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Characteristics of clove leaf essential oil (*Eugenia aromatica* o.k) in various range of elevation

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Abstract

Indonesia is an agricultural country which total area 485 304 hectares of clove plantations. Clove leaf is the result of the clove tree that has not been widely used by farmers as compared to flowers or stems of clove cigarettes is widely used for industrial and food. The objective of this research was to analyze characteristics of the leaf essential oil of clove on the elevation ranges from 100 to 800 m above sea level, with an increase in elevation range of 100 m above sea level. At the study site the rate of decrease in temperature of about 0.9 °C every additional height of 100 m above sea level. This research was conducted in the laboratory with the UNIMA IBIKK sampling in the Kapataran Village to villages around DAS Tondano of Minahasa, North Sulawesi. For analysis performed on components of the Lab. Organic Chemistry UGM. The results showed that the characteristics of the leaf essential oil of clove on a variety of different elevation ranges. At the elevation range of 100-200 m above sea level clove leaf essential oil obtained with a yield 2.8% and in the range of 701-800 m above sea level elevation obtained with clove leaf essential oil yield of 1.27%. based on elevation range of the highest oil yield obtained from the elevation of 301-400 m above sea level with essential oil yield as much as 3.08%. The content of eugenol in clove essential oil obtained at the highest elevation range of 301-400 m above sea level with a percentage of 68.37% as much as the content of eugenol, eugenol content in the range of 100-200 m above sea level elevation of as much as 63.38% and the lowest content of eugenol at 701-800 m above sea level with percentage content of eugenol as much as 59.56%.

Keywords: *Eugenia aromatica*, clove leaf essential oil

Introduction

Indonesia is an agricultural country that has vast clove plantations total 485,304 Hectares and North Sulawesi is a potential province that has the largest area of clove plants, a broad area of North Sulawesi cloves achieve 74,162 Hectares (Dirjen Perke-bunan, 2012) The results of research of Arrijani *et al.* (2010) shows that 60% of the total area of the plant the cloves in the Mina-hasa (15,357 hectares) are in the area of DAS Tondano (9,214 hectares) and is commonly grown in monoculture.

Essential oil is one of the products that are needed in a variety of industries such as the industry of cosmetics, pharmaceuticals, food and drinks. Essential oils can also be used as an aroma therapy (Nurdjannah, 2004). Clove leaf oil refinery is a solution that can address many of the problems faced by farmers in economic and ecological issues. Arrijani (2012) stated that the production of clove leaf litter ranged from 0.96 kg/tree and overflow available year-round and can be harvested every day (9,214 ha x 600 phn x 0.96 (clove leaf litter mass/day) = 5307 kg/day). Elevation that is the height of a point on the Earth above sea level. The addition of height causes the temperature getting down. The rate of decrease in temperature is generally around 0.6 °C per the addition of height of 100 m above sea level. However this varies depending on the season, time, place, content of water vapor in the air, and other environmental factors (Whitten *et al.* in Fatchurrozak *et al.*, 1995). The difference in the temperature of each altitude range causing metabolic processes on a different plant, so the secondary production of metabolism is different.

Muhdi (2004) stated that the usual plants live in areas of high elevation is the kind that is able to adapt to the climatic conditions of low temperature, high humidity and the intensity of the Sun. These factors affect photosynthesis and other physiological activities. When the usual tree living in low elevation, then planted in high elevation, then this type of tree growth will be slow.

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Nurnasari *et al.* (2010) States that environmental elements such as elevation site, air temperature, and relative humidity affect the levels of nicotine in tobacco. Height affects the production and content of nicotine in tobacco. As long as it does not yet exist that examine the characteristics of the leaf essential oil of clove with at some elevation so it still required a study about "Characteristics of the Leaf essential oil of Eugenia aromatic at different Elevation Ranges "

This research aims is to analyze the main components of clove leaf essential oil constituents and to know the characteristics of the leaf essential oil of clove based on ranges of elevation to define the optimal elevation for industrial raw material distillation of clove leaf.

Research Methodology

Place and Time

This research was carried out in the laboratory, with UNIMA IBIKK sample obtained in Kapataran arrived at the village around DAS Tondano. For the analysis of the constituent components of the essential oil of clove leaf by using instruments GC-MS at different elevation range is done in the laboratory of organic chemistry. This research was conducted for 4 months starting from February-may 2014.

Instrument and Materials

The instrument used in this research is a set of tools a steam distillation consists of boilers, boiler, condenser, pump and reservoir samples, GPS, temperature and humidity meters, instruments, GC-MS, funnels, scales, measuring cup and other support instruments.

The materials used in this research is the clove leaf obtained on the elevation ranges from 100 to 800 m above sea level obtained in Kapataran to villages around DAS Tondano.

Research Procedure

Taking a sampling of raw materials is carried out on each elevation ranges from 100 to 800 m above sea level at a location of clove plantations Kapataran to villages around DAS Tondano. In this research was conducted 7 strata based

on height in the following order:

1. Strata 1 with 100 elevation range up to 200 m above sea level.
2. Strata 2 with elevation range 201 up to 300 m above sea level.
3. Strata 3 with elevation range 301 up to 400 m above sea level.
4. Strata 4 with elevation range 401 up to 500 m above sea level.
5. Strata 5 with elevation range 501 up to 600 m above sea level.
6. Strata 6 with elevation range 601 up to 700 m above sea level.
7. Strata 7 with elevation range 701 up to 800 m above sea level.

The raw material is obtained then is distilled in the laboratory IBIKK UNIMA and essential oil obtained is calculated per cent its rendement. The sample is then analyzed using GC-MS in Labo-ratorium organic chemistry.

Analysis of the Chemical Composition of the Essential Oil of Clove Leaf Constituent.

The equipment used was the QP2010S column with SHIMADZU GCMS AGILENT HP 5MS 30 m in length and a diameter of 0.25 mm. Condition column is set up with an initial Temperature of 60 °C, the final Temperature is 300 °C. This type of detector is FTD with temperature of the injector is 310 °C. The carrier gas is Helium (He) with pressure: 6.8 kPa. Determination of the structure of the compound is done using a standard that is already known by matching the fragmentation of its compounds are. Every peak that appear in kromatogram has a retention time.

Result and Discussion

Elevation range 100-200 m dpl

In the range of elevation 100-200 m dpl is obtained essential oil clove leaves with 2.8% yield, Nurdjannah 2004 stated that the content of essential oil of clove leaf reaches 1-4%. Clove leaf essential oil has a high enough yield.

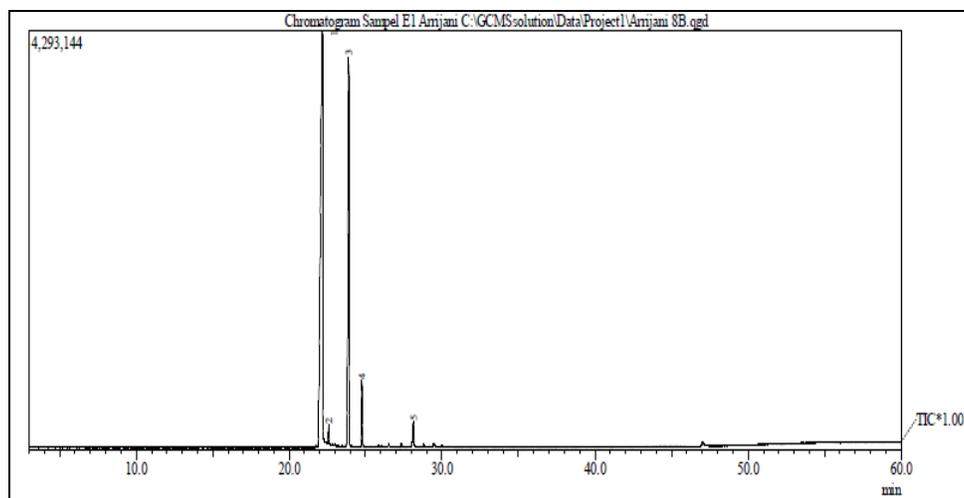


Fig 1

Kromatogram essential oils on elevation of 100-200 mdpl are-NC's GC-MS Kromatogram results of GC-MS leaf essential oil of clove plants found 5 components of the Summit, the main components of essential oil of clove leaf namely eugenol with composition as much as 30.59 63.38%, Kariofilen%, α -Humulen 3.7%, oxide Kariofilen 1.37% and

α -kopaen 0.96%.

Elevation range 200-300 m dpl

On the elevation range 201-300 m above sea level is obtained with clove leaf essential oil yield 2.92%.

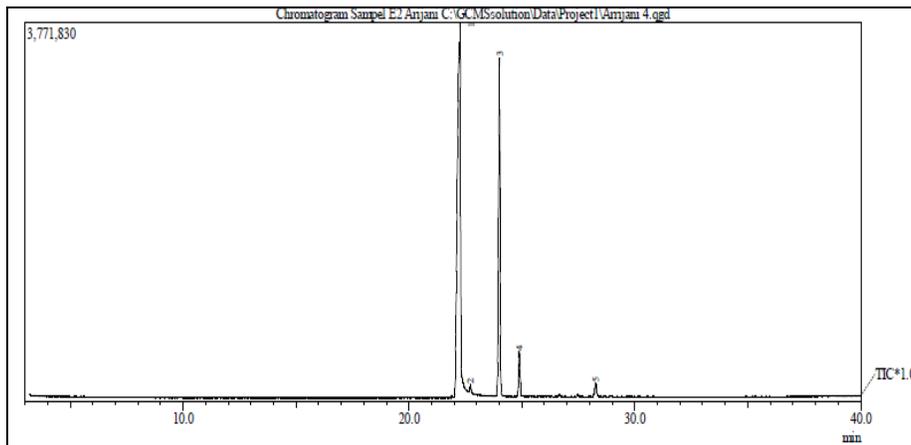


Fig 2: Kromatogram essential oils on the elevation of 201-300 mdpl using GC-MS

Kromatogram results of GC-MS leaf essential oil of clove plants found 5 peak component, the main components of essential oil of clove leaf namely eugenol composition as much as Kariofilen 28.69%, 66.44%, α -Humulen + 3.43%, 0.88% oxide Kariofilen and α -kopaen 0.56%.

Elevation range 301-400 m dpl

On the elevation range 301-400 m above sea level is obtained with clove leaf essential oil yield 3.08%,

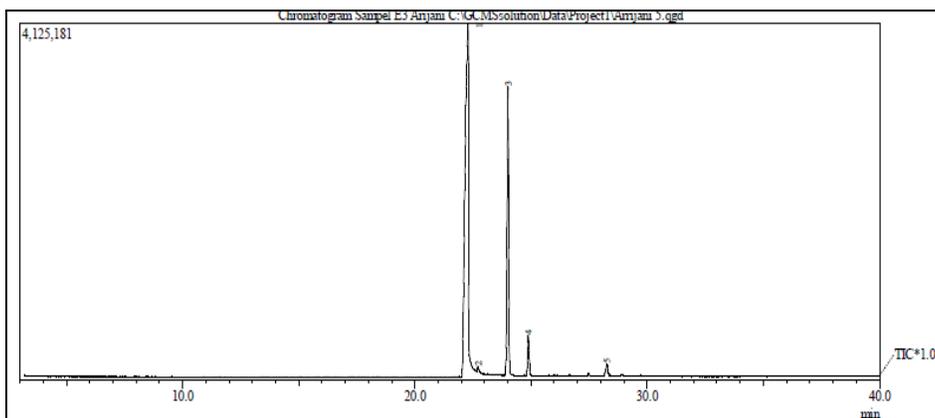


Fig 3: Kromatogram essential oils on elevation 301-400 mdpl are-NC's GC-MS

Kromatogram results of GC-MS leaf essential oil of clove plants found 5 components of the Summit, the main components of essential oil of clove leaf namely eugenol composition as much as 68.37%, 26.99% Kariofilen, α -

Humulen 3.3%, Kariofilen oxide 0.86% and α -Kopaen 0.48%.

Elevation range 401-500 m dpl

On the elevation range 401-500 m above sea level with clove leaf essential oil yield of 1.9%.

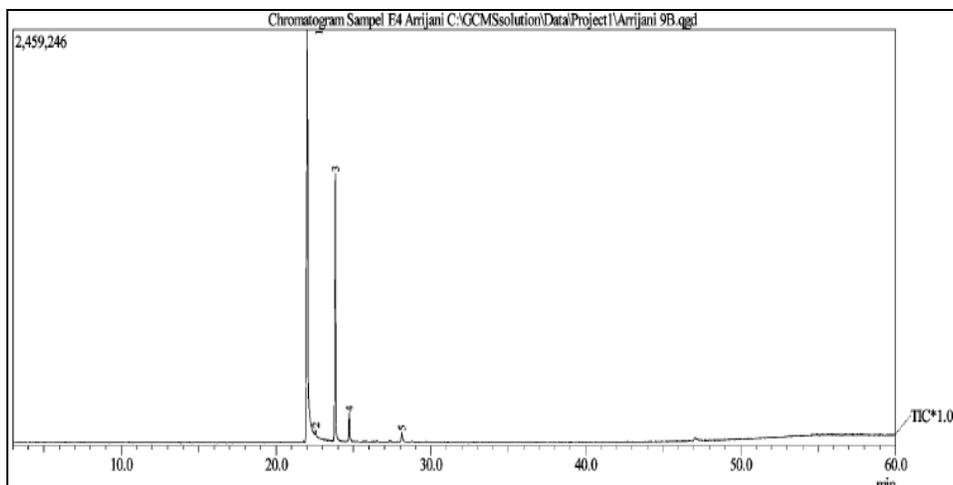


Fig 4: Kromatogram essential oils on the 401-500 mdpl elevation are the NC-GC-MS

Kromatogram results of GC-MS leaf essential oil of clove plants found 5 components of the Summit, the main components of essential oil of clove leaf namely eugenol composition as much as 65.62%, trans-Kariofilen 30.26%, α -

kariofilen 2.99%, 0.75% and oxide Kariofilen Kopaen 0.38%.

Elevation range 501-600

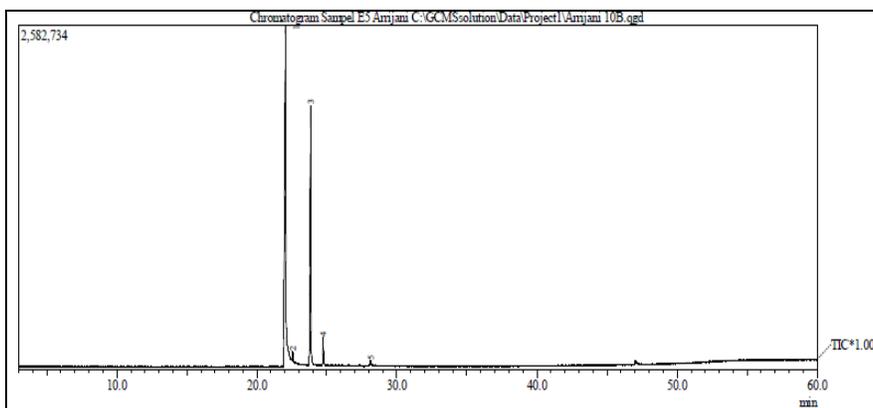


Fig 5: On the elevation range of 501-600 m above sea level leaves clove essential oil is obtained by 1.62% yield,

Kromatogram results of GC-MS plant leaf essential oil of clove has-5 peak, component was nowhere to the main components of essential oil of clove leaf namely eugenol composition as much as 62.02%, trans-Kariofilen 33.23%, α -Humulen α -3.41%, 0.96% Kopaen and% Kariofilen oxide,

0.38%
Elevation range 601-700
Elevation range at 601-700 m above sea level leaves clove essential oil is obtained by 1.36% yield.

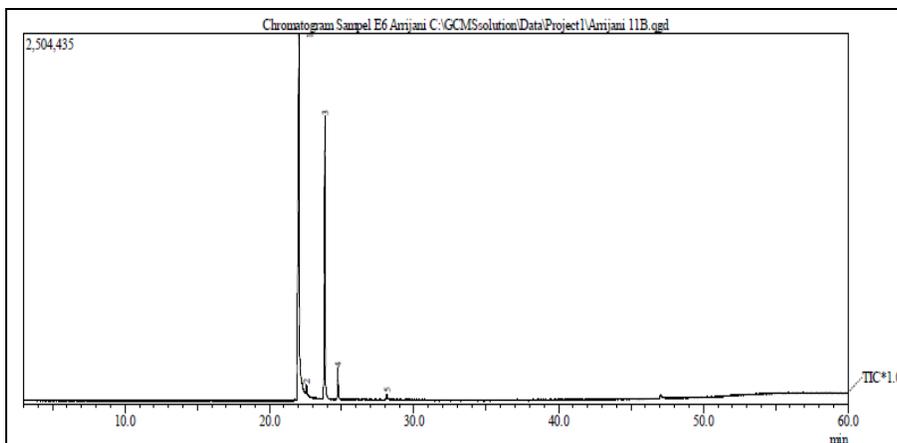


Fig 6: Kromatogram essential oils on the 601-700 mdpl elevation are the NC-GC-MS

Kromatogram results of GC-MS leaf essential oil of clove plants found 5 components of the Summit, the main components of essential oil of clove leaf namely eugenol composition as much as 61.37%, trans-Kariofilen 34.19%, α -Humulen α -3.42%, 0.89% Kopaen and% Kariofilen oxide,

0.39%.
Elevation range 701-800 m dpl
Elevation range at 701-800 m above sea level is obtained with clove leaf essential oil yield in 1.27%

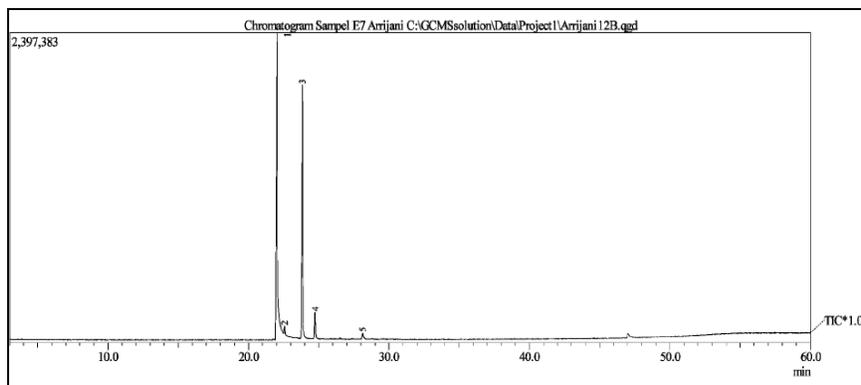


Fig 7: Kromatogram essential oils on elevation 701-800 m dpl using GC-MS

Kromatogram results of GC-MS leaf essential oil of clove plants found 5 components of the Summit, the main components of essential oil of clove leaf namely eugenol composition as much as 59.56%, Kariofilen 35.02%, α -Humulen α -3.65%, 0.97% Kopaen and Kariofilen oxides of 0.79%.

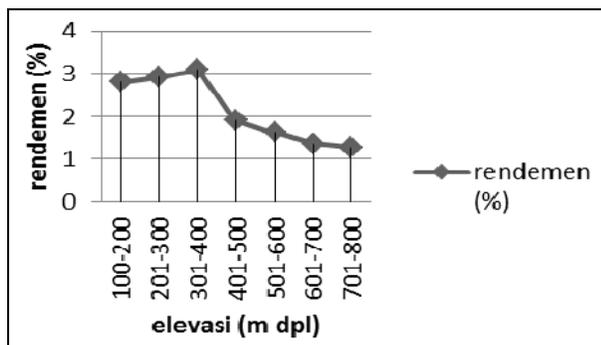


Fig 8: The percentage yield of essential oil of clove leaves with a wide range of elevation.

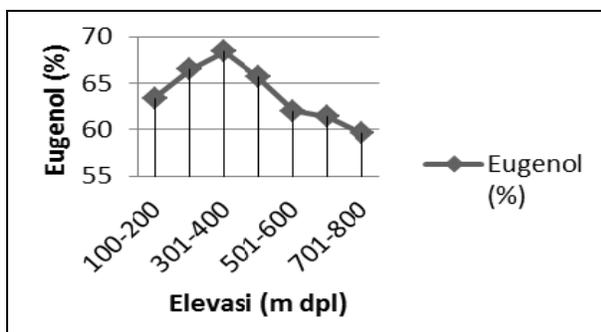


Fig 9: Percentage content of eugenol clove leaf essential oil based on elevation range.

2. Discussion

Yield essential oil obtained from 100-800 m dpl elevation varies, in the range of 100-200 m dpl elevation is obtained with clove leaf essential oil yield of 2.8% and in the elevation range 701-800 m dpl it gets leaf essential oil of clove with yield 1.27%, based on the range of elevation of most oil yield obtained from the elevation of 301-400 m above sea level with a yield of essential oil as much as 3.08%. Nurdjannah, 2004 stated that the content of essential oil of clove leaf reaches 1-4%. Guenther (1990) States that the results of oil refining clove around 17-18%, the distillation of clove and about 6% of the leaves are about 2-3%. Oil yield obtained from this study in accordance with the yield of essential oil of clove leaf is 1-4% (Nurdjannah, 2004). On the elevation range 301-400 m dpl is the optimum elevation for the raw material distillation of clove leaf this is caused due to the influence of environmental factors such as air temperature, humidity, and photos with the location of the research. The addition of height causes the temperature getting down. The rate of decrease in temperature is generally around 0.6 °C per the addition of height of 100 m dpl. However this varies depending on the season, time, place, content of water vapor in the air, and other environmental factors (Whitten *et al.*, 1984). The difference in the temperature of each altitude range causing metabolic processes on a different plant, so that the production of any secondary metabolism is different. On the research area the rate of decrease of temperature of about 0.6 °C per the addition of height 100 m dpl and the level of humidity is between 72-77%. The content of eugenol in clove

leaf essential oil on the highest elevation in the range obtained 301-400 m dpl with the percentage content of eugenol 68.37% as much. This is caused due to environmental factors such as air temperature (32.7 °C), humidity (73%), and photograph with high enough on the location of research. Eugenol is a main component of essential oil constituents that as the result of secondary metabolites from plant cloves. According to Mariska i. (2013) the production of secondary metabolites was influenced by various physical factors such as temperature, light, humidity. On the elevation ranges from 100 to 800 m dpl the content of eugenol in essential oil experienced a negative correlation relationship with increased elevation due to any increase in elevation causes a decline in temperatures and rising humidity. Clove plants able to grow in elevation range 0-900 m dpl but grows optimally at elevation ranges from 300 to 600 m dpl for flowering and from this research obtained that range in elevation 301-400 is the optimum height to obtain the essential oil of clove leaf characteristics, both in terms of yield as well as the content of eugenol.

Based on the results of Jayanudin research (2011) the obtained yield essential oil of clove is the largest leaves 1.84% levels that determined by GC-MS instruments namely eugenol 65.03 transcaryophyllene 20.94% and%. The low levels of eugenol occur due to system cooling and shelter sample is not perfect, so a lot of eugenol which evaporate. According to Putri *et al.* (2001) percentage of eugenol in clove oil after done tests with GC-MS is 63,56%, kariofilen of 22,43%. Alpha Humulene of 5.82% and caryophyllene oxide of 3%. Other compounds that has a percentage of less than 1%.

Artati (2012) stated levels of eugenol clove oil is 55,14%. Environment and the method of refining of clove plants affect levels of eugenol. In addition, clove oil can be distilled from the flowers, leaves and stems, which have different levels of eugenol.

Anonymous in Nindarti (2006) adds that the leaves have the same content with flower buds just the difference on clove leaf content of its eugenol content is quite low.

Ayoola (2008) States that the compound contained in oil of clove, among others, eugenol, kariofilen, eugenol acetate and α -humelene, and eu-genol is most compounds.

Elevation range at 701-800 m dpl 2 factions obtained essential oil clove leaf oil, namely light and heavy oil. Guenther 1990 stated that at the time there were two clove oil distillation fractions i.e. the fraction that is lighter than water and a fraction heavier than water.

Conclusions

The main components of essential oil of clove leaf constituents, namely eugenol, kariofilen, α -kariofilen, β -kariofilen, α -hu-mulen, kopaen, α -kopaen and kariofilen oxide. Based on the range of elevation of most oil yield obtained from the elevation of 301-400 m dpl with a yield of essential oil as much as 3.08% with the highest content of eugenol 68.37% as much, i.e. is yellow and has a peculiar smell of clove oil.

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