

## Process design of patchouli oil distillation by varying operating conditions to increase yields of patchouli oil

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**Abstract.** Patchouli oil is part of the essential oils obtained from patchouli plants by distillation. Patchouli oil is widely used in industry as provider of aroma and flavour. Quality of patchouli oil is determined by its natural characteristics and foreign materials contain in the patchouli oil. The foreign materials contain in the patchouli oil can be damage the quality of patchouli oil. Aceh Province is the largest contribute in producing patchouli oil in Indonesia. Patchouli oil processing areas in the Aceh region, precisely in the North Aceh and South Aceh district. In generally farmer of patchouli in Aceh is traditional farmer and many of them not yet follow the best refine system. They do it base of previously experience. Refinery equipment that used from former drum that can be reaction with patchouli oil, with the result can to change chemistry structure of patchouli oil, so that the oil produced is dirty and has dark colour and does not meet the specified quality requirements). The main purpose of this research is to increase yield and the quality of patchouli oil by using of refinery equipment modification process to meet quality standards. In this research the former drum is replaced by stainless steel drum. Method of test quality and procedure of test quality same as standard method of SNI-06-2385-2006. The results showed that the using of refinery equipment (stainless steel drum) able to increase the yield and oil quality, especially in terms of colour, physicochemical properties and concentration of its main components and also meet the quality requirements of national standards.

**Keywords:** Increase, Yield, Patchouli oil quality, Patchouli Alcohol, refinery time

### Introduction

Patchouli (*Pogostemon cablin* benth) is one type of essential oil plants. The name 'patchouli' comes from the Tamil language, which means pacchilai or paculli green leaves. However, this plant is known by different name in different local languages. In Indonesia, people are more often called patchouli (in Sumatra) or glued fragrance (in Java), the names that were introduced during the Dutch colonial era. In international trade market, patchouli are traded as oil form and known as patchouli oil. Patchouli oil contains patchouli alcohol as major components and also contains other component as minor components (Guenther, 1990) and constituent compounds are generally are volatile and neutral. Patchouli oil quality is determined by the physical characteristics and chemical content of oil. Its quality is mainly measured by patchouli alcohol or PA, which is a component of most high patchouli plant. PA-containing *norpatchoulene*, which gives the smell / aroma that, is typical of patchouli oil. Patchouli oil Aceh (*Pogostemon cablin Benth*) in Sumatra is considered to have the highest quality because they contain high levels of patchouli alcohol. However, the patchouli alcohol alone does not ensure good quality. Standardization Agency of Indonesia (SNI-06-2385-2006) has set some standards for the quality of patchouli oil. While International buyers also have their own standards. Patchouli oil is good to have patchouli alcohol (PA) levels above 30%, clear yellow colour and has a distinctive odour that difficult to remove, because the nature of a strong scent, patchouli oil widely used in perfumery and cosmetics industry (Grieve, 2002).

There are various types of essential oils that existed in Indonesia and the patchouli oil is one excellent commodity (Brown, 1984). Patchouli oil have the biggest volume in the total Indonesian essential oil export and each year more than 45% of foreign exchange resulting from the patchouli oil and about 90% of the world patchouli oil from Indonesia (Santoso, 1990). Survey showed that Aceh Province is the largest contribute in producing

patchouli oil in Indonesia (Benjamin, 1995). There are several sub-varieties of the patchouli plant in Aceh. The major ones are Tapaktuan patchouli in South Aceh, Lhokseumawe patchouli (North Aceh), and Sidikalang patchouli (Aceh Tamiang). They each have different physical and chemical characteristics. However, farmers in Aceh Province began to face problems when quality and patchouli oil prices dropped sharply in 2006 after tsunami. A lot of refinery equipment destroyed and subsequently, exports declined Patchouli oil. To solve this problem, it was decided to survey, one of the patchouli oil processing areas in the Aceh region, precisely in the Aceh Province. Lower quality of patchouli oil in Aceh cause of generally farmer of patchouli in Aceh is traditional farmer and many of them not yet follow the best refine system. They do it base of previously experience. Refinery equipment that used from former drum that can be reaction with patchouli oil, with the result can to change chemistry structure of patchouli oil. So that, as the result the patchouli oil produced is dirty and has dark colour. Its quality is low and its price is lower. The purposes of this research was to study effect of temperature and duration time distillation process on yield and to also influence of chelating agents on quality of patchouli oil. In this research the *patchouli* (*Pogostemon cablin benth/Nilam Aceh*) was distilled by steam distillation is reported. An important goal was to learn the best way to distil *patchouli* leaves and stems.

## Materials and Methods

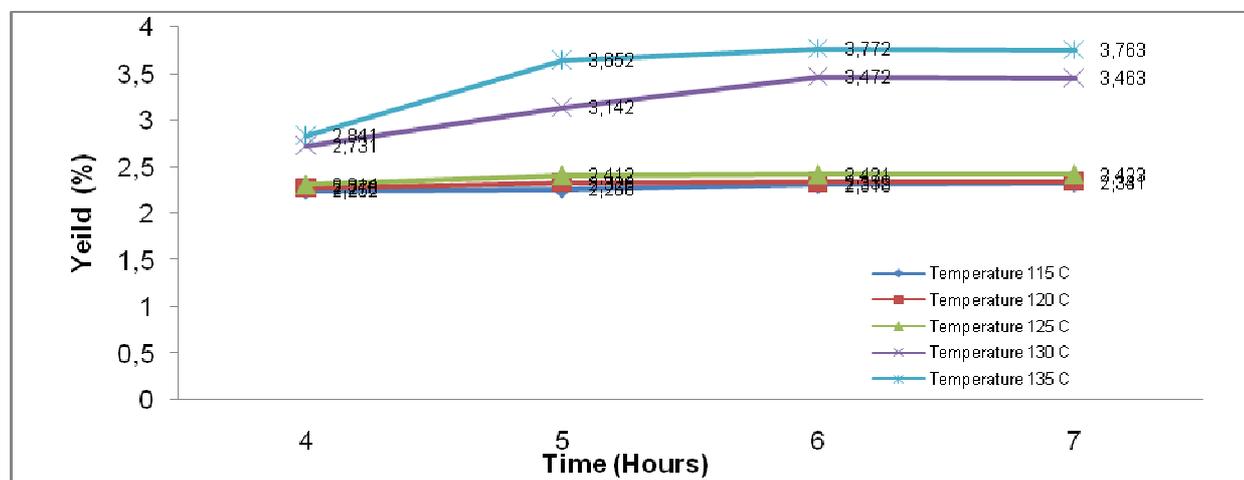
The study is divided into tri parts, preliminary studies, main research, and analysis. The preliminary study aims to determine the good condition patchouli leaves for refining. The main research aims to investigate the influence temperature and refinery time to enhance of the yield of the patchouli oil. The oil obtained from the main study will be analysed. Experiment was conducted in the Chemical Technology Laboratory, Chemical Engineering Department, Lhokseumawe State Polytechnic, from January to August 2012. Material that was to be used in this research is patchouli leaf to collect from crop farmers in north Aceh regency. Pre-treatment such as drying, withering and size reduction is very important to obtain optimal results (Nurdjanah and Marwati, 1998). This is necessary because the oil content is surrounded by oil glands, vessels and oil bag or hair granular. Without pre-treatment or in the form of whole patchouli spending only depends on the diffusion process and the process is very slow.

This research used steam distillation direct method at varieties temperature and varieties refinery time (The experiment was done repeatedly at different time and temperature). Parameters used for evaluating the effect of the treatment were the clearness of the oil, iron (Fe) content, and the main component patchouli alcohol in oil produced. The patchouli alcohol were analysed by combined Gas Chromatography and Mass Spectrometry (Corinne, 2004) and content of patchouli alcohol in patchouli oil is compared and to meet the requirements of Indonesia National Standard.

## Results and Discussion

### Effect of temperatures and refinery times on yield of patchouli oil

The main objectives of research as mentioned that for the election of patchouli oil refinery equipment design that can increase yield, process efficiency and fuel without lowering the quality of patchouli oil produced. The results showed that the yield is affected by temperature and duration refinery time and their interactions each other. From figure 1. is showed that the higher the temperature and long refinery time in process, the yield of patchouli oil is also obtained the greater. This is due to the higher temperature, the diffusion of the steam (driving force) (Geankoplish, 1983 and McCabe, 1993) can extract oil contain in leaf bone. Combination treatment gave the highest yield was 6 hours old distillery and temperature 135°C which is 3,772%, while the lowest was 4 hours old distillery and temperature 115°C, which is 2.525%.



Tabel 1. Comparative results of patchouli oil farmer product with result research

No	Parameter	Specified Quality Requirements (SNI 06-2385-2006)	Farmer Product	Result Research
1	Color	Light Yellow – Red Brown	Dark Yellow	Light Yellow
2	Density, 25°C/25°C	0,950-0,975	0,972	0,954
3	Refractive index 20°C (nD <sup>20</sup> )	1,507-1,515	1,537	1,506
4	Solubl in Etanol 90% at temperature 20°C ± 3°C	Larutan jernih atau opalesensi ringan dengan perbandingan volume 1:10	1:1 unclear 1:9 clear	1:1 unclear 1:8 clear
5	Acid Numbers	Maks 8,0	4,60	4,66
6	Ester Numbers	Maks 20,0	7,68	7,94
7	Putaran Optik	(-)-48° – (-)-65°	-53,84°	-54,46°
8	Patchouli Alcohol, PA (C <sub>15</sub> H <sub>25</sub> O)	Min 30%	26,41 %	31,115 %
9	Iron Content, (Fe), ppm	Maks 25 mg/kg	384	18

### Effect of temperatures and refinery time on patchouli alcohol (PA)

Quality of analytical results of experiments showed that the type of equipment, fuel providing a different quality is very real, but it still meets the criteria of Indonesia National Standard (SNI). Patchouli alcohol in patchouli oil is strongly influenced by treatment process. Level of patchouli alcohol in patchouli oil increased to 31.115%. For other parameters such as refractive index and ester numbers showed no significant improvement of the quality of patchouli. The content of patchouli alcohol in patchouli oil to meet the requirements of Indonesia National Standard (SNI).

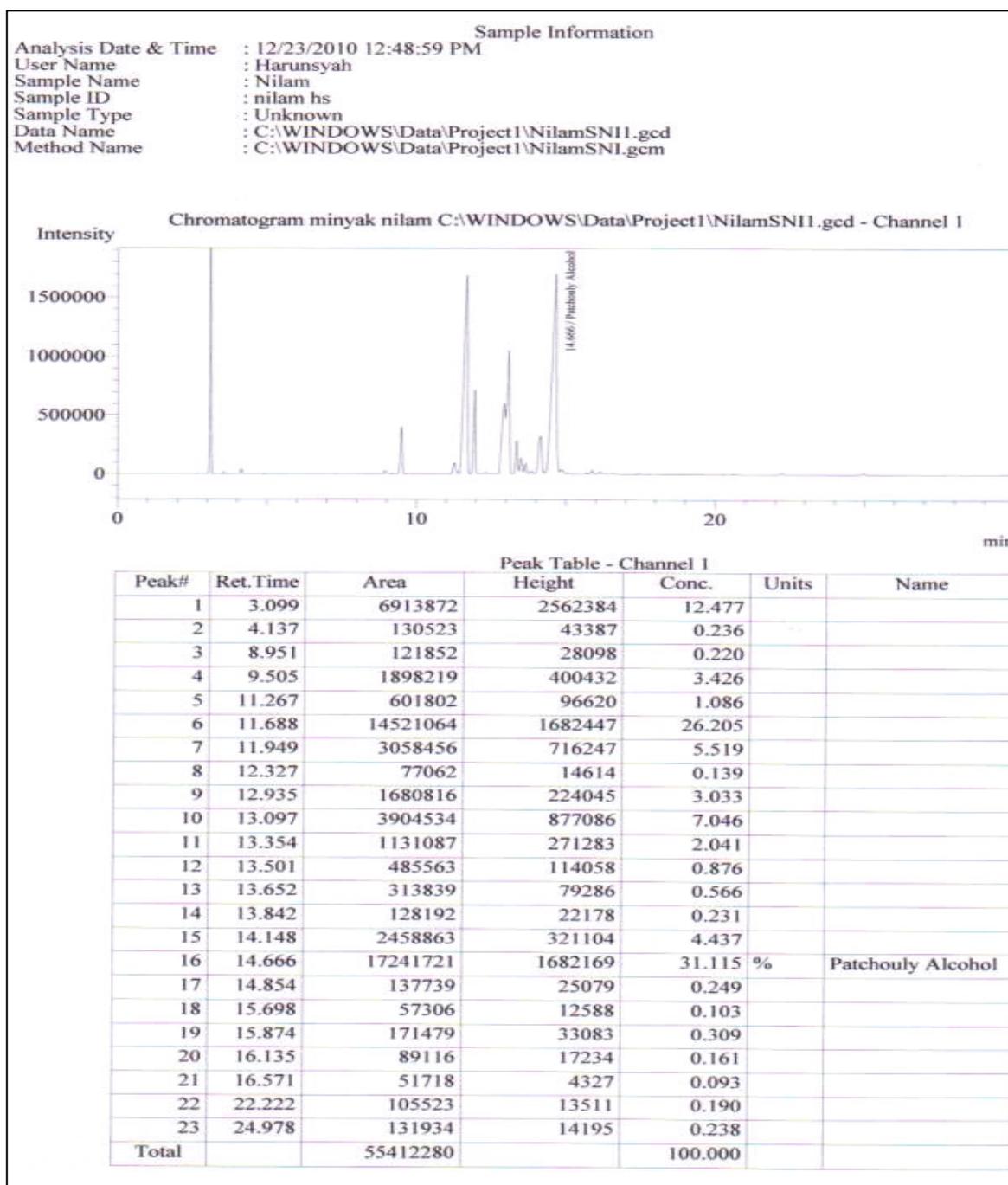


Figure 2. Analytic result using GC/MS

### Effect of temperatures and refinery time on colour of patchouli oil

For the farmer product, the dark colour of the oil causes the oil is very low level of clarity and this is caused by a high metal content. Dark colour of the patchouli oil caused by metal content that occurs during the refining process that uses a boiler made of ferrous metals, such drum or iron plate, and therefore its presence in the oil must be reduced as low as possible (EOA OF USA, 1975).

In this study, the oil obtained in accordance with SNI 06-2385-2006 produce the bright yellow to reddish brown, but after the oil storage changes colour to dark yellow to light brown. Guenther (1990) says that oil will be dark by the aging, smelly and flavourly typical spices, aromatic tall, strong and durable.

## **Conclusions**

From these results some conclusions can be drawn as follows:

1. The results showed that the using of refinery equipment design modified (former drum replaced with stainless steel drum) process can increase the oil quality, especially in terms of colour, physicochemical properties and concentration of its main components.
2. From the oil refining process also can produce a brighter and the characteristic also meet the quality requirements of Indonesia national standards. Time of refine faster and economical material burn.
3. Patchouli Alcohol content after refinery is higher at around 30.16% - 31.115% and its value compared to Indonesia National Standard (SNI 06-2385-2006) requirements prior to the traditional farmer high is 26,41%.
4. The use of stainless steel construction materials can produce appropriate patchouli oil quality standards.
5. Colour, solubility, acid number, ester number, and the specific gravity of the oil would be fine if kept longer in a good container.

## **Acknowledgements**

The authors are very grateful to The National Strategic Research-Higher Education Department (DIKTI) have financial supported this research.

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