Analysis of Bioactive Content of White Turmeric Rhizome (*Kaempferia rotunda*) Growing In Central Kalimantan

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Abstrak: The purpose of this study was to determine the levels and components of essential oils between the rhizome and tuber parts of the white turmeric (Kaempferi rotunda) plant. Sampling of white turmeric was done purposively. The plant parts analyzed were the rhizome and tuber of white turmeric. The study was conducted in August 2021. Sampling of white turmeric was carried out in Hampatung Village, Kapuas Hilir District, Kapuas Regency. Laboratory studies were carried out in 3 places, namely the Laboratory of Chemical Technology for Forest Products, Department of Forestry, University of Palangka Raya, BPOM Laboratory of Palangka Raya City and the Test Laboratory of the Academy of Analytical Chemistry, Bogor Polytechnic. From the results of the analysis of white turmeric essential oil content in the rhizome (0.2969%). The results of GC-MS analysis of essential oils obtained from the rhizome showed 33 components and there were 4 main component compounds, namely Bornyl acetate (64.81%), Champhene (35.07%), Pentadecane (47.53%) and ethyl cinnamate (48.57%).

Keywords: White turmeric, bioactive.

I. INTRODUCTION

Indonesia is a country that has the potential for essential oil production (Arniputri *et al*., 2007; Rusli, 20012; Alighiri et l., 2017; Soetjipto, 2018; Alighiri et l., 2018; Alighiri et al., 2018; Andila et l., 2018; Alighiri et al., 2018; Hidayat et al., 2021). According to the Indonesian Atsiri Council & IPB (2009), essential oils are one of the potential agro-industrial export commodities that can be a mainstay for Indonesia to earn foreign exchange. This is driven by the growing demand for the food flavoring industry, pharmaceutical industry, cosmetic and fragrance industries. One of the plants that contain essential oils and is used for generations, especially in Indonesia, is the white turmeric plant (Kaempferia rotunda). White turmeric plants produce white rhizomes and from the rhizomes come out rough roots with fleshy ends and are often called tubers (Astutiningsih *et al*., 2014; Sharma *et al*., 2016; Hirko Ararsa& Mitiku, 2018). Essential oil is not a single compound, but consists of various components of compounds that have volatile properties at room temperature. Constraints that are commonly faced during the analysis of the components that make up essential oils are the loss of some components during the analysis procedure. Constraints in the analysis can be overcome after the discovery of the GC - MS (Gas Chromatography - Mass Spectrometer) technique (Amirav et al., 2008; Luedemann et al., 2008; Krone et al., 2010; Purba, 2013; Teubel et al., 2018; Gruber et al., 2020; Khodadadi et al., 2020; Zhang et al., 2020; Pico et al., 2020; Carpita & Shea, 2021). So in this study, the GC-MS tool was used in order to reduce the risk of loss of some components of the volatile oil compounds during the analysis of the identification of the volatile oil components in white turmeric rhizomes and tubers. The purpose of this study was to determine the levels and components of essential oils between white turmeric rhizomes and tubers by GC-MS.

White turmeric rhizome is commonly used as a medicine for stomach pain, dysentery and vaginal discharge. Meanwhile, in the tuber part, the surrounding community mostly uses it as a raw material for making acne powder and an appetite enhancer (Astutiningsih et al., 2014; Money, 2018; Az-Zahra et al., 2021). According to Tan (2015); Elzaawely *et al*., (2007); Sellami *et al*., (2012); Muchtaridi (2014); Aćimović et l., (2020); Abdul Aziz *et al*., (2021); Aswandi & Kholibrina (2021), distilled rhizomes and tubers can produce essential oils that contain cineol, a substance that smells of camphor. However, with the difference in benefits between the rhizome and tuber parts of white turmeric, the researchers wanted to compare the content and components of the oil. The results of this study are expected to be useful for developing research on natural ingredients that produce essential oils and can provide information on the comparison of levels and components of essential oils between white turmeric rhizomes and tubers.

II. MATERIALS AND METHODS

This research was carried out in August 2021, for sampling the white turmeric plant was carried out in Hampatung Village, Kapuas Hilir District, Kapuas Regency, Central Kalimantan. Laboratory studies were carried out in three places, namely the Laboratory of Chemical Technology for Forest Products, Department of Forestry, Palangka Raya University, the BPOM Laboratory of Palangka Raya City and the Test Laboratory of the Academy of Analytical Chemistry (LU-AKA), Bogor Polytechnic. This research was conducted in several stages, namely 1). Preparation of plant materials (taking plant materials and making simplicia); 2). Isolation of essential oils on samples of rhizomes and samples of white turmeric tubers; 3). Analysis of essential oil content in samples of rhizomes and samples of lutih turmeric tubers; 4). Analysis of the specific gravity of the two volatile oil samples using a pycnometer; 5). Analysis of the volatile oil components of the two samples using GC-MS (Gas Chromatography – Mass Spectrometer). Data obtained from a series of observations and observations are presented in tabular form with narrative explanations.

III. RESULTS AND DISCUSSION

A. Analysis of Essential Oil Levels

Based on the results of observations of rhizome essential oil levels, where the volatile oil content found in the white turmeric rhizome is 0.2969%. Plant parts (rhizomes and tubers) of each white turmeric plant can produce different levels of essential oil obtained depending on the number of spread of oil glands on that part of the plant. According to Gunawan and Mulyani (2004); Baran et al., (2010); Sharma & Pegu (2011); Singh et al., (2018); Guesmi et al., (2019); Haratym et al., (2020); Elmurodovich & Shavkatovna (2022), essential oils are contained in glandular hairs and in certain plant tribes they are abundant in glandular hairs of stems, leaves and rhizomes.

The volatile oil content of the white turmeric plant from the results of this study in the rhizome was still far below the maximum value of the white turmeric essential oil content. According to research by Braga et al., (2003); Funk et al., (2010); Zhao et al., (2010); Evizal (2013); Akbar et al., (2015); Sompinit et al., (2020); Hemmati et al., (2021), the highest white turmeric essential oil content was obtained as much as 1.6%. This can be caused by several factors, according to Guanther (1999); Salgueiro *et al*., (2010); Bhattacharya (2016); Alamgir (2017), The levels of essential oils contained in a part of the plant are also influenced by several factors, namely chopping, storage of processed materials, condition of materials, age of harvest and drying. The white turmeric plant used for analysis was harvested at the age of 9 months. Meanwhile, according to Evizal (2013); Balasubramanian et al., (2016); Sarkar et al., (2020); Przybylska et al., (2021), the ideal harvest time where the active compound content in white turmeric is in optimal condition is 10-11 months, which is marked when the second leaf falls. Harvest time is an aspect that is closely related to the plant growth phase which reflects the physiological maturity level of the plant and has a strong relevance to the production and content in the plant (Buxton, 1996; Delfine et al., 2005; HongBo et al., 2005; Takai et al., 2006; Prasad et al., 2008; Hariyani et al, 2015).

B. Analysis of the Specific Gravity of Essential Oils

In this study, the highest specific gravity of essential oils was found in the white turmeric rhizome, which was 0.8990. The difference in specific gravity of essential oils between the rhizome and the white turmeric tuber indicates that there are differences in the number of essential oil components contained in the plant parts. The highest number of components based on the largest specific gravity is the difference in the specific gravity of essential oils between the rhizome and white turmeric tubers, indicating that there are differences in the number of essential oil components contained in the plant parts. The highest number of components based on the largest specific gravity is found in the white turmeric rhizome. Guenther (1987); Puhan et al, (2010); Galià et al., (2010); Westbrook et al., (2013) stated that in general, essential oils contain long chain molecules and many double bonds, so the more double bonds in the oil, the higher the specific gravity value of the oil produced. According to (Armando, 2009; Barku et al., 2012; Awadh & Al-Mimar 2015) the greater the number of components contained in the oil, the greater the value of specific gravity.

C. Analysis of Essential Oil Components with GC-MS

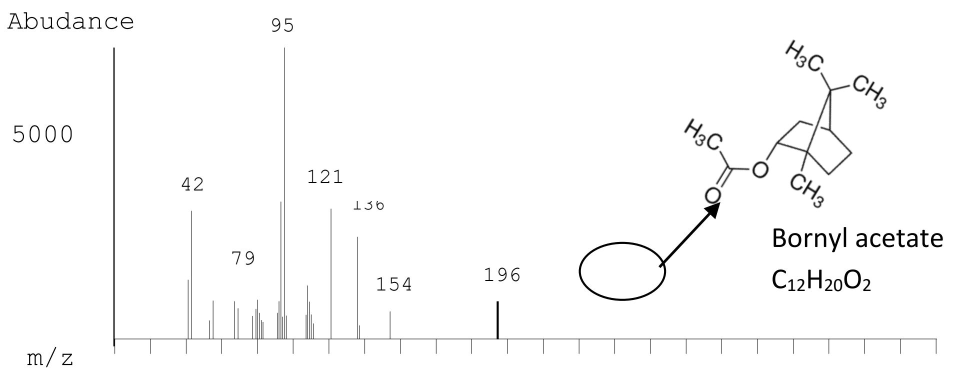
Based on the results of the analysis of the volatile oil components of white turmeric rhizome with GC – MS obtained 33 compounds based on the number of peaks on the GC chromotogram. Of the 33 compounds, there are 4 main components of essential oil compounds in the white turmeric rhizome. The four main components of the essential oil obtained from the white turmeric rhizome are bornyl acetate, camphene, pentadecane and ethyl cinnamate. The retention time and levels of the 4 components of essential oil from white turmeric rhizome based on the results of the GC-MS analysis can be seen in Table 1.

Table 1. Mooring Time and Content of Essential Oil Components Result of GC-MS Analysis of White Turmeric Rhizome

No.	Component Name	Mooring Time (Minutes)	Molecular Formula	Molecular Weight	Rate (%)
1	Bornyl acetate	5.576	$C_{12}H_{20}O_2$	196	64.81%
2	Camphene	7.866	$C_{10}H_{16}$	136	35,07%
3	Pentadecane	8.311	$C_{15}H_{32}$	212	47.53%
4	Ethyl cinnamate	11.162	$C_{11}H_{12}O_2$	176	48.57%

Analysis and fragmentation of the results from the Mass spectrometer, the main components of the essential oil from the white turmeric rhizome are as follows:

- Peak with mooring time (Retention Time) 5.576



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20 4 0 6 0 80 100 120 140 160 180 190 200 220 240 260 280 300 320 340 360 380

Figure 1. Fragment pattern and structural formula of Bornyl acetate . compound

- Peak with mooring time (Retention Time) 7.866

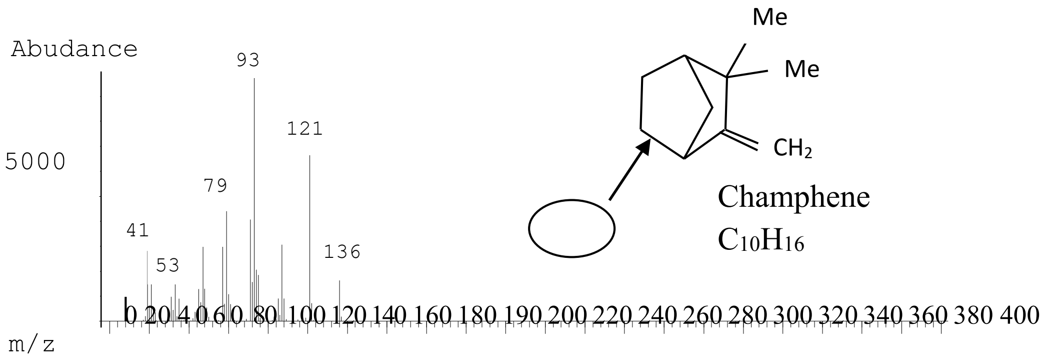

Figure 2. Fragment pattern and compound formula for Champhene

Bornyl acetate with molecular formula $C_{12}H_{20}O_2$ is one of the main components in the white turmeric rhizome with a content of 64.81%. Bornyl acetate is a colorless liquid that has a characteristic piney champhoraceous odor. Given its therapeutic aroma, bornyl acetate is often used as a perfume and as a flavoring agent. Bornyl acetate is also used in several products, such as cleaning products and detergents, personal care products and plastic and rubber products. Bornyl acetate also exhibits anti-inflammatory properties and is used as an analgesic.

Champagne with molecular formula $C_{10}H_{16}$ is one of the main components in the white turmeric rhizome with a content of 47.07%. Champhene is a colorless crystal and has a camphor-like aroma and a mint-like taste. Champhane is an important commercial chemical that is used as an additive (eg food, frozen milk, gelatin and pudding). Champhane is also used to make camphor, perfume and additives to make plastic more flexible (U.S. National Library of Medicine. 2011; Barana, 2017; Kouhi et al., 2020).

- Peak with mooring time (Retention Time) 8.311

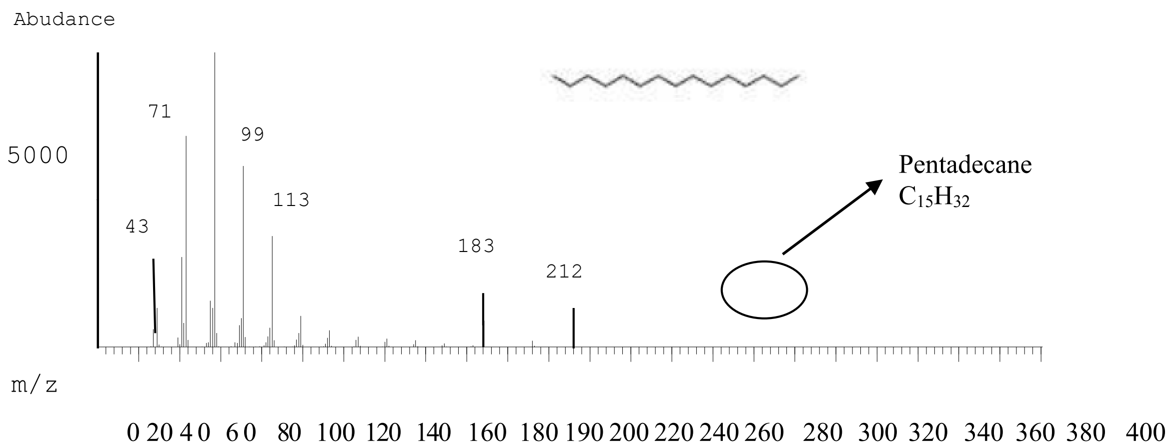

Figure 3. Fragment pattern and structure formula for Pentadecane . compound

Pentadecane with molecular formula $C_{15}H_{32}$ is one of the main components contained in the rhizome of white turmeric with levels of 47.53%. Pentadecane is a colorless liquid found in crude oil and is widely detected in marijuana smoke. Pentadecane is also commonly used as a pesticide (U.S. National Library of Medicine. 2008;

Sadiki& Poissant, 2008; Hale et al., 2010; Olulakin et al., 2015).

- Peak with mooring time (Retention Time) 11.162

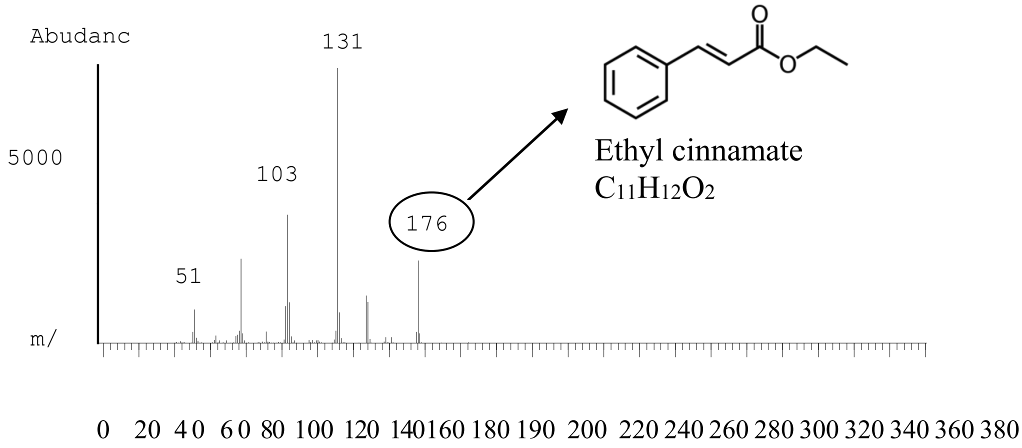

Figure 4. Fragment pattern and structural formula of Ethyl cinnamate . compound

Ethyl cinnamate with molecular formula $C_{11}H_{12}O_2$ is one of the main components in the white turmeric rhizome with a level of 48.57%. Ethyl cinnamate has a fruity and balsamic aroma and a clear, sweet taste. Ethyl cinnamate is commonly used as a food flavoring, cosmetic mixture and thickening agent (Lee. 2012; Surburg & Panten, 2016; Stefaniak et al., 2021; Buljeta et al., 2021).

IV. CONCLUSION

The essential oil content between the rhizome and white turmeric tubers is different. The part of white turmeric that has the highest oil content is the rhizome, which is 0.2969%, while the tuber is only around 0.0720%. The volatile oil components between rhizome and white turmeric tubers by GC – MS have differences. The highest volatile oil components are found in the rhizome of white turmeric tubers, which are 33 components and there are 4 main component compounds, namely Bornyl acetate (64.81%), Champhene (35.07%), Pentadecane (47.53%) and ethyl cinnamate (48.57%). While the tuber only shows 28 components and there are 3 main component compounds, namely Bornyl acetate (62.36%), Hexadecane (45.53%) and Ethyl cinnamate (24.90%).

D. Recommendation

Recommendation that can be given include a) it is necessary to do further research on the isolation of the single active ingredient component of white turmeric essential oil and b) further research is needed to identify the components and levels of essential oil with different harvest ages of white turmeric.

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