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Component Analysis of White Ginger (*Zingiber officinale* Roscoe) Extract and Red Ginger (*Zingiber officinale* Rubra) Extract

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ABSTRACT

Ginger is believed to be a multifunctional medicinal plant that can be used for the treatment of various diseases. Ginger contains large quantities of essential oils, hence, it is possible to use it for pharmacological purposes. Ginger has two varieties, white ginger and red ginger. Essential oils are widely used in aromatherapy as a complementary therapy. The aim of this research was to analyze the differences of chemical content in extracts of white ginger and red ginger. Samples of white ginger and red ginger were extracted by using a Soxhlet extractor with n-hexane as a solvent. Extracts were further analyzed by gas chromatography mass spectrometry. Samples of white ginger and red ginger were obtained at yields of 1.26% and 1.32% respectively. Content of linalool, borneol, zingiberene, and zingerone were significant difference which are higher in red ginger than in white ginger.

***Keywords*:** Component Analysis, White Ginger, Red Ginger, Extract.

Introduction

Indonesia has a wealth of biological resources. Various types of plants in this country have the potential to be used as therapeutic agents, and many have already been developed into modern medicine.[1] One of these potential resources is the ginger plant, which is believed to be a multifunctional medicinal plant that can be used for the treatment of various diseases. Ginger contains large quantities of essential oils, which means that it has potential for pharmacological use.[2]

The characteristics of essential oils are; easily evaporated at room temperature, have a bitter taste, pleasant smell according to the aroma of the plant that produces them, and are generally soluble in organic solvents.[3] In a fresh and pure state, essential oils are generally colourless. Essential oils are produced from certain plant parts such as the roots, stems, bark, leaves, flowers, or seeds.[4]

Today, essential oil-producing plants are widely used in aromatherapy as a complementary therapy. These oils have certain chemical components, which in principle, provide specific functions for plants.[5] Essential oils are widely needed in various industries, such as in the cosmetic industry for soap, toothpaste, shampoo, lotion and perfume; in the food industry as a flavoring or flavor enhancer; in the pharmaceutical or drug industry for anti-pain, anti-infection, and anti-bacterial use; they can even be used as insecticides.[6]

Terpenes contain single bonds and double bonds. Terpenes have a less fragrant aroma, are difficult to dissolve in diluted alcohol, and if stored for a long time will form resins. The oxygenated hydrocarbon group is an important compound in essential oils because they generally have a more fragrant aroma. Essential oils are one of the end products of secondary metabolic processes in plants.

Plants that produce essential oils include the Pinaceae, Labiatae, Compositae, Lauraceae, Myrtaceae, rutaceae, Piperaceae, Zingiberaceae, Umbelliferae and Gramineae families. Essential oils are found in every part of the plant, namely in the leaves, flowers, fruit, seeds, stems, bark, roots and rhizomes.[7]

Essential oils are very useful in various sectors due to their high economic value, especially in the industry such as the pharmaceutical sector. They even have been shown to have a calming effect which in turn can be used in mental health treatments. Some essential oils, in addition to providing a pleasant fragrance, can also help digestion by stimulating the nervous system. The aroma of the oils mimic the smell and taste of food which increases the secretion of gastric juices. In the cosmetics sector, essential oils such as patchouli oil, vetiver oil and sandalwood oil function as fixatives in perfumes. Essential oils derived from spices, such as pepper oil, cinnamon oil, ginger oil, clove oil, and coriander oil, are generally used as flavoring agents in food and beverages. As mentioned before, essential oils can be added to food in order to enhance its aroma and taste. Based on the description above, the researchers were interested in conducting research which would benefit all of these areas related to the use of essential oils.[8] The aim of this study was to analyze the differences of chemical content in extracts of white ginger and red ginger.

Materials and Methods

Plant collection

Samples of white ginger and red ginger were obtained from farmers in Bantan Subdistrict, Medan Tembung District, Medan City, North Sumatra Province, Republic of Indonesia, on 14th May 2018. The samples collected were authenticated at the Medanese Herbarium, Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Sumatera Utara, Padang Bulan Subdistrict, Medan Baru District, Medan City, North Sumatra Province, Republic of Indonesia; the voucher number of authentication of the samples were 1822/MEDA/2018 for white ginger and 1823/MEDA/2018 for red ginger.

Preparation of extract

The method used in this research for extract preparation was a slightly modified form of the Saptarini and Wardati 2020 method. Extracts were made using a Soxhlet extractor with n-hexane as a solvent (500 g of dried and powdered sample with 1000 mL of n-hexane), continuously heated at 69°C until the solvent becomes

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clear which indicated that the extraction process has been completed. The aqueous extract obtained was then concentrated with a rotary evaporator at 69°C to obtained the volatile oil. The percentage yield of the volatile oil obtained was calculated using the Equation below.[9]

$$\text{Percentage Yield } = \frac{\text{Weight of Extract Obtained}}{\text{Weigh of Sample}} \times 100\% \text{ ---------- (1)}$$

Analysis of Volatile Oil Component by Gas Chromatography Mass Spectrometry

The method used in this research for volatile oil component by gas chromatography mass spectrometry was a slightly modified form of the dos Santos Niculau *et al* method. Determination of the volatile oil components was carried out by using a set of gas chromatography mass spectrometry tools. A capillary column with nonpolar stationary phase was used, then a capillary column type Agilent 19091S-433 HP-5MS. Next a Phenyl Methyl Silox stationary phase with a column temperature of 325°C, and a length of 29.81 m and diameter of 250 m and particle size of 0.25 m. Helium was used as a carrier gas with a flow rate of 15 mL/min. The initial temperature of the programmed column (Temperature programming) was adjusted for 4 minutes, then slowly increased at 10°C/minute increments to a temperature of 299°C for 29,633 minutes. Finally, a Mass Spectrometer was used as the detector.[10]

Results and Discussion

The samples of white ginger before drying weighed 10.09 kg, and after drying the weight was 3.98 kg. The samples of red ginger before drying weighed 10.01 kg, and after drying the obtained weight was 4.10 kg. Extraction of samples of dried white ginger and dried red ginger were carried out by the Soxhlet method. The n-hexane extract obtained was weighed and the yield of the extraction was calculated for both the wet and dry samples. The samples used were half of dried ginger and dried red ginger. The calculation of extract yields for wet samples and dry samples can be seen in Table 1.

High yields of extract correlate to high phytochemical compounds in the extract.[11] The extract obtained was analysed by gas chromatography to determine the composition of the content in both the white ginger and red ginger extracts. Figure 1 shows the chromatogram of the white ginger extract analysis by gas chromatography-mass spectrometry, while figure 2 shows the chromatogram of the red ginger extract. Table 2 shows the constituents analysis of extracts of white ginger and red ginger by gas chromatography-mass spectrometry.

The results of the analysis of essential oils from white ginger extract and red ginger extract revealed that the main components were linalool, borneol, zingiberene, and zingerone.[12] Zingerone, which is contained in high quantities in ginger extract, contributes to providing various pharmacological effects, namely: as an antidiabetic, antidiarrheal, antivirus, antioxidant, and anti –inflammatory agent.[13,14] Zingiberene, which is the second largest amount of essential oil contained in ginger extract, contributes to various pharmacological effects, namely as an anti-hyperlipidemia and anti-inflammatory agent.[15] Linalool and borneol, which are the third and fourth largest amounts of essential oil in ginger extract, contribute to sleep regulation.[16,17]

Based on the results of the research above, it can be seen that there are very significant differences in the content of linalool, borneol, zingiberene, and zingerone between red and white ginger. Red ginger extract contains much greater linalool, borneol, zingiberene, and zingerone than white ginger extract. This shows that red ginger extract has much more potential as a pharmacology agent than white ginger extract.[18]

Table 1: Extract yields for wet samples and dry samples

N-Hexane Extract	Extract Weight (g)	Yield Based on Wet Sample(%)	Yield Based on Dry Sample (%)
White Ginger	50.04	0.50	1.26
Red Ginger	54.15	0.54	1.32

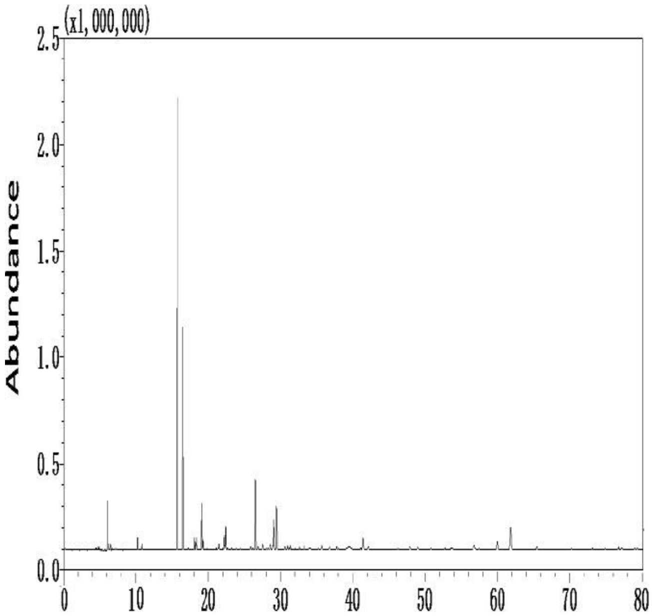

Figure 1: Chromatogram of the white ginger extract analysis by gas chromatography-mass spectrometry

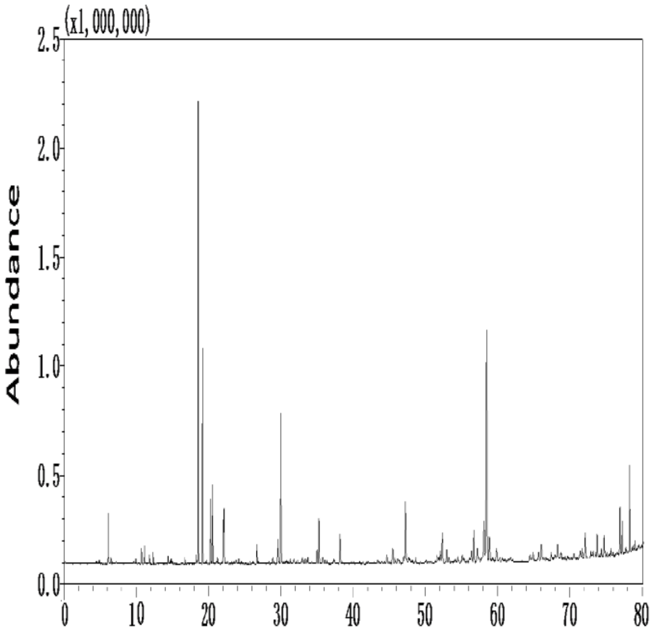

Figure 2: Chromatogram of the white ginger extract analysis by gas chromatography-mass spectrometry

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Tabel 2: Constituent analysis of extracts of white ginger and red ginger by gas chromatography-mass spectrometry

No.	Compound	Component White Ginger (%)	Component Red Ginger (%)
1.	Alpha-Pinene	2.34	2.45
2.	Camphene	3.46	3.42
3.	Beta-myrcene	2.67	3.08
4.	Beta-Phellandrene	2.89	3.04
5.	Octanal	3.67	3.51
6.	Linalool	2.67	5.66
7.	Borneol	3.42	7.64
8.	Citral	4.54	4.32
9.	Isobornyl Acetate	2.34	2.41
10.	Geranyl Acetate	3.48	3.44
11.	Zingiberene	5.67	9.87
12.	Alpha-farnesene	3.45	3.69
13.	Beta-farnesene	2.64	2.74
14.	Isocaryophyllen	3.64	3.53
15.	Beta-bisabolene	4.54	4.29
16.	Carene	2.34	2.17
17.	Elemol	2.39	2.55
18.	Nerolidol	3.84	4.07
19.	Zingerone	5.97	10.67
20.	Cis-Carveol	2.94	3.15
21.	Geranyl butyrate	3.17	3.27
22.	Surfynol	2.58	2.39

Conclusion

Findings from this study has shown that the content of linalool, borneol, zingiberene, and zingerone were significant different in the two gingers. The components were higher in red ginger than in white ginger.

Conflict of Interest

The authors declare no conflict of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

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