by determining the slope of the linear section contained on the temperature profile.[7] From Figure 2, it can be seen that the rate of temperature rise for each of the used microwave power in the extraction process is as follows: 100 W is 3.35°C/min; 240 W is 14.48°C/min, and 380 is 18.70°C/min.

From Figure 2, it can generally be seen that the most rapid microwave power to raise the temperature is 380 W. However, in the extraction process using SFME method, there are material characteristics that affect the extraction process. The presence of the material characteristics may cause the extraction process of cananga oil using SFME method with the microwave power of 380 W not necessarily produce the optimum yield.

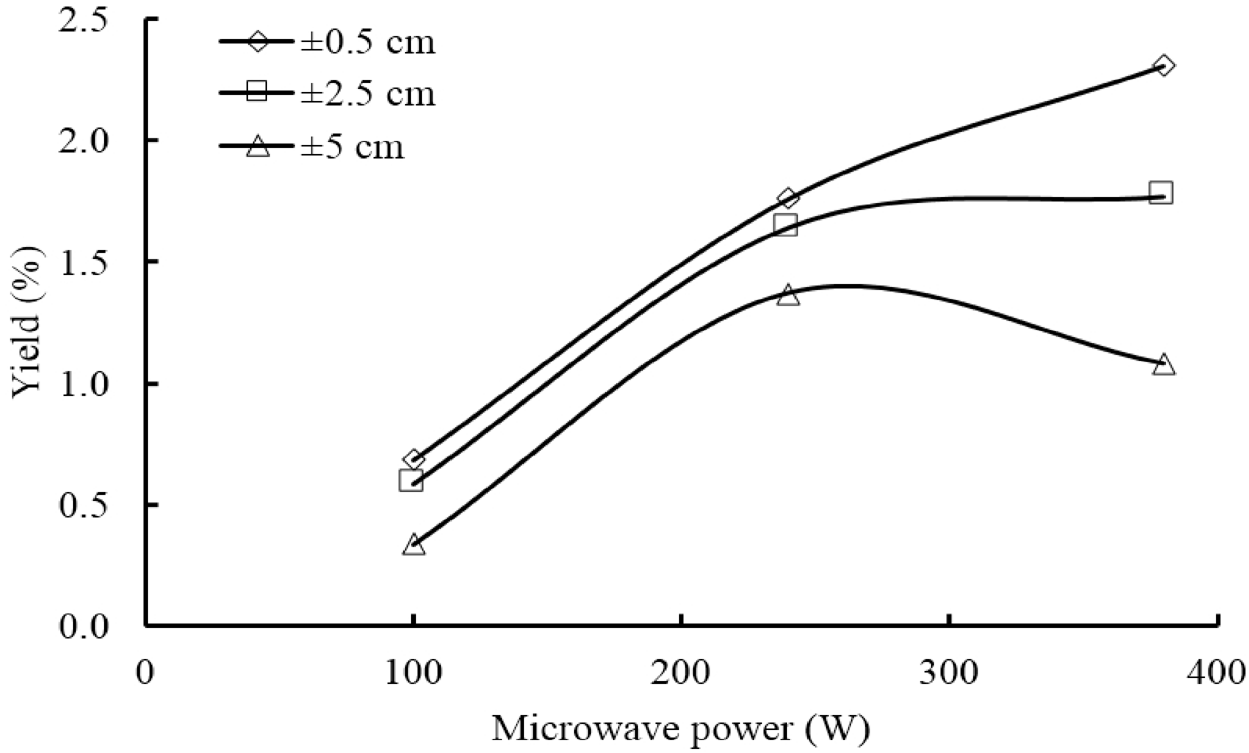

Fig.-3: The effect of microwave power to yield of cananga oil (F/D ratio of 0.05 g/mL)

In general, it can be seen that the optimum microwave power to optimally produce cananga oil yield for dried material is 380 W. The effect of the microwave power to yield of cananga oil can be seen in Fig.-3. In this research was obtained optimum yield is 2.304% on the operating conditions: microwave power of 380 W, F/D ratio of 0.05 g/mL and flower size of ±0.5 cm. The cananga oil yield obtained in the extraction using SFME method is higher when compared to the extraction using water-steam distillation method that has been done by Megawati and Saputra (2012)[8]. In the extraction using water-steam distillation for 8 hours obtained cananga oil yield is 0.936%. So it can be said that the extraction of cananga oil using SFME method is faster when compared with water-steam distillation method.

GC-MS Analysis

To find out the components contained in cananga oil analysis is done using Gas Chromatography-Mass Spectrometry (GC-MS). The results of the GC-MS analysis can be seen from the obtained chromatogram (Figure-4). From the chromatogram can be seen that in the cananga oil that has been extracted using SFME method there are 63 components. Based on the results of GC-MS analysis also showed that the main components of cananga oil produced by SFME method were β-caryophyllene (16.855%), benzyl benzoate (14.326%), caryophyllene oxide (13.484%) and germacrene (10.692%). The results of the GC-MS analysis for cananga oil that has been extracted by other methods showed different results. It can be seen from the results of the GC-MS analysis for cananga oil that has been extracted using water-steam distillation method that has been done by Megawati and Saputra (2012)[8]. The main components of cananga oil produced by water-steam distillation method were trans-carryophyllene (39.03%), α-humulene (11.59%), α-bergamotene (11.29%) and germacrene (10.94%).

The significant difference can be seen in the main components that have been extracted. Where in the cananga oil that has been extracted using SFME method there are oxygenated components on its main components. While in the cananga oil that has been extracted using water-steam distillation method there is no presence of oxygenated components on its main components. In addition we need to know that the scent of essential oils is very affected by the amount of oxygenated components. The oxygenated component is highly odoriferous, while the sesquiterpene hydrocarbon contributes only little to fragrance produced. So based on the results of the GC-MS analysis that presented in Table-1 it can be said that the cananga oil that has been extracted using SFME method offers the possibility for better reproduction of the natural aroma of the flower essential oil than that obtained using water-steam distillation method.

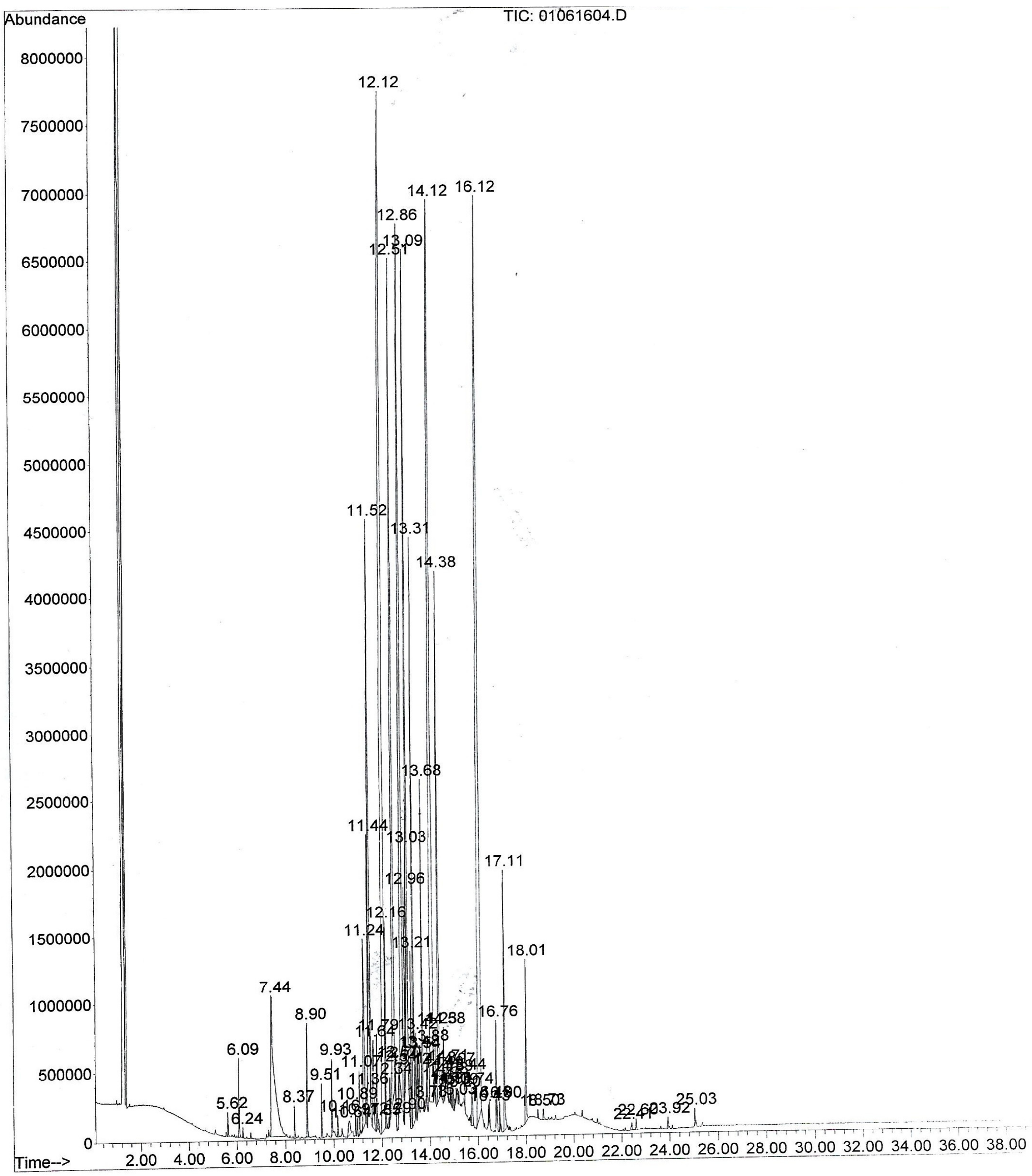

Fig.-4: A chromatogram of cananga oil extracted using solvent-free microwave extraction (SFME) method

Tabel-1: Class of components contained in cananga oil

No	Class of Components	Area (%)	
		SFME (this research)	Water-steam distillation (Megawati and Saputra, 2012)
1	Monoterpenes	0.448	0.00
2	Oxygeneted Monoterpenes	6.781	11.49
3	Sesquiterpenes	49.937	84.13
4	Oxygeneted Sesquiterpenes	17.619	1.39
5	Other Components	0.093	0.00
6	Other Oxygenated Components	25.121	2.98
Yield (%)		2.304	0.936

CONCLUSION

Solvent-free microwave extraction (SFME) method can be used for extraction of essential oils from dried cananga flowers. The optimum yield in the extraction of cananga oil using SFME method is 2.304%. The optimum yield is obtained on the operating conditions: microwave power of 380 W, feed to distiller (F/D) ratio of 0.05 g/mL and flower size of ±0.5 cm. Based on the results of the GC-MS analysis showed that the main components of cananga oil produced by SFME method were β-caryophyllene (16.855%), benzyl benzoate (14.326%), caryophyllene oxide (13.484%) and germacrene (10.692%). Additionally, from GC-MS analysis can be said that the cananga oil that has been extracted using SFME method offers the possibility for better reproduction of the natural aroma of the flower essential oil than that obtained using the conventional method.

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