11. Effect of Power and Feed to Solvent Ratio Toward Yield of Essential Oil from Crystal Guava Leaves (Psidium guajava) Using Microwave Hydroditillation

by Anugerah Dany Priyanto

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Effect of Power and Feed to Solvent Ratio Toward Yield of Essential Oil from Crystal Guava Leaves (*Psidium guajava) Using Microwave Hydroditillation*

[1] Caecilia Pujiastuti *, [1] Nove Kartika Erliyanti [2] Anugerah Dany Priyanto

[1] Department of Engineering, Faculty of Engineering, Universitas Pembangunan Nasional "Veteran" Surabaya, East Java
[2] Department of Food Technology, Faculty of Engineering, Universitas Pembangunan Nasional "Veteran" Surabaya, East Java

Abstract

The essential oil from crystal seedless guava leaves has several utilization as an antioxidant and antimicrobial active compound. Essential oil extraction with maceration and conventional method has many disadvantages, so the microwave hydrodistillation method is used as an alternative to optimizing its quantity and quality. This research aims to obtain the effect of microwave power and feed to the solvent ratio toward essential oil yield. The extraction of essential oil used crystal guava leaves with feed and solvent ratio (w/v) 1:4; 1:5; 1:6; 1:7. The extraction process was carried out at atmospheric pressure and 100 °C with an electrical power of microwave from 300, 450, and 600 watts over 3 hours. The result shows that microwave power and the ratio of feed to solvent (F/S) give a significant ratio to essential oil yield. Its yield rises significantly along with increasing microwave power and ratio of feed and solvent. The highest yield is obtained at 600 watts and 1:7 (w/v) ratio that is 1.0 %.

Keywords: crystal seedless guava leaves, essential oil, extraction, microwave hydrodistillation.

Introduction

Essential oils are secondary metabolites produced from a plant (Dhifi *et al.,* 2016). The particular physical properties of essential oils are their sharp specific aroma. This is due to the components present in essential oils which are volatile compounds. The utilization of essential oils is widely applied in food and non-food products such as aromatherapy, perfume, flavor, and food preservatives. The development of various essential oils in Indonesia mostly utilizes local commodities from leaves and spices. One of the leaves which have the potential to produce essential oils is guava leaves. Several kinds of guava leaves have been widely used as essential oils. Until now, one of the new varieties of guava leaves that have not been widely used as essential oils is crystal guava leaves.

Crystal guava is one of the newest varieties cultivated in Indonesia. Crystal guava leaves only utilizes as a functional food, such as tea and diarrhea medicine. Mostly, the leaves are discarded and not utilized optimally. The composition of oil contained in guava leaves include iso-caryophyllene (33.53%), veridiflorene (13.00%), farnesene (11.65%), limonene (9.84%), dcadinene (1.75%), a-copaene (2.80%), a-humulene (3.74%), and scadinol (0.08%). Therefore, it is necessary to utilize the crystal guava leaves to possess high economic value by extracting the guava leaves into essential oil.

* Corresponding author
Email address: caeciliapujiastuti@gmail.com

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Consideration of essential oil extraction method is quantity and quality. Those properties have an impact on the economic value of the crystal guava leaves essential oil getting higher. One of the efforts to get the quantity and quality of essential oils to be following predetermined quality standards, namely the use of essential oil extraction methods and operating conditions (operating time, heating rate, and raw material composition).

Several studies on the extraction of crystal guava leave essential oil have been carried out in various countries. The study was adjusted by different varieties, growing conditions of agricultural land, and different extraction methods. Research using conventional methods, namely extraction using the distillation of water for 4 hours with raw materials in the form of guava leaves obtained from the plains of Kathmandu, Nepal has been carried out (Satyal *et al.,* 2015). Thus, research produced a yield was 0.5% and was used as an antimicrobial with a 4 hours extraction time. Research on guava leaf essential oil taken from the Indian plains using maceration extraction methods using ethanol: water (1: 1) solvent showed that essential oils have antioxidants with IC_{50} values was 45.50 ± 1.44 µg/ml (Vyas et al., 2010).

Research about microwaves as an extraction tool is an alternative due to the high level of product purity, the minimum use of solvents, and the short processing time (Ferhat *et al*., 2006). The method that has been successfully developed is the microwave hydrodistillation (MHD) method, which is a combination of water distillation and microwave heating (Stashenko *et al*., 2004). Therefore, is necessary to extract the essential oils from guava leaves using the MHD method. This study aimed to determine the effect of microwave power and the ratio of ingredients: solvent (w/v) toward the yield of essential oils from guava leaves.

Research Method

Materials

The raw material used in this study was crystal guava leaves obtained from the Prambon, Sidoarjo, East Java. The solvent used in this study was Aquadest. The leaves were taken from the plant with the age was over 2 years. The leaves were obtained from the waste of cutting stalk.

Equipment

The main equipment used in this study was a microwave as a heater equipped with a Clevenger, condenser, regulator, and temperature indicator.

Research Methods

The extraction of essential oils from crystal guava (*Psidium guajava*) leaves was carried out in three stages. The first step is the size reduction of the crystal guava leaves until its size was ± 1 cm. Crystal guava leaves that have been size reducing then was put in the cabinet dryer for 6 hours at 55 ± 2^{o}C. The second step in this research was extracting the essential oils from crystal guava leaves using the microwave hydrodistillation method. The process of extracting essential oils from crystal guava leaves was carried out in the system shown in Figure 1.

The extraction of crystal guava leaves with a water solvent was carried out using a microwave. The ratio of crystal guava leaves to solvents (water) w/v was 1:4, 1:5, 1:6, and 1:7. The extraction process was assisted by microwaves with a power of 300, 450, and 600 Watt. The extraction process was used atmospheric pressure at a temperature of ± 100 ^{o}C, and the extraction time was 3 hours. A condenser and Clevenger were connected to a 1-liter flask (a container for raw materials and solvents) that functions to convert the vapor phase into a liquid phase and accommodate a mixture of products (solvents and essential oils). The vapors produced pass through the condenser to chill the temperature at 30 ^{o}C and produce a distillate product consisting of the oil and water phases. The resulting product was separated between oil and water.

The third stage of this research was calculating the yield.

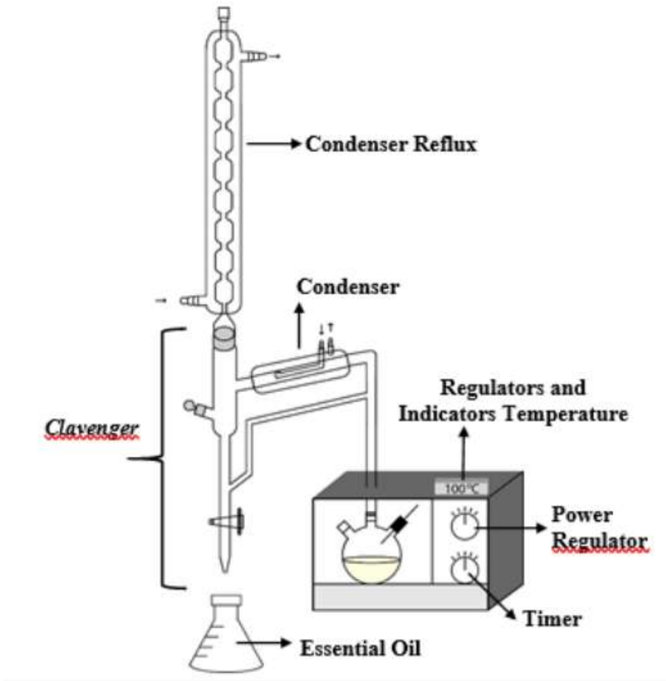

Figure 1. Schematic of the Research Tool for Extracting Essential Oils from Crystal Guava Leaves Using the Microwave Hydrodistillation Method

beef cattle breeders. Secondary data is data obtained from statistics books, related service reports. This research was conducted at 3 Animal Husbandry Centers in Subang Regency in 2018. The population of this research is 1500 productive female beef cattle spread in Subang Regency, the number of samples taken is 20% of the population, namely 300 productive female beef cattle that have received animal health services.

The type of data analysis used in this study is a descriptive analysis of John A Martila and Joh James in (Santosa, 2015). Descriptive is a method in researching the status of a group of people, an object, a set of conditions, a system of thought or even a class of events in the present. The purpose of this descriptive study is to create a systematic, factual and accurate description of the factors, traits and relationships or phenomena investigated.

Result and Discussion

Effect of Microwave Power on Yield of Essential Oil from Crystal Guava Leaves

Microwave power and temperature are interconnected, high power will increase the operating temperature above the boiling point of the solvent. Therefore, the yield of products will increase.

In this study, the microwave power was used 300, 450, and 600 Watt, the mass of crystal guava leaves was 50 grams, and the ratio of material to solvents was 1:4, 1:5, 1:6, and 1:7. The effect of microwave power on the yield of essential oils from crystal guava leaves is shown in Figure 2.

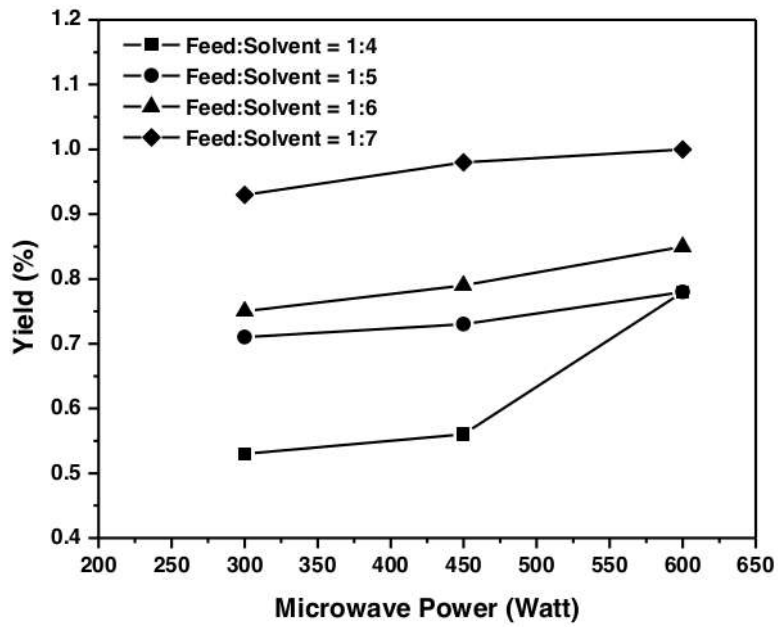

Figure 2. Effect of Microwave Power on Yield of Essential Oil from Crystal Guava Leaves

Figure 2 shows that microwave power has a significant effect on the yield of essential oils from crystal guava leaves. The higher power caused the yield of essential oils from crystal guava leaves produced tends to increase. The highest yield of essential oils from crystal guava leaves was produced at 600 watt microwave power that was equal to 1.0%.

The higher power caused the temperature to increase. The rate of refining (evaporation) also becomes greater. Thus, the ability of materials and solvents to absorb energy from microwaves was greater. High power caused the energy received by the material to be converted into heat was greater. Microwave heating increases for liquids or solids that can convert electromagnetic energy into heat. Higher electromagnetic energy is converted to heat energy causing the temperature will increases. Thus, the phenomenon effected on the yield of essential oils from crystal guava leaves produced was also greater.

The Ratio Effect of Feed: Solvent (w/v) on Yield of Crystal Guava Leaf Essential Oil

In this study water was used as a solvent because of its polarity and has a high dielectric constant value of 80.4, making it easier to absorb microwaves. The ratio of materials extracted to solvents was a factor that must be considered to get a high yield. This study used a variable ratio of ingredients to solvents (w / v) of 1: 4, 1: 5, 1: 6, and 1: 7. The effect of the ratio of material: solvent (w / v) to the yield of essential oils of guava leaves was shown in Figure 3.

As seen in Figure 3 that the ratio of material to solvents has a significant effect on the yield of essential oils from crystal guava leaves. The higher the ratio of material to solvents caused the yield produced tends to increase. The highest yield was obtained 1.0% with the ratio 1:7. The high ratio of material to solvents and assisted by microwave power makes the components contained in the crystal guava leaves will be more quickly extracted. The higher volume of the solvent conduced the higher capacity of the solvent to absorb microwave energy because water has a high dielectric constant.

The capacity of the solvent to absorb microwave energy is high when the dielectric constant and dielectric loss factor are high (Mandal *et al*., 2007; Spigno and Faveri, 2009; Tatke and Jaiswal, 2011). The higher the dielectric constant of the solvent, accordingly the higher ability of the solvent to absorb energy from microwaves. The criterion that shows the ability to absorb microwave energy is called dielectric constants.

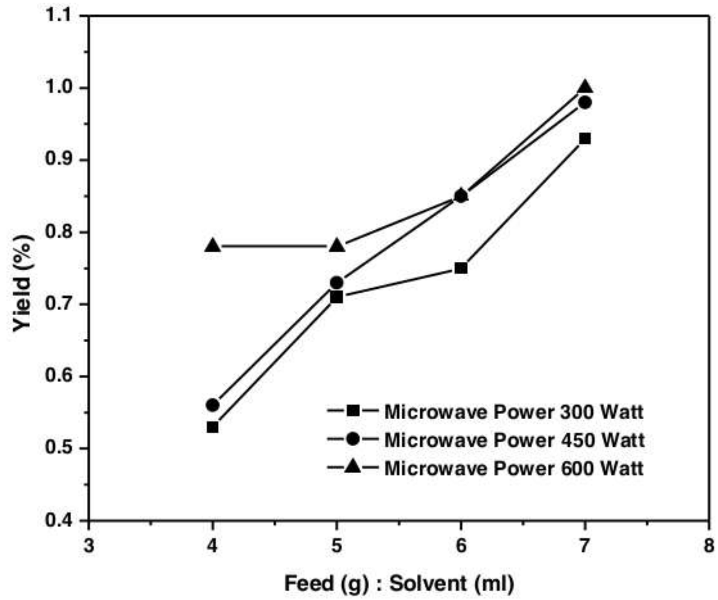

Figure 3. The Ratio Effect of Feed: Solvent (w/v) on Yield of Crystal Guava Leaf Essential Oil

Conclusion

The conclusion of this study was the microwave power and the ratio of material to solvents (w / v) have a significant effect on the yield of essential oils from crystal guava leaves. The higher microwave power and the ratio of material: solvents conduced the yield of essential oils produced has a greater tendency. The highest yield was produced at 600 Watt, the ratio of material: solvent (w / v) 1: 7 was equal to 1.0%.

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