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The Impact of Redistillation Temperature using Rotary Vacuum Evaporator on the Quality of Aceh Patchouli Oil

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Abstract

Patchouli oil is one of the most important essential oil commodities in Indonesia. At present the Special Region of Aceh, especially Aceh Jaya, Gayo, West Aceh, South and Southeast Aceh, is still the largest patchouli plant centre in Indonesia. So that many Aceh patchouli artisans sell their patchouli products to industries. However, there are several obstacles in this industry that cause the prices of patchouli oil products to become unstable and reduce the competitiveness of the national patchouli oil industry. One innovation that can be done to improve competitiveness is to make isolate products from patchouli oil which has a high selling value, namely patchouli alcohol (PA). PA isolation from patchouli oil can be done by a combination of vacuum distillation. In this study begins with a vacuum distillation process of patchouli oil. Patchouli oil used is taken from sources refined by Aceh farmers. Variable is refining temperature. The distillation temperature is set at 120, 125, 130, 135, 145, 155, 165, and 175 ^{o}C. Patchouli oil was analysed with patchouli alcohol, specific gravity, refractive index and acid number. The results showed that the value of patchouli oil refractive index increased from 1.507 to 1.512; density increased to 1.005 g/ml; acid number increased slightly from 5.5 to 5.8; and patchouli alcohol increased from 34% to 65.9%.

Keywords: patchouli oil, patchouli alcohol, vacuum distillation

1. INTRODUCTION

One variety of essential oil that has a very bright future prospect is patchouli oil. This patchouli plant was believed originally came from Philippines (Swamy and Sinniah 2015). Patchouli oil has a very large role in various industries and it is very difficult to find other substitute alternatives because it contains a fixative substance that can bind fragrances and evaporates so that the scented effect will last longer (Idris et al. 2014). Patchouli oil widely use in various industries which includes cosmetics, perfume even the pharmaceutical industry that utilize the antiseptic, antivirus, and antibacteria characteristics of patchouli oil (Hamidi 2016; Isnaini et al. 2022).

Patchouli oil is commonly used as fragrance (parfume), body butter, sunscreen, aromatheraphy and fixative ingredients (Isnaini et al. 2022; Muhammad et al. 2022; Sufriadi et al. 2022). Fixative is a characteristic that can inhibit the rate of evaporation of perfume so that perfumes mixed with fixative materials will be long-lasting (Syahputra et al. 2017). The fixative effect on patchouli oil is caused by the sustention of patchouli alcohol. Patchouli alcohol sustention in patchouli oil greatly affects the quality of patchouli oil. The higher the patchouli alcohol fill in patchouli oil, the better the quality of the oil. So far, in general the quality of patchouli produced by patchouli farmers has not met the patchouli national standard (SNI) yet. This is due to several factors such as limited farmers land, lack of superior patchouli seeds, difficult pest control and poor post-harvest storage. However, the main problem that causes low quality patchouli oil is because patchouli farmers still use traditional kettles such as using drums in the distillation process.

Patchouli plants are very suitable to grow in tropical regions such as Indonesia (Srivastava et al. 2022). There are three types of patchouli that grow in Indonesia, which are Java Patchouli (*P. Hortensis* Backer), Aceh Patchouli (*P. Cablin* Benth) and Patchouli Soap (*P. Heyneanus*). From these three types, the most developed and have the highest selling value is Aceh patchouli because of its high oil sustention which can reach more than 3% (Kandarihi et al. 2015). Compared to other patchouli species, Aceh patchouli has several advantages which support it to be the best type of patchouli exports, which shown in the Table 1.

Currently patchouli farmers in Aceh only use simple steam distillation equipment so if they want to improve the quality of the oil to a standard level of export, it requires

further processing (Muhammad et al. 2022). Some advanced processes for purifying patchouli from the remaining impurities include laying and adsorption process. The cultivation of patchouli oil can also be done using redistillation (redistillation of patchouli oil) process by revaporizing the distilled patchouli oil (Muhammad et al. 2022). Redistillation is the process of refining essential oil by adding water with a ratio of essential oils and water ranging from 1: 5 in a distillation flask, after the process completed, the oil distillation mixture produced will look clearer or better (Nurjanah et al. 2016).

Table 1. Comparison of various types of patchouli in Indonesia

Parameter	Aceh Patchouli	Java Patchouli	Patchouli Soap
Rendemen	2.5-5%	0.5-15%	0.5-1.5%
Savor	Strong, typical	Less powerful	Less powerful
Quality	According to SNI specifications	Not recommended for commercial use	Not recommended for commercial use

This research not only purifies patchouli oil by re-distillation, but also adds innovation through vacuum distillation. This vacuum distillation technology is more emphasized on the optimization process, because this tool able to carry out the refining process as has been done by large-scale fractionation equipment. What sets it apart is that this vacuum distillation is accentuated by the simplicity of the process and its affordability. This is supported by Walangare et al. (2013) who revealed that vacuum distillation prioritizes process simplicity and affordability as well as lower component boiling points, so the temperature used for the distillation process does not need to be too high.

One example is in the separation of heavy oil fractions with high boiling points. In this separation, the vacuum distillation method is carried out because if it is boiled under atmospheric conditions, cracking will occur in the oil (Afriani et al. 2015). Therefore, the impact of redistillation temperature using rotary vacuum evaporator on the quality of Aceh patchouli oil will be investigated in this work.

2. MATERIALS AND METHODS

2.1 Structure of Patchouli

Patchouli oil is the oil produced from distillation of patchouli parts (*Pogostemon Cablin* Benth) such as stems, branches and patchouli leaves. The materials used in this research were patchouli oil from Gayo Lues, water, 0.01 N NaOH, alcohol 96% and phenolfthalein 1%. Patchouli alcohol is a component of oxygenated hydrocarbons, a compound that determines the smell of patchouli oil and is the largest component in patchouli oil. Therefore, patchouli alcohol is an indicator of determining the quality of patchouli oil (Muharam et al. 2017). The structure of patchouli alcohol is in Figure 1.

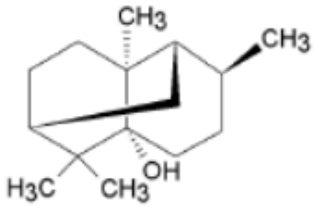
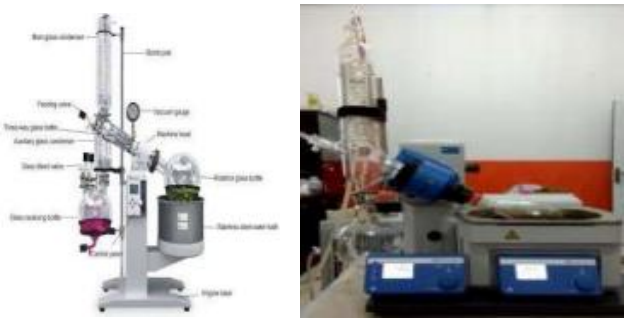


Figure 1. Structure of Patchouli Alcohol (Su et al. 2014)

2.2 Tools

The tools used are rotary vacuum evaporator (IKA, RV 10 D S99), vacuum pump (KRISBOW, 1 Stage Vacuum Pump), silicone hose, water hose, chillers (RESUN, CW 1000P), Erlenmeyer, chemical gaskets, burette, pycnometer, refractometer, measuring cup and drop pipettes and GC-MS analysis instrument tool (SHIMADZU, GCMS QP2010 PLUS). Design sketch and rotary vacuum distillation used were shown in Figure 2.



(a) (b)

Figure 2. Design sketch (a) and Rotary Vacuum Distillation (b)

2.3 Processing Method

This research uses a series of distillation tools as shown in Figure 3. Patchouli oil is entered in a feed flask on a rotary vacuum evaporator equipped with a predetermined volume. After the distillation operation conditions are set at an initial temperature of 120, 125, 130, 135 °C, then the separation begins to run until no more distillates are dripping. The distillate products obtained are then stored and separated which then named as light fractions, after that, distillation is continued by heating up to the final temperature of 145, 155, 165, 175 °C and awaited until the distillate additives that come out separated and then called as heavy fractions.

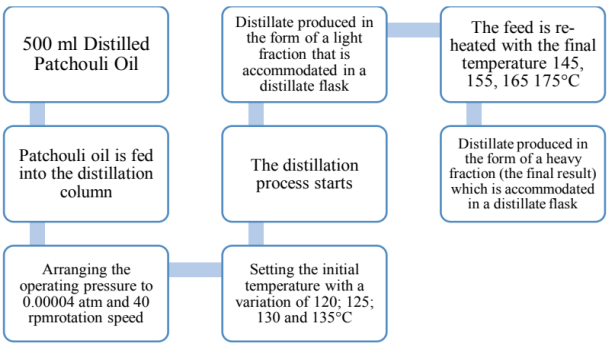


Figure 3. Processing Flow Chart

3. RESULTS AND DISCUSSIONS

The results analysis shows that the refractive index for heavy fraction distillates is in the SNI range which ranges from 1.507 to 1.515, whereas for light fraction distillates the refractive index numbers are slightly below the SNI standard. The weight of the light fraction types obtained is in the SNI range which ranges from 0.950-0.975, while the density of the fraction is slightly above the SNI standard. While the acid number before redistillation is 5.5 which is still included in the SNI range.

After the redistillation, it is obtained that the acid numbers of the light fraction were very low which indicated that the quality of the oil resistance was very good while the acid number of the heavy fraction was lightly diffracted but still included in the SNI range. The distillate colour produced is in accordance with the SNI standard, which is yellow for the light fraction and brownish yellow for the heavy fraction. Patchouli alcohol proportions in early patchouli oil was 34% but after the re distillation process it is increased to 65.9%.

The analysis of patchouli alcohol proportions was carried out using a gas chromatography tool. This test was carried out on the initial patchouli oil taken from Aceh farmers and the re-distillate patchouli oil. Patchouli oil from redistillation process results is divided into 2 parts (fraction) which are light fraction distillate and heavy fraction distillate.

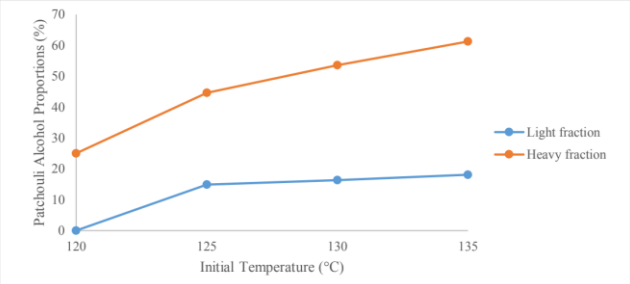


Figure 4. Patchouli alcohol analysis of redistillate Patchouli Oil

Figure 4 shows the relationship between the initial heating temperature and the patchouli alcohol proportions obtained by light fraction distillates. Initial patchouli oil has patchouli alcohol proportions of 34%, then after the redistillation process, it can be seen that the PA proportions turned to 14.90; 16.33 and 18.09 respectively at the preheating temperature 125; 130 and 135°C. This decrease in PA occurs because at this temperature, most of the distilled components which have boiling points below the boiling point of patchouli alcohol, so that the level of PA in the distilled oil is still very little.

It is also can be seen that the effect of the initial temperature heating variation on the patchouli alcohol proportions on the distillate of the patchouli oil heavy fraction produced. There is a slight decrease in the initial temperature of 120 °C and then continues to increase until the distillate reaches the highest PA proportions at the initial temperature of 135 °C. This is because at the initial temperature of 120 °C there is no distilled light fraction which causes all the light fractions that have not been distilled in the first distillation to be distilled during the second heating at the final temperature of 165 °C.

4. CONCLUSIONS

The Impact of redistillation temperature using rotary vacuum evaporator on the quality of aceh patchouli oil has been studied. Vacuum redistillation is effective to improve the quality of patchouli oil, especially patchouli alcohol. The initial patchouli oil extracted from Aceh farmers had been increased its patchouli alcohol proportions from 34% to 65.9%. The higher the distillation temperature, the greater the refractive index of the distillate produced. The initial refractive index value is 1.507 after redistilled with an initial temperature of 135 °C and at the final temperature of 165 °C the refractive index becomes 1.512. Heating with high temperature for a long time can produce free fatty acid compounds and increase the acid number of oil. The density is closely related to the oil constituent components. The heavier fractions in oil, the higher the density of the oil. the density of distillate light fraction obtained are 0.933; 0.942 and 0.944. While the density of the distillate heavy fraction is 0.950; 0.990; 0.994 and 1.005. Heating temperatures are interrelated with the volume of distillate produced. The higher the initial heating temperature, the lighter the fraction of the distillate produced but it causes less heavy fraction of the distillate.

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