

DISTRIBUTION OF LEMONGRASS OIL (CYMBOPOGON NARDUS L) USING SUN RAYS BY USING SOLAR CELL (PHOTOVOLTAIC)

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ABSTRACT

In the use of solar light, many things can be applied with electrical energy produced using solar cells. With the use of solar cells that are used as many as 4 units of solar cells with a capacity of 1000 wp, so in a day able to produce electrical energy as much as 28,000 watts. This is a very potential electrical energy because it is commonly used to facilitate the process of refining essential oils. The results and the quality of the oil obtained in refining research using electrical energy by utilizing sunlight using solar cells shows that the refining time of 6 hours is the best time for the refining process, while the 1 day drying time is better than 2 and 3 days. This is consistent with the oil yield obtained. As for the results of the Fragrant Lemongrass, Laboratory Test produced already meet the Indonesian quality standard, where the value of the density test, Bias Index, Uv-Vis and GC-MS are in the range of the Indonesian National Standard (SNI) 2385-2006.

Keywords: Photovoltaic, Distillation of Essential Oils, Solar Cell

INTRODUCTION

In the industrial world, the results of distillation (distillation) of essential oils are known as seeds of perfume. Like the essential oil industry in Indonesia is still carried out by entrepreneurs who have large capital, because the process of extraction and distillation of essential oils that require equipment at very high prices, so essential oils have not become a home industry with a small production scale. For this reason, it is necessary to develop cheaper process equipment that is affordable to the home industry and can generate profits for its entrepreneurs, so that the essential oil industry can be more popular in the community so that natural resources, especially in the plantation sector can be utilized optimally and can also become new jobs that absorb human Resources. This essential oil is used in food, medicine and cosmetics, etc. (Gil.J.D, et al 2017). Lemongrass oil is an export commodity, especially in Aceh Province. Generally produced by 3 methods, namely the Distillation (distillation) method, extraction, and compression. Here I want to try with the Distillation Method (distillation) because the distillation method (refining) is a cheap and simple technology to be applied especially farmers from North Aceh and Lhokseumawe, while the method can use water as a solvent, steam or water-steam mixture. Farmers in Indonesia Steam distillation (distillation) method is the most widely used by farmers today.

The principle of separation by distillation is by evaporation based on differences in boiling points, against substances that are volatile (quickly evaporates). The distillation in general uses firewood, gas, conventional electricity where its function as a heater is increasingly diminishing capacity, therefore researchers want to utilize the sunlight that will never run out because of its use as a source of heat in the distillation process by utilizing solar

radiation with using solar panels commonly referred to as photovoltaic systems because one type of alternative energy that is growing rapidly and is widely used today is sunlight which is used as a power plant (Gil.JD, et al 2017). The amount of potential sunlight that can be absorbed depends on the area of the cell and the absorption of solar cells to sunlight. In optimizing the use of solar panels, we need a control system that can control the position of the solar panels to always follow the direction and position of the sun automatically. This system is called solar cell tracking so that the efficiency of sunlight radiation can be increased.

Solar cells with technological advances are becoming very common nowadays. The use of solar cells is very widespread in the world, for example, the most common use in calculators and replacing battery functions. During the availability of light, the calculator can function forever (Gupta.V.S, et al 2018). Larger solar panels are also used to provide power for traffic lights, telephones, street lights, houses, ships, solar electric cars that can operate without oil, and others. In this case, researchers want to utilize solar power for the distillation process (distillation) of citronella essential oils (Cymbopogon Nardus L).

2. RESEARCH METHODOLOGY

2.1 Tool

Refining citronella oil (Cymbopogon Nardus L) by utilizing sunlight using Solar Cell (Photovoltaic). 1000Wp Solar Panel, 12V 200Ah Battery, Solar Charge Control, DC-AC Inverter, Heater Element, A set of fragrant lemongrass distillers, 100 ml Erlenmeyer, 100 ml measuring cup, scales, separating funnel, knife and filter paper.

2.2 Material

The raw material used in this research is fragrant lemongrass (Cymbopogon Nardus L) which is purchased

from farmers' harvests in the Dusun Sp. 2 Pase Sentosa Village, Simpang Keuramat District, North Aceh Regency, Aceh Province. The farmer immediately produced his own lemongrass plants. Before going through the distillation process, the raw materials must be chopped \pm 5 cm, then the lemongrass raw material to be distilled weighed as much as 5 kg, and then put into the distilled kettle and water as a solvent.

2.1 Density analysis

Weigh Empty Pycnometer, Fill an empty pycnometer with 10 grams of citronella oil distillate. Furthermore, the value of the scales from the citronella weighing is reduced by an empty pycnometer. The second result is the value of the density of the fragrant lemongrass. This treatment is done by varying the drying time (0, 1, 2 and 3 days) and the distillation time (4, 5 and 6 hours).

2.3 Biased index analysis

Drop the sample to be checked for its refractive index at the refractometer sample. Cover tightly and let the light pass through the solution and through the prism so that the light on the screen in the device is divided into two. Slide the boundary mark by turning the control knob, so that the intersecting point of two intersecting diagonal lines is visible on the screen. Observe and read the refractive index scale indicated by the scale screen needle through a microscope. The two colour display screen has been arranged so that it gives two colours that have clear and distinct colours. This treatment is done by varying the drying time (0, 1, 2 and 3 days) and the distillation time (4, 5 and 6 hours).

2.4 Gas Chromatography-Mass Spectrometry (GC-MS) Analysis

The GC-MS was connected with a mass spectrometer (Agilent 5975C) using a DB-1MS capillary column (30 x 0.25 mm D 0.25 μ m layer thickness). The injector and detector temperatures are set at 250 ° C. The

oven temperature is programmed at 60 ° C for 3 minutes, raised at 3 ° C / min to 240 ° C and then held for 10 minutes. Helium as a gas carrier is regulated at a flow rate of 1.2 mL/min. The sample volume injected is 1.0 μ L. This treatment is done by varying the cooking time (0, 1, 2 and 3 days) and the distillation time (2, 4 and 6 hours).

3. RESULTS AND DISCUSSION

In this research, it is focused on producing citronella oil (*Cymbopogon Nardus* L) by utilizing sunlight using solar energy (photovoltaic) output (energy output) consisting of an electric element (heater) which has an energy absorption of 2,000 watts / hour and pumps which has an absorption of electrical energy as much as 125 watts / hour with varying use of time which is at 4, 5 and 6 hours. Then the energy needed for this system is taken at maximum energy that is at 6 hours, thus the number of energy requirements for electric element (Heater) 2000 watts x 6 hours = 12,000 Watts and for a 125-watt pump x 6 hours = 750 watts. Thus the total electrical energy needs for the process of refining lemongrass oil is 12,000 watts + 750 watts = 12,750 watts. In the case in accordance with the calculations stated by Sebastijan S, et al in his journal entitled Performance Analysis of the photovoltaic system of power calculation before the application will thus facilitate the process of preparing solar cells for the application was to calculate the total power used x time usage.

The time of day irradiation lasts from 09.00 to 14.00 with a time of absorption of energy for 7 hours. For the use of Solar Cell here we use a solar cell with a capacity of 1,000 Wp. With the consideration of the energy needed as much as 12,750 watts. Thus the energy needed to determine the maximum usage is 12,750 watts. So with 12,750 watts of power with irradiation time for 7 hours/day with a capacity of 1000 Wp solar cell, the number of solar cells needed is 12,750: (7 x 1000) = 1.8 (2) units of solar

cell needed, with consideration of energy saving 2 times the electricity needed. Based on an experimental study journal, the configuration of the installation of photovoltaic panels for lighting structures written by Sredenšek K et al. / hour with lighting time (usage) for 10 hours, the total electrical energy needed is 11 units x 80 watts x 10 hours = 8,800 watts. Then the need for solar cells to produce electrical energy as much as 8,800 watts with the formula Scn (Solar cell needs) = Ten (total energy needs) / (It (irradiation time) x Csc (solar cell capacity)) = $8,800 / (5 \times 1000) = 1,76$ (2 units of solar cell needed).

For power storage using batteries (batteries) with a capacity of 12V / 200 Ah to deliver the energy produced as much as 12,750 watts, the number of batteries needed to store electric current is $12,750 : (12 \times 200) = 5.3$ (6) Units with batteries 12V / 200 Ah capacity. In this case in accordance with the calculations contained in the journal Study of experimental configuration of the installation of photovoltaic panels for lighting structures written by Sredenšek K, et al. the batteries they use are 12v 250 ah with the total battery requirement / battery capacity ($8,800 / (12 \times 250) = 2.93$ (3 units of batteries used).

And to control excessive electrical current or to decide the distribution of electrical energy produced by solar cells stored in batteries, then we use the Controller as a safeguard against damage to the solar cell and battery damage due to excessive supply of electrical energy. One of the stages to extend the life of a photovoltaic device. In this case, it is in accordance with the calculations contained in the journal Experimental Study configuration of the installation of photovoltaic panels for lighting structures written by Sredenšek K, et al.

And to distribute the energy used inverters to convert In flowing electric current from the battery to the electric element (Heater on a distillation device) and pump, the inverter is used to convert

electrical power from direct current (DC = Direct Current) electricity to alternating current (AC) = Alternative Current). In this case, it is in accordance with the calculations contained in the journal Experimental Study configuration of the installation of photovoltaic panels for lighting structures written by Sredenšek K, et al.

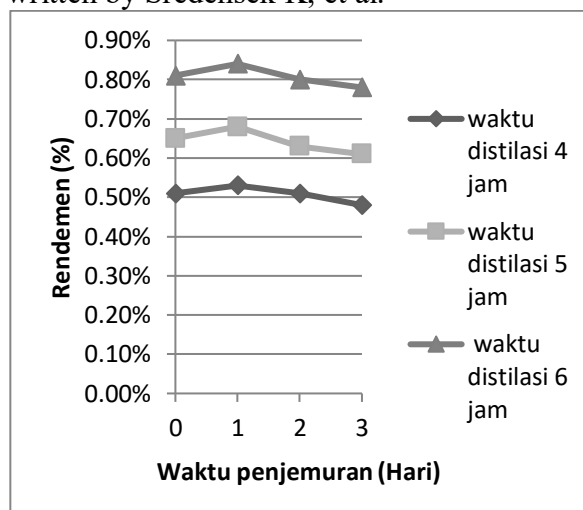


Figure 3.1 Graph Effect of Drying & Distillation Time Against Rendemen

From the graph above it can be seen that the amount of yield produced has fluctuated. The highest yield was 0.84% with 6 hours of distillation treatment and 1-day drying time. The efficient drying time for lemongrass is 1 day because the longer the drying time the oil content in plants will decrease. The best distillation time is 6 hours, this is due to the longer a material receives heat, the more even the diffusion process causes the more efficient distillation process.

The effect of drying time on yield proves that the condition of the material that produces a large% yield is when the condition of the material starts to wilt compared to the condition of the fresh material. So the conditions and treatment of these ingredients can improve the process of% essential oil yields in accordance with the literature which states that the process of withering aims to reduce the water content in the material glands, so that the extraction process is easier to do and enumeration is an

effort to expand the evaporation area and contact with water so that the lemongrass oil fragrance is easier to extract.

Drying is the process of reducing the water content of a material until it reaches a certain water content. The basis of the drying process is the evaporation of material water into the air due to differences in the moisture content between the air and the dried material. In order for a material to become dry, air must have a moisture content or moisture lower than the material to be dried (Trayball E. Robert, 1981). Drying is the occurrence of evaporation of water into the air due to differences in the content of water vapour between the air and the dried material. In this case, the air vapour content is less or air has a low relative humidity resulting in evaporation (Adawyah, 2014).

According to Momo (2008), there are 2 main factors that influence drying, namely:

1. Factors related to drying air, including:

a. Temperature

The higher the air temperature, the faster the drying will be

b. Airflow velocity

The faster the air, the faster the drying will be

c. Humidity

The more humid the air, the slower the drying process

d. Air flow direction

The smaller the angle of air direction to the position of material, the faster the material dries.

2. Factors related to the nature of the material, including:

a. Material size

The smaller the material size, the faster the drying will be.

b. Water content

The less water contained, the faster the drying will be.

3.1 Photovoltaic Distillation

The distillation process of essential oils so far only utilizes the artificial heat generated from the combustion process both

firewood and stoves commonly used for cooking. Therefore this study utilizes sunlight as a substitute for heat sources for distillation or what is commonly called photovoltaic. Photovoltaic technology always has more advantages compared to other technologies because it is free of pollution and uses freely available and very much solar energy. Another advantage of photovoltaic technology is that it does not emit greenhouse gases during operations and is environmentally friendly. Intermittency of solar radiation can be a limitation for technology because it cannot supply electricity continuously during periods of sunlight, but this problem can be overcome by using battery storage. However, there is a need to understand the application of this technology to be feasible for its users (Joshi et al, 2009).

This research was carried out by preparing the iron for the solar panel holder, then measured the length and width of the solar panel to facilitate the process of making a panel holder, amounting to 4 pieces. After that, the iron is cut using a grinder according to the required size. The iron that has been cut is put together to form a series using bolts 12 and tightening the bolts until the panel stand is strong and does not shake in accordance with the size of the solar panel with a capacity of 1000 WP/unit.

The finished solar panel holder is connected one by one so that the 4 panels become 1 panel that had a capacity of 1000 WP to 4000 WP, before being connected to the controller where the panel holder is installed, a breaker or commonly referred to as MCB, which is useful for deciding the flow of current from the panel to controller if at any time a disturbance occurs at least the MCB immediately breaks the flow by itself so that the tool is maintained properly.

The solar panel is connected to the MCB using a power cable with a size of 2×1.5 and then the cable is connected to the controller, the controller is a device that regulates the direct current that is charged to

the battery while also functioning as a current connector from the solar panel to the battery. The cable that has been connected between the panel, the controller and the battery then the cable from the battery is connected to a DC to AC converter, which is the inverter, which has a power of 3000 watts/hour. The current from the battery which is still in the form of DC and then connected to the inverter so that it turns into an AC current which is then ready to be distributed to the Heater and Pump, the absorption of electrical energy required by the Heater is 2000 watts/hour and for the absorption pump the electrical energy is 125 watts/hour.

The process of distillation of citronella oil begins after all the solar cell equipment is assembled. The raw materials in the form of lemongrass are dried in the sun according to the variables that have been set. The raw material that has passed the drying process is then poured as much as 5 kg and then chopped to speed up the distillation process after the raw material is enumerated into the distilled kettle. The method used in the form of steam distillation in which water as a solvent is inserted at a ratio of 1: 5. During the process, at the time of distillation began to enter the second-hour yield of citronella oil began to be obtained. The length of time for the distillation takes place in accordance with the assigned job description. The following is the amount of yield that has been obtained tabulated in tabular form.

3.2 Characterization Analysis According to SNI

The characteristic analysis was carried out on 12 run experiments, analysis carried out including analysis of refractive index, density, and GC-MS, UV-Vis, colour.

3.2.1 Bias Index Analysis

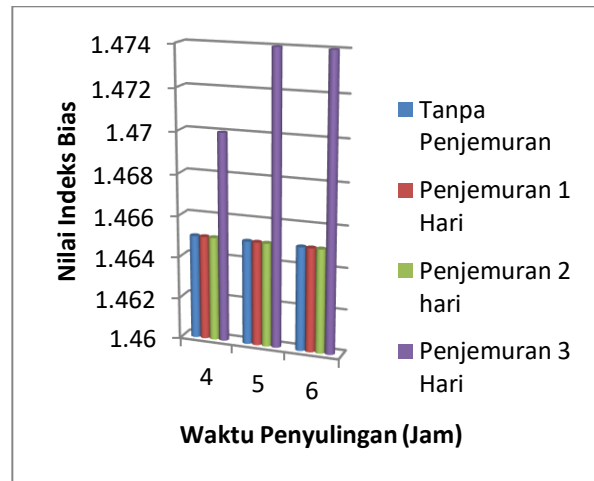


Figure 3.2 Bias Index Analysis Graph

It can be seen in the graph that it is observed that the 12 trial runs have almost the same refractive index value of around 1.465, the refractive index obtained is in accordance with the Indonesian National Standard (SNI). From all the experiments, there were 2 trials whose refractive index value was higher than the others, with a refractive index value of 1.474, which was run at a distillation time of 5 and 6 hours at 3 days of drying. This shows that the longer the time of drying the lemongrass, the better the resulting refractive index will be. At the highest citronellal volume, a refractive index of 1.465 was obtained in the experiment on one drying day and at 6 hours of refining time.

3.2.2 Density Analysis

3.2.2 The results of the density test of lemongrass oil

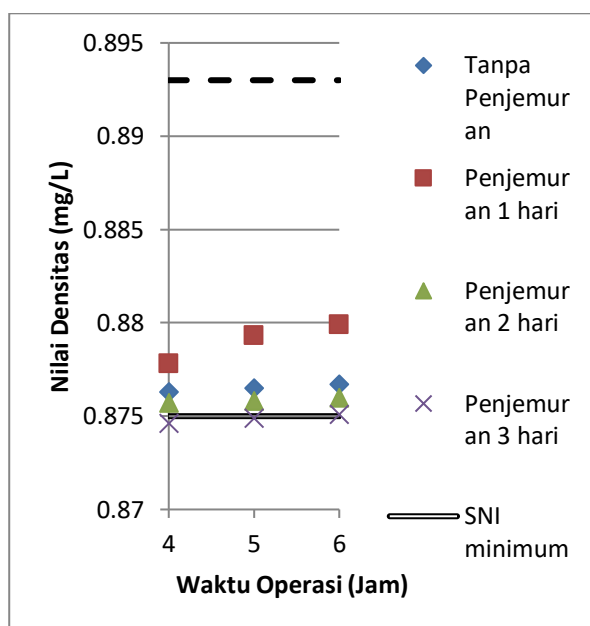


Figure 3.3 Density Value Against Operating Time.

From the graph above it can be seen that the density value does not exceed the value of the SNI range and the density value above greatly affects the operation time and the drying time. The highest value of the density of lemongrass oil was obtained at 1-day drying time with 6 hours operating time. While the lowest density of fragrant lemongrass oil values obtained at 3 days of drying at 4 hours of operation.

Density expresses the density between molecules in citronella oil which is defined as the ratio between mass and volume of material. In general, density is related to viscosity, which is more liquid (high density) has higher viscosity compared to liquid with low density. The value of the density of citronella oil ranged from 0.8757. The effect of refining time on the density of lemongrass oil showed that the third time of heating the material showed a significant effect on the density value.

4.3.3 Compound Analysis Using GC-MS

Analysis using GC-MS was conducted to determine the levels of citronellal and geraniol from the distillation

results by utilizing sunlight using solar cells (photovoltaic)

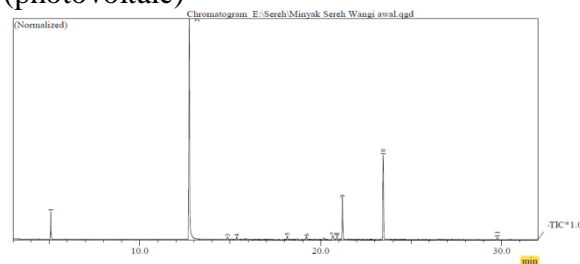


Figure 2.4 GC-MS Graph of Refined Lemongrass Oil

From the results of the analysis using GC-MS showed the presence of identified chemical compounds including Citronellal, Geraniol and several other compounds in citronellal, based on GC-MS results obtained 59.28% citronellal, and Geraniol by 20.32%. According to International Market Standards, the content of citronellal must be higher than 35%, therefore this material meets the Indonesian National Standard (SNI) and besides the physical and chemical properties of citronella oil produced from the distillation process by utilizing sunlight using a solar cell (photovoltaic). From these results, it can be seen that the citronella oil produced during this research can be sold in the market because it meets the Indonesian National Standards.

4. CONCLUSION

I. Utilization of heat generated from sunlight is able to produce electricity that can be used as raw material as a heater which generally uses firewood, gas and even conventional electricity, thus the distillation of essential oils using a heater from electricity produced by utilizing sunlight is very effective because the results from refining lemongrass able to match the quality of citronella distilled by using a heater from you burn, conventional electric gas juga in general.

From the research results, the process of refining essential oils from citronella plants can be concluded that the optimum drying

time to produce the highest% yield is at the time of drying for 1 day. The optimum refining time to produce the highest% yield is at the refining time of 6 hours. The capacity of the solar cell used for the process of refining lemongrass is 1000 WP, while the required power consumption is 12,750 watts. The quality of citronella oil produced has met the specifications and characteristics of the quality of citronella oil quality (SNI-2385-2006).

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