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Development of Vacuum Hydrodistillation Technology in Citronella Oil Distillation (*Cymbopogon nardus*) as an Effort to Improve The Economy of the People of Blang Poroh Village, Lhokseumawe

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ABSTRACT

Fragrant lemongrass oil is one of the products of non-timber forest products (HHBK) and is commercially obtained from the distillation of the leaves of the citronella plant (*Cymbopogon nardus*). Fragrant lemongrass leaves are one of the raw materials to obtain vegetable oil in the form of essential oils. Essential oils are the main components consisting of geraniol and citronellal arrangements. The essential oil extract process can be done by various methods, one of which is the Vacuum Distillation method. The Vacuum Distillation Method is carried out using a vacuum pump as a pressure guard and the boiling point of the distillation process does not exceed the temperature of the boiling point of water, which is 100°C, so that the oil produced is maintained purity. The Vacuum Hydrodistillation Process of citronella is carried out for 3, 5, and 7 hours with each treatment using raw materials of random and whole cut sizes. The essential oil products produced are analyzed in the form of yield, density, refractive index and oil composition analysis with GC-MS. The best essential oil results from citronella were obtained under operating conditions with random cut samples and a distillation time of 5 hours. Where the yield produced is 0.17% with a refractive index of 1.41570 and a density of 0.92735 gr / ml.

Keywords: Essential Oils, Vacuum Hydrodistillation, Citronella, Geraniol

INTRODUCTION

Lemongrass plant production in Indonesia is quite abundant, especially in Nanggroe Aceh Darussalam (NAD) Province, Java island, such as West Java and Central Java. Usually lemongrass plants are used as essential oil and exported in the form of crude oil. So it is not uncommon to hear that citronella oil is the mainstay commodity of essential oils. Fragrant lemongrass oil in Indonesia is still classified as having low quality, where lemongrass oil contains citronellal compounds around 32-42%, geraniol 10-12%, geranyl acetate 3-8%, and citronellyl acetate 2-4%. Meanwhile, the requirements for lemongrass oil exports include pale yellow to brownish yellow color, density around 0.850-0.892 and total geraniol of 85% (including 35% citronellal). Citronella oil is one of the most prospective oil commodities among the 12 essential oils exported by Indonesia. The market demand for essential oils is very large, especially in citronella oil, ranging from 9-10%. BPS export data in 2020 shows that citronella oil to essential oil revenue is around 6.89% compared to patchouli oil and vetiver oil which are in the position below the demand for veniter oil (BPS, 2020). However, it is very concerning that so far many people have processed citronella oil in a traditional way so that it is difficult to meet export quality requirements. The low quality of citronella oil makes farmers and communities sell products in raw form at prices that are cheap for export market economic speculators. The content of citronellal and geraniol found in citronella can also function as a mosquito repellent. By looking at the opportunity of lemongrass oil as a room fragrance and anti-insecta, citronella fragrance can be used as a product that has a double function (two functions). The 2 in 1 products offered can be very attractive products and in demand by consumers because they are practical and multipurpose. So that this product can later become a product that adds to the selling value of citronella in the future.

The essential oil distillation technique that has been cultivated by farmers is still done simply and has not used distillation techniques properly and correctly. The people of Blang Poroh Village, Lhokseumawe City, experience major problems in terms of citronella oil refining techniques, which still have very low quality below average. The low quality of citronella oil greatly affects the selling value of the price of raw citronella. Sometimes many citronella farmers complain about the very low selling price of citronella crude. To overcome this, we propose a distillation device in the form of vacuum hydrodistillation that uses a low boiling point of water so that distillation occurs quickly. The advantage obtained from this distillation is that it produces a high yield and does not damage the components of the substance separated 3 because of its low boiling point. Improving the quality of citronella quality in Blang Poroh Village, Lhokseumawe City is also good for the production of higher quality anti-insect room fragrance products.

One solution to meet the quality of lemongrass oil is the vacuum hydrodistillation distillation technique. Vacuum hydrodistillation is one of the distillation techniques

operated under atmospheric pressure. This distillation principle is based on the laws of physics where the boiling point used becomes very low so as to accelerate the process of distillation. Vacuum distillation is usually used if the compound to be distilled is unstable, with the sense that it can be decomposed before or near its boiling point or a mixture that has a very high boiling point (above 150 °C) by lowering the surface pressure lower than 1 atm, so that the boiling point becomes very low and the amount of yield to be produced becomes very high. The temperature used for the distillation process does not need to be too high. To reduce the surface pressure of substance liquid is used with a jet ejector and barometric condenser. The function of vacuum hydrodistillation is to lower the boiling point so as not to damage the components of the separated substance. This principle of pressure drop is very suitable for essential oil refining to avoid cracking or damage to essential oils.



(a)



(b)

Figure 1. (a) Citronella Oil Distillation Process with Vacuum Distillation Device, (b) Citronella Oil Distillation Products

When viewed from an economic point of view, the existence of vacuum hydrodistillation distillation has a great impact on the economic aspect. The selling value of citronella oil using ordinary distillation techniques is priced at a low price because the quality of citronella oil is low. By using vacuum techniques, it has been proven that the content levels produced by citronella oil become quality so that the sales value increases.

METHOD

The following is an overview of the design of citronella oil vacuum hydrodistillation distillation equipment for the production of raw materials for anti-insect room fragrance products.

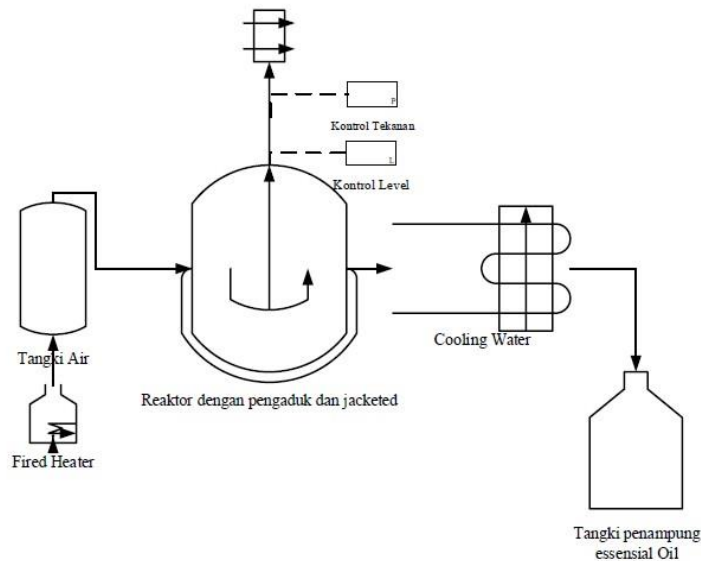


Figure 2. Design of Vacuum Distillation Equipment

The methods of activities that will be carried out in Blang Poroh Village, Lhokseumawe are by:

1. Providing learning to the community / citronella farmers in Blang poroh Village, Lhokseumawe City by means of Project Based Learning (PBL). PBL is one effective way to increase knowledge among others.
2. Demonstration, this method demonstrates equipment ranging from how to assemble and process citronella oil refined into oil. After that, processing citronella oil into an innovative double function room fragrance anti-insect product.
3. Introducing derivative product innovations in the form of practical 2 in 1 products, namely room fragrance (air freshener) and anti-insect (mosquito repellent products).

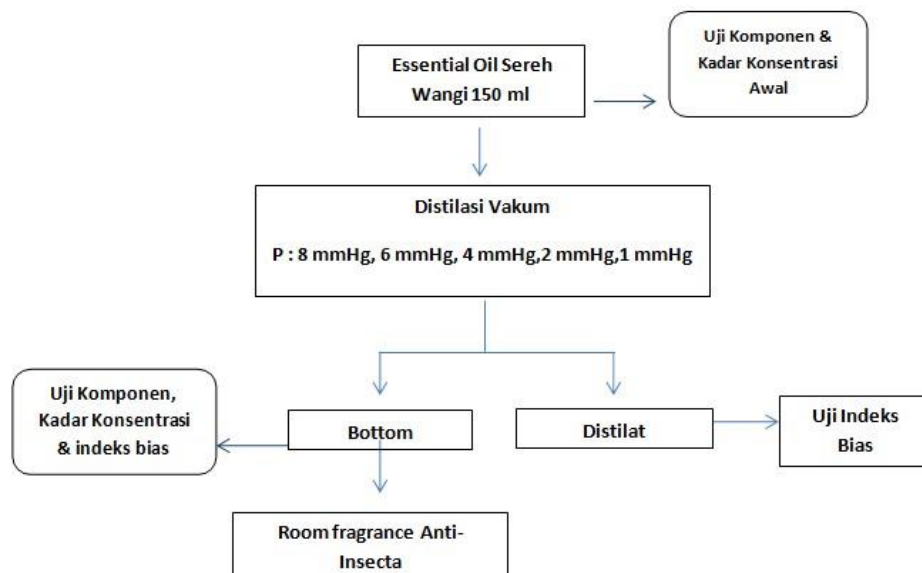


Figure 3. Citronella Oil Distillation Process Flow Diagram

The way of refining citronella oil that will be disseminated to the community is to put raw materials, either withered, dry or wet into the distiller's boiler that has been filled with water and then heated. The steam coming out of the boiler is flowed by a pipe connected to the condenser. Steam which is a mixture of water vapor and oil will be condensed into liquid and accommodated in a container. Furthermore, the oil liquid and water are separated by an oil separator separator for oil only. Fragrant lemongrass oil as a carrier oil is taken as much as 15 ml then poured into a beaker glass. Added indigo oil as a room fragrance enhancer as much as 25 ml. Added 10 ml drops of geraniol extract as Base notes obtained from the results of the study, using a drip pipette into a beaker glass that has been filled with carrier oil. Furthermore, the oil liquid and water are separated by an oil separator separator for oil only. Fragrant lemongrass oil as a carrier oil is taken as much as 15 ml then poured into a beaker glass. Added indigo oil as a room fragrance enhancer as much as 25 ml. Added 10 ml drops of geraniol extract as Base notes obtained from the results of the study, using a drip pipette into a beaker glass that has been filled with carrier oil.

RESULTS AND DISCUSSION

Paying attention to some of the problems faced by Business Groups that produce citronella oil such as the Mitra Sejahtera Business Group of Lhokseumawe City, where the business group still uses the traditional refining system, namely the hydrodistillation distillation system. Therefore, the research team had an idea for the design of a vacuum hydrodistillation device.



Figure 4. Vacuum hydrodistillation device

The specifications of vacuum hydrodistillation equipment are as follows:

Table 1 Product Specification of Vacuum Hydrodistillation Equipment

Machine Specification	Description	Machine Specification	Description
Distillation production capacity	10 kg	Condenser height	120 cm
Tool height	+/- 280 cm	Condenser diameter	6 cm
Material holding tank diameter	84 cm	Condenser buffer height	62 cm
The height of the holding tank from the surface	61 cm	Storage tank material	Stainless steel
The height of the upper stalk of the tank	29 cm	Condenser Type	glass

Usually, people only use simple distillation methods or techniques (distillation with water and steam), namely only by using iron stoves and firewood as fuel. The use of this technique is difficult in controlling the vapor will always change due to temperature and pressure. In fact, this kind of refining method has no better yield than that of laboratory-scale distillation methods. So that the quality of lemongrass oil produced is low and sometimes damages the geraniol component. Distillation using the vacuum technique takes only 4 hours. Meanwhile, if you use a simple distillation technique, it takes 8-12 hours. So that productivity savings per time can reach 4-8 hours.

From the results of research on the distillation of essential oils from citronella using the vacuum hydrodistillation method as follows:

Table 2 Research Results of Distillation of Essential Oil from Citronella Using Vacuum Hydrodistillation Method

Ukuran Sampel	Waktu Penyulingan (Jam)	Warna	Indeks Bias (π)	Bilangan Asam	Densitas (gr/ml)	Rendemen (%)
Potongan Acak	5	Bening	1.41570	4.32	0.92735	0.17
	6	Bening	1.41508	4.49	0.85838	0.29
	7	Bening	1.41493	4.66	0.86406	0.37
Utuh	5	Bening	1.41547	4.32	0.83954	0.13
	6	Bening	1.41484	4.88	0.83000	0.22
	7	Bening	1.41464	4.49	0.82947	0.27

YIELD

Here is a graph showing the yield rates for samples with whole sizes and random pieces:

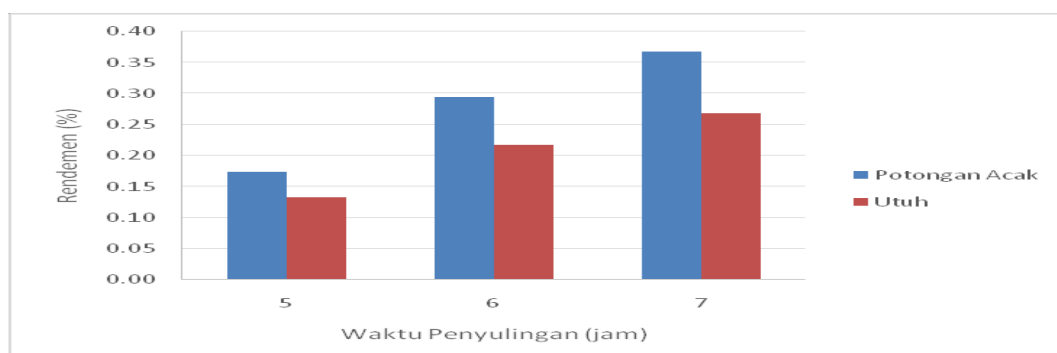


Figure 5. The Effect of Distillation Time on the Yield Rate of Essential Oils

The results showed that the highest oil yield was obtained from the vacuum hydrodistillation process with random sample pieces and a distillation time of 5 hours which was 0.17%. This is because randomly cut samples have a smaller size than the entire piece the more surface area, so the oil will be easier to extract.

DENSITY

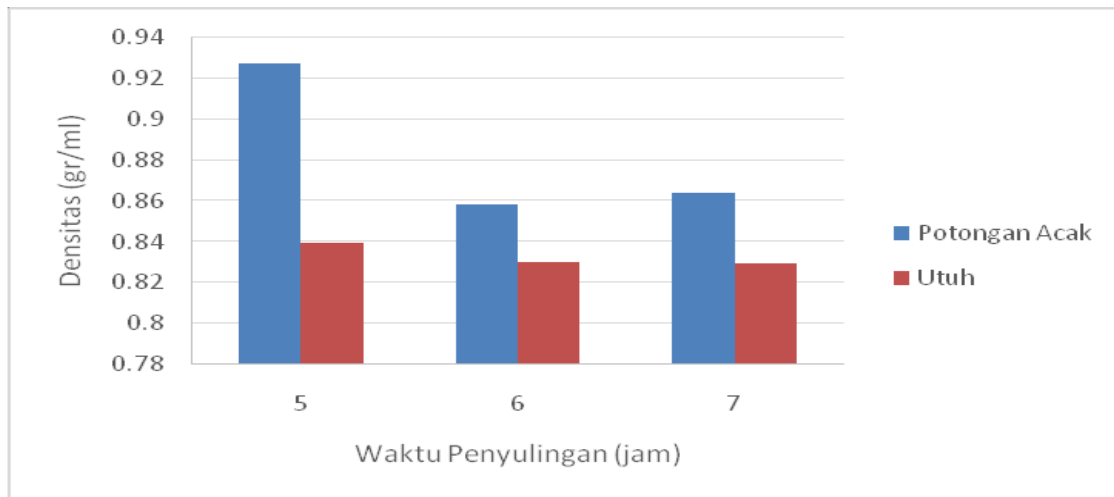
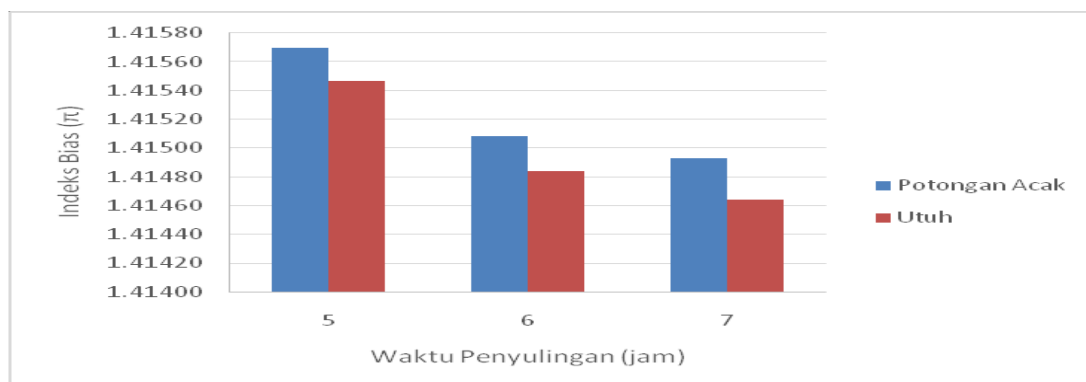


Figure 6. The Effect of Distillation Time on the Density of Essential Oils

From the graph above, it can be seen that the distillation time affects the density of the essential oil obtained, where the longer the distillation time, the lower the density of the oil. And for the best density value found in samples with random pieces and a distillation time of 5 hours, which is 0.92735 grams / ml.

BIAS INDEX

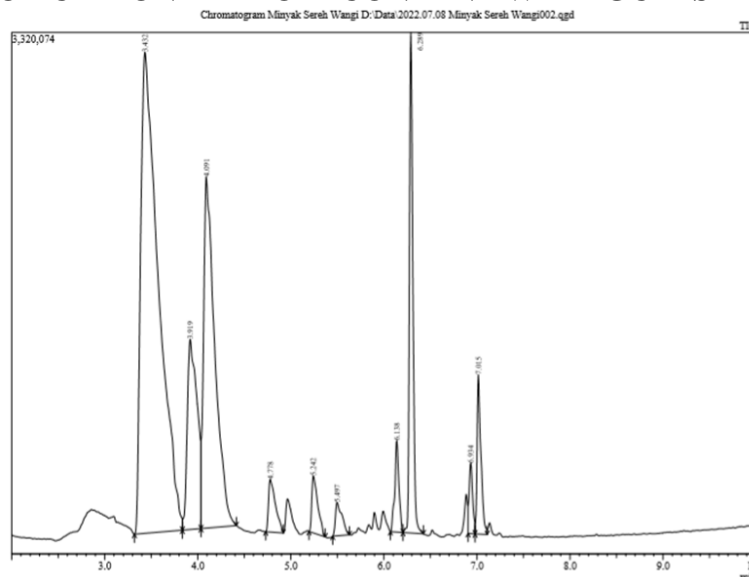
Refractive index analysis was carried out on 6 samples which included samples with different sample size variations and distillation times. For the results of the refractive index of essential oil from citronella can be seen in the following figure:



Picture 7. Effect of Distillation Time on Essential Oil Refractive Index

From the graph of the relationship between distillation time and the refractive index value of essential oil samples, it can be seen that distillation time affects the refractive index. Where the longer the refining time, the lower the refractive index. This is because the longer the oil is extracted at a certain temperature, the essential oil component will be damaged, so that the refractive index value decreases. While the comparison between the size of the whole sample and random pieces found that the refractive index in random pieces was higher than that of whole samples. The higher the refractive index obtained, the better the quality of essential oils obtained. Essential oils with the best refractive index were obtained in samples with random sample sizes and distillation time of 5 hours.

ANALYSIS OF CITRONELLA OIL CONTENT WITH GC-MS



Peak Report TIC						
Peak#	R.Time	Area	Area%	Height	Height%	A/H Name
1	3.432	40772483	46.77	3064429	24.20	13.31 6-Octenal, 3,7-dimethyl-, (R)-
2	3.919	9029261	10.36	1211753	9.57	7.45 .beta.-Citronellol
3	4.091	18803410	21.57	2238904	17.68	8.40 trans-Geraniol
4	4.778	1751286	2.01	336127	2.65	5.21 6-Octen-1-ol, 3,7-dimethyl-, acetate
5	5.242	1616776	1.85	363999	2.87	4.44 .BETA. ELEMENE
6	5.497	1039205	1.19	213935	1.69	4.86 Caryophyllene
7	6.138	1811570	2.08	582174	4.60	3.11 .delta.-Cadinene
8	6.289	8300166	9.52	3186705	25.17	2.60 Cyclohexanemethanol, 4-ethenyl-.alpha.,...al
9	6.934	1173044	1.35	448426	3.54	2.62 1-Naphthalenol, 1,2,3,4,4a,7,8,8a-octahydr
10	7.015	2880290	3.30	1015849	8.02	2.84 .alpha.-Cadinol
		87177491	100.00	12662301	100.00	

From the results of GC-MS analysis, it can be seen that the chemical compounds identified are Geraniol 21.57% and Citronellol 10.36%. Geraniol levels in essential oils are usually used for perfume making. The essential oils that have been produced are then used as the main ingredient in making perfumes.

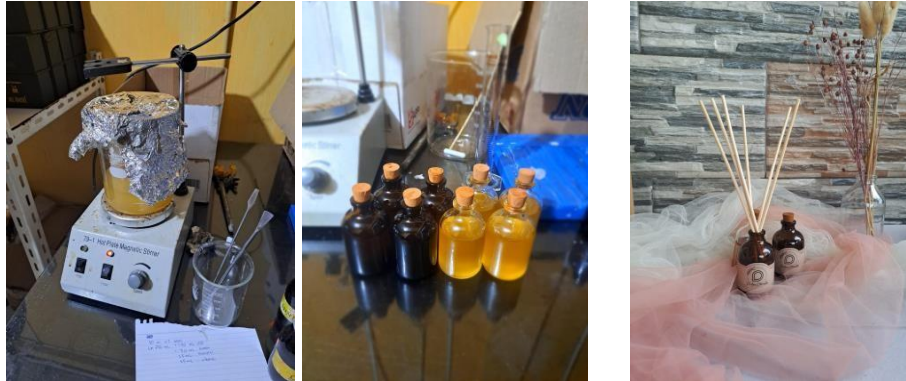


Figure 8. The process of making perfumes and the resulting products

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In terms of social, improving the welfare of the community and farmers of Blang Poroh Village, Lhokseumawe City. Not only that, community involvement in this activity is that the community, especially farmers, contribute to providing suppliers of citronella raw materials. By making the farming community the main supplier of raw material suppliers for Doufun Citronella research activities, it can increase sales of citronella fragrant lemongrass for the people of Blang Poroh Village, Lhokseumawe City. With this activity, the people of Blang Poroh Village, Lhokseumawe City, gained knowledge about citronella and knew the distillation process from the beginning of the process to obtain distillate in the form of citronella oil.

CONCLUSION

The conclusion in this activity is that the distillation of citronella oil by vacuum hydrodistillation method is very effective and able to help the economy of the community, especially citronella farmers in Blang Poroh Village, Lhokseumawe City, which can be seen from the results of the essential oil analysis obtained. For the best distillation time for 5 hours distillation with random cut shapes. This technology is expected to facilitate farmers in collaborating with consumers in producing and producing essential oil products, introducing products to local, local, and national areas.

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