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Extraction of Essential Oil From Red Lettage (Andropogon Citratus DC) with Microwave Hydrodestillation Method

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ABSTRACT

Essential oil derived from the red citronella plant (Andropogon Citratus DC) is usually used as fragrance and other ingredients. This study aims to study the extraction of essential oil from red lemongrass by hydrodistillation method with the help of microwave heating or known as microwave hydrodestillation. In the microwave hydrodestillation method, water is used as a solvent and using a conventional microwave with a power of 300 W and extraction time of 3 hours. The results of the study using the microwave hydrodestillation method obtained a yield of 0.5704%.

INTRODUCTION

Essential oils are volatile aromatic compounds produced by plants that can be extracted from flowers, leaves, stems, roots, seeds and fruit skins (1). Plants from the family classification Lamiaceae and Apiaceae are very rich in aromatic plants. Essential oils can be found in the flowers, leaves, roots, rhizomes, fruits, seeds, wood and resins of plants. On the surface of leaves and petals, essential oils are located in special cells called trichome glands (2). Essential oils are called etheral or volatile oils because of their ability to easily evaporate when exposed to air at ordinary temperatures. In general, essential oils consist of many mixtures including various compounds of various molecules (3).

The very wide use of its extracts including medicines, food, cosmetics and perfumes makes essential oils make essential oils widely traded and have high economic value both in international trade. One of the essential oils that has high economic value is red citronella oil. This essential oil derived from the red citronella plant is usually used as a fragrance and fixative. A fixative is a material that has a high boiling point (4). The fixative will slow down the evaporation rate of the perfume (5). So, perfumes that are mixed with fixatives will last longer. Optimization of the essential oil extraction process is still being carried out, with the development of the MAHD method with modifications, namely the microwave air-hydrodistillation (MA-HD) method. The MA-HD method generally consists of three main components: a compressor as a provider of air to be injected into the extraction flask (there are raw materials and solvents), a microwave as a heat source and a condenser circuit as a cooling system (Kusuma and Mahfud, 2017).

METHODOLOGY

In this study, the extraction of essential oil from red lemongrass with the microwave hydrodistillation method will be carried out. It was carried out in the UMTS Chemistry laboratory with a time of 2 months. The microwave hydrodistillation method uses microwaves generated from the magnetron as a heating source during the extraction process. Microwaves or microwaves are electromagnetic waves with a super high frequency (Super High Frequency, SHF), which is between 300 Mhz - 300 Ghz. Microwaves have a wavelength range from 1 mm to 1

m. The basic mechanism of microwave heating involves stirring polar molecules or ions which oscillate under the influence of electric and magnetic fields called dipolar polarization. In the presence of an oscillating field, the particle will adapt where the particle's motion is limited by the interaction force between the particles and the electrical resistance. As a result, the particles produce random motion that generates heat. The advantage in choosing a microwave as a heating medium is because the microwave can work quickly and efficiently. This is due to the presence of electromagnetic waves that can penetrate the material and excite the molecules of the material evenly. Waves at a frequency of 2450MHz (2.45 GHz) are absorbed by the material. When absorbed, the atoms will be excited and generate heat. This process does not require heat conduction like a regular oven. Therefore, the process can be done very quickly. In addition, microwaves at this frequency are absorbed by glass, ceramics, and some types of plastic.

The material used for this research is red lemongrass. First, fresh red lemongrass is cleaned from the roots and cut into 1 cm pieces. Red lemongrass that has been cut into pieces is dried at room temperature. The dried red lemongrass was stored at room temperature in a tightly closed container. The purpose of drying the sample and reducing the size of red lemongrass is that the yield obtained on dried red lemongrass is higher than that of fresh red lemongrass, thereby reducing the sample size. The dried red lemongrass was used as a sample for further research.

Microwave Hydrodistillation Method The experimental design for the microwave hydrodistillation method begins by preparing 60g of red citronella powder as raw material and then puts it into a 1000 mL distiller flask and adds 200 mL of solvent in the form of water. The extraction equipment is arranged as shown in Figure 1. In this method, a clavenger tool is used which has the function of automatically returning water condensate back into the distiller flask to maintain the ratio of raw materials and solvents and prevent scorching due to lack of water, the process of returning condensate water into the process. This extraction is called cohobation. Then the distiller flask was put into the microwave and connected to the clavenger. The experiment was carried out with a microwave power of 300 W and extraction time for 3 hours with sampling time every 1 hour.

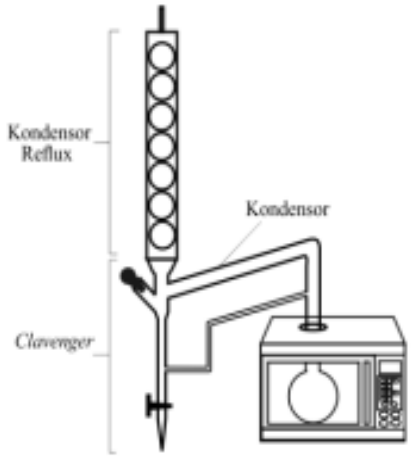


Figure 1. Microwave Hydrodistillation equipment (6).

Calculation is achieved Calculation of Moisture Content of Raw Materials. 2 grams of red lemongrass pieces were dried in an oven at 105˚C for 2 hours, then cooled in a desiccator and weighed. Drying in the oven again for 30 minutes, cooled in a desiccator and weighed, this treatment was repeated until the weight was constant. The water content is calculated based on equation 3.1 (7).

Water Content = a-bb x 100%, where a is the initial weight of red lemongrass (grams) and b is the dry weight of red lemongrass (grams).

Determination of Essential Oil Yield, yield can be used as a reference for the comparison of each essential oil yield obtained in each treatment. Significantly the yield gives an overview of the success of the essential oil extraction process. Yield of essential oils can be defined through equation 3.2 (6).

Yield = ma/mb.100, where ma is the mass of the essential oil obtained (grams) and mb is the mass of red lemongrass used (grams).

RESULTS AND DISCUSSION

In this study, the microwave hydrodestillation method was used using red citronella material with powder size because by reducing the size of the material, the surface area of the material will be greater. This can make the extraction process more efficient, besides that with a smaller size the diffusion process for red citronella oil is easier because the diffusion resistance experienced is smaller.

The microwave hydrodistillation method uses water as a solvent because it has a high dielectric constant so that microwave absorption is more optimal (8). In general, the capacity of the solvent to absorb microwave energy will be high if the solvent used has a high dielectric constant. The value of the dielectric constant itself indicates the ability of the solvent to be polarized by an external electric field and can be considered as a relative measure of microwave energy density. In addition, the dielectric constant also plays an important role in determining the interaction between the electric field and the matrix. So that the higher the dielectric constant value of the solvent, the better the solvent will absorb microwave energy. Therefore, in this study, water was used as a solvent. The choice of water as a solvent in this study was also based on what was previously explained, namely that distilled water has a high dielectric constant, which is 80.4 [10]. It is assumed that the water used as the solvent has the same dielectric constant as the distilled water because both have the same dominant compound, namely H2O. When compared with several other solvents such as methanol, ethanol, and hexane, distilled water can is said to have a higher dielectric constant.

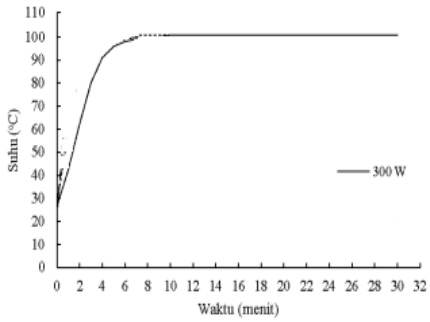
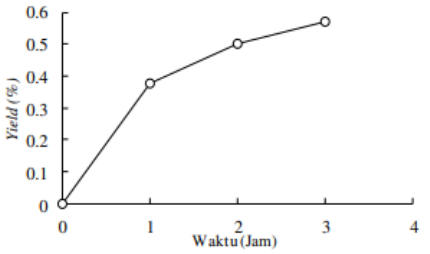


Figure 2. Temperature-time profile on the microwave hydrodistillation method

Based on the observations in this study, it can be seen that the microwave hydrodistillation method produces red citronella oil yield of 0.5704% during the extraction time of 3 hours.



Graph of yield gain on the microwave hydrodistillation method

When viewed from the yield gain, the microwave hydrodistillation method showed a rapid increase with extraction time. The figure shows a graph of yield gain on the microwave hydrodistillation method, it can be seen that the yield produced has an upward trend and has not yet reached a constant rising phase. This shows that the red citronella oil produced can still increase if the extraction time is continued for more than 3 hours until the diffusion phase is reached. The comparison of each method can be seen from the yield of red lemongrass produced. From the experimental results, the yield of red citronella oil is shown in Table 1.

Table 1. The yield of red citronella oil in the microwave hydrodistillation method

Extraction Method	Duration Extraction (Hours)	Yield (%)
Microwave Hydrodistillation	3 hours	0,5704

In the microwave hydrodistillation method, the yield of red citronella oil is 0.5704%.

CONCLUSION

The conclusion of this study is that the microwave hydrodistillation method succeeded in extracting red citronella oil with a yield of 0.5704% during an extraction time of 3 hours with a microwave power of 300 W.

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