Study of Bioactive Content in Liberica Ground Coffee *(Coffea liberica* Var*.)* and Bajakah Tampala Roots *(Spatholobus littoralis* Hassk*)* Growing in Peatland Using GC-MS

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Abstract

Liberica coffee (Coffee liberica Var.) is known as a typical peatland coffee because of its ability to adapt to peat soils compared to other types of coffee. The bajakah tampala plant (Spatholobus littoralis Hassk*) is a plant from the genus Spatholobus. The roots of the bajakah tampala are used empirically as medicine by the Dayak community. Based on hereditary experience, boiled water from bajakah tampala root can be used as a medicine for stomach pain, diarrhea, and dysentery. This plant contains phenolics, flavonoids, tannins and saponins so bajakah tampala can be used as herbal medicine. Until now, the active compound content of the combination of Liberica coffee and bajakah tampala root is unknown. Thus, this research aims to determine the bioactive content of Liberica coffee and bajakah tampala roots. This research was conducted using two factorials, Randomized Complete Block Design (RCBD), where Factor 1, consists of Liberica coffee powder concentrations, and Factor 2 consists of bajakah tampala powder concentrations. Each factor had 3 levels. Bajakah tampala roots were sorted, washed, cut into small pieces, oven-dried at 50°C for 6 hours, ground, sieved using an 80 mesh, then weighed and ready to be used as an herbal coffee additive. Bajakah tampala was oven-dried at 50°C for 6 hours, ground, sifted, then mixed with Liberica coffee powder according to treatment groups (L1, L2, L3 and B1, B2, B3) for 9 combination treatments with 3 repetitions. Analysis of bioactive compounds in this research was determined using GC-MS. The analysis results show that 8 main components seen based on retention time, namely caffeine, hexadecanoic acid, palmitic acid, hexadecanoic acid, ethyl ester, octadec-9-enoic acid, octadecanoic acid, stearic acid, octadeca-9,12-dienoic acid methyl, 9,12-octadecadienoic acid (Z, Z)-Lino and ethyl linoleate. It is recommended that further research be carried out regarding the bioactive content of Liberica and bajakah coffee as herbal medicine.*

Keywords: *bioactive compounds; central kalimantan; GC-MS; liberica coffee; bajakah tampala root*

1. INTRODUCTION

Liberica coffee (*Coffea liberica* Var.) is a coffee plant originating from Liberia and West Africa. It can grow up to 9 meters high, which is suitable for growing on peatlands. Liberica coffee is a typical peat coffee because it can adapt to peat soil more than other types of coffee (Hulupi, 2014). The coffee has a distinctive jackfruit taste, which is called jackfruit coffee in some areas. This coffee has begun to be developed in the Central Kalimantan area.

Coffee beans contain 10 to 15% oil composed of many acid compounds, such as palmitic, linoleic, and stearic acids. Coffee also contains nicotinic acid, pyrogallic acid, trigonelline, and caffeine. It also contains minerals such as chromium and magnesium and is an important source of polyphenols, including ferulic acid, caffeic acid, coumaric acid, chlorogenic acid, and cinnamic acid (Hecimovic et al., 2011).

Based on the data from Statistics Indonesia of Central Kalimantan Province (2021), the area of coffee plantations reached 2,600 hectares, and production reached 405 tons. Liberica coffee production in Central Kalimantan is precisely grown in West Kotawaringin Regency, whose capital is Pangkalan Bun, spans in the equatorial area between 1°19'- 3° 36' South Latitude, 110° 25' to 112° 50' East Longitude. With an altitude of 900 m asl, the average rainfall is 3000 mm/year, and the air temperature ranges from 23.1°C to 24.2°C.

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The quality of coffee depends on coffee varieties and proper post-harvest handling processes such as drying, roasting, brewing, and storage conditions. Proper post-harvest handling in each process can improve coffee quality (Yusdiali, 2008), identified in terms of taste, aroma, and flavor. These three factors are characteristics that influence the quality of coffee.

Consuming too much coffee will cause stomachache, so it is not good for people with stomach ulcers. In this case, it is necessary to add additional ingredients so that coffee drinkers can enjoy every day without worrying about the side effects. Bajakah tampala (*Spatholobus littoralis* Hassk) is a suitable additional ingredient because it contains antioxidants to ward off free radicals. Besides, bajakah tampala is also believed by the Dayak tribe to cure various diseases (Astuti et al., 2014).

Bajakah tampala is a plant from the genus Spatholobus, which is widespread and cultivated in many areas of Asia. The roots of the bajakah tampala are used empirically as medicine by the Dayak people of Central Kalimantan. Based on the experience passed down from generation to generation by Dayak people, boiled water from bajakah tampala roots can be used as a medicine for stomachaches, diarrhea, and dysentery. This plant root contains phenolics, flavonoids, tannins, and saponins so bajakah tampala can be used as an herbal medicine (Mochammad et al., 2019).

Bajaka tampala contains phenolic compounds that have antioxidant activity, it can ward off free radicals in the body, apart from that, antioxidants also play a role in healing degenerative diseases such as diabetes, liver damage, inflammation, cancer, and cardiovascular and nervous disorders. Although bajakah tampala is often used as herbal medicine by boiling it, its use by mixing it into food or drinks has not been used by the public. So, if bajakah tampala is used by combining it with brewed coffee, it will increase people's interest in consuming bajakah tampala without worrying about the bitter taste. Considering the importance of phenolic compounds in the realm of medicine, it is necessary to determine the total phenolic content contained in bajakah tampala so that bajakah tampala can be better utilized for its medicinal properties (Ayuchecaria et al., 2020).

While processing coffee with bajakah tampala powder, some components must be maintained. The chemical elements in bajakah tampala are susceptible to high temperatures, so during the drying process, attention must be paid to the temperature. Apart from that, the problem in making herbal coffee is that bajakah tampala can affect the taste of the coffee itself, so proper treatment and handling are required to get benefits. It can be maintained without affecting the quality of the coffee (Sianipar, 2017). Until now, the active compound content of the combination of Liberica coffee and bajakah tampala roots are not yet known, therefore research needs to be carried out on the bioactive content contained in Liberica coffee and bajakah tampala roots. This research aims to determine the bioactive components contained in the formulation of Liberia coffee and bajakah tampala, which are grown on peatlands in Central Kalimantan.

2. MATERIAL AND METHODS

2.1 Material and Tools

The ingredients used in this product were Liberia coffee, bajakah tampala powder, granulated sugar, and water. The bajakah tampala powder is originated from Mantaren Village, Pulang Pisau Regency, Central Kalimantan. Meanwhile, the materials used for analysis were chloroform, ammonia, sulfuric acid, hydrochloric acid, ethanol, H_2O_2 solution, HCl solution, NaOH, distilled water, and Na_2CO_3.

The tools used in this product were porcelain cups, glasses, thermometers, 80 mesh sieves, filters, aluminum foil, knives, trays, cutting boards, ovens, blenders, basins, scales, dropper pipettes, burettes, spoons, Erlenmeyer, volumetric flask, and GC-MS.

2.2. Research Design

This research was conducted using a factorial Randomized Complete Block Design (RCBD). Factor 1 was the concentration of Liberica coffee powder consisting of 3 levels, and factor 2 was the concentration of bajakah tampala powder consisting of 3 levels. The experiment was carried out with 9 treatment combinations with 3 repetitions so that 27 experimental samples were obtained. The following is a comparison of Liberica coffee powder and ajakah tampala coffee powder. Factor 1

concentration of Liberica coffee grounds (L) consists of several levels, namely L1 = 80%, L2 = 70%, and L3 = 60%. Factor 2, the concentration of bajakah tampala powder (B) consists of several levels, namely B1 = 0%, B2 = 6%, and B3 = 12%.

2.1.1 Sample Analysis

About 1000 grams of bajakah tampala was sorted, washed, and cut into small pieces. The pieces were then oven-dried at 50°C for 6 hours. Once dried, the bajakah tampala was ground using a blender and sieved with an 80-mesh sieve to obtain finer powder. The bajakah powder was weighed and set aside for use as an additional ingredient in herbal coffee. Additionally, 800 grams of Liberica coffee was sorted, washed, oven-dried at 50°C for 6 hours, ground, and sieved using an 80-mesh sieve. Liberica coffee powder and bajakah powder were then mixed and weighed according to the treatment groups of coffee powder (L1, L2, L3) and bajakah tampala powder (B1, B2, B3) for 9 combination treatments and 3 repetitions.

Analysis of bioactive compounds in this research can be determined using GC-MS. GC-MS is a tool that consists of two instruments, namely gas chromatography and mass spectroscopy (GC-MS). This tool detects types of compounds based on their fragmentation patterns (Cazes, 2001). Coffee samples with the addition of bajakah were then analyzed for bioactive compounds using a Shimadzu QP 2010 SE brand GC-MS with an RTX5Ms semipolar column with a length of 30m. Helium gas is used as the mobile phase with a column temperature of 80°-250° C, using a split injection ratio of 51:0. Column temperature settings start at 40° C, hold time for 5 minutes, rate 30 ml/minute, and final temperature 250° C. Analysis was carried out at a pressure of 149.6 kPa with a total flow of 147 ml/minute, column flow 2.77 ml/minute with a linear velocity of 60/sec. The results of the analysis of compounds detected in bajakah and leaves were obtained by observing the relative area of each peak in the chromatogram and detecting the compounds using a similarity index according to the retention time of each peak with the names of compounds contained in the Wiley 7.0 library on the instrument

3. RESULTS AND DISCUSSION

Bioactive Content in Coffee Treatment 85% and Bajakah 7.5%

The results of the GC-MS chromatogram screening of coffee in the K_1B_2 treatment (coffee 85% and bajakah 7.5%) can be seen in Figure 1. In the analysis of bioactive components in the K_1B_2 treatment (coffee 85% and bajakah 7.5%), 15 compounds were obtained. The results of this analysis, 9 main components were obtained based on peak and content, namely ethanol, ethyl alcohol, caffeine, hexadecanoic acid, palmitic acid, octadec-9-enoic acid, octadecanoic acid, stearic acid, octadecanoic acid, ethyl ester, octadeca- 9,12-dienoic acid methyl, 9,12-octadecadienoic acid. The concentration of volatile components from the extraction results analyzed based on GC-MS can be seen in Table 1.

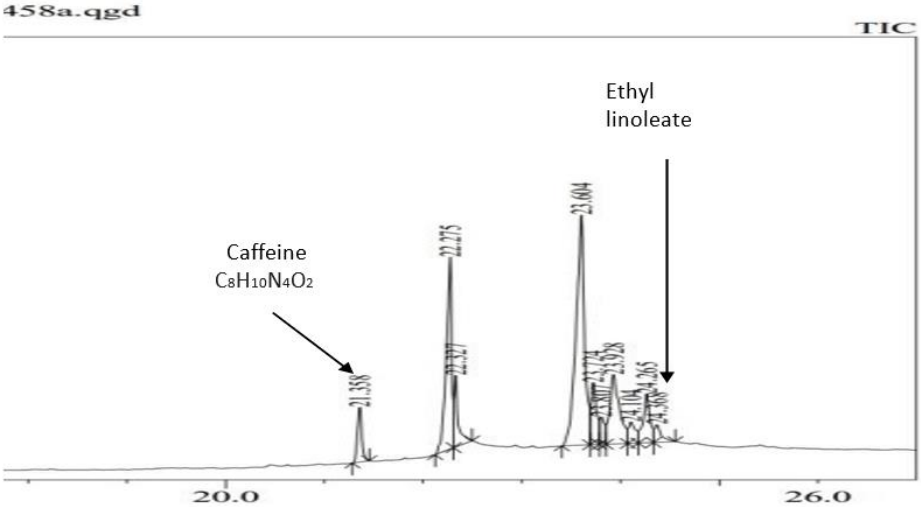

Figure 1. GC Chromatogram in K_1B_2 Treatment

Table 1. Concentration of Bioactive Compounds Result of GC-MS Analysis in Coffee Treatment 85% and Bajakah 7.5%

No	Molecular Formula	Compound	Molecular weight (g/mol)	Concentration %
1.	C_2H_6O	Ethanol ethyl alcohol	46.07	1.626
2.	$C_8H_{10}N_4O_2$	Caffeine	194.19	15.018
3.	$C_{16}H_{32}O_2$	Hexadecanoic acid	256.4	21.959
4.	$C_{18}H_{34}O_2$	Octadec-9-enoic acid	282.47	36.467
5.	$C_{18}H_{36}O_2$	Octadecanoic acidstearic acid	284.48	4.34
6.	$C_{20}H_{40}O_2$	Octadecanoic acid, ethylester ethyl	312.53	0.982
7.	$C_{19}H_{34}O_2$	Octadeca-9,12-dienoicacid methyl	294	16.395
8.	$C_{18}H_{32}O_2$	9,12-octadecadienoic acid	280.4	1.699
9.	$C_{20}H_{36}O_2$	Ethyl linoleate	308.5	1.513

Based on the results of the GCMS analysis in Table 1, it is known that the bioactive components contained in the L_1B_2 treatment (coffee 85% and bajakah 7.5%) are ethanol ethyl alcohol content of 1.626%, the caffeine content of 15.018%, hexadecenoic acid, palmitic acid levels are 21.959%, octadec-9-enoic acid levels are 36.467%, octadecanoic acid, stearic acid 4.340%, octadecanoic acid, ethyl ester levels are 0.982%, octadeca-9,12-dienoic acid methyl levels are 16.395%, 9,12-octadecadienoic acid levels are 1.699% and ethyl linoleate levels are 1.513%.

Ethanol

Ethanol is one of the main compound components in the GCMS results of coffee in the K_1B_2 treatment. The molecular formula of this compound is C_2H_6O, with a molecular weight of 46.07 g/mol and produces a concentration of 1.626%. Ethanol is currently widely used as an ingredient in making cosmetics, medicines, synthetic rubber, and as fuel. Moreover, ethanol ethyl alcohol is also used as an organic solvent (Sebayar, 2006)

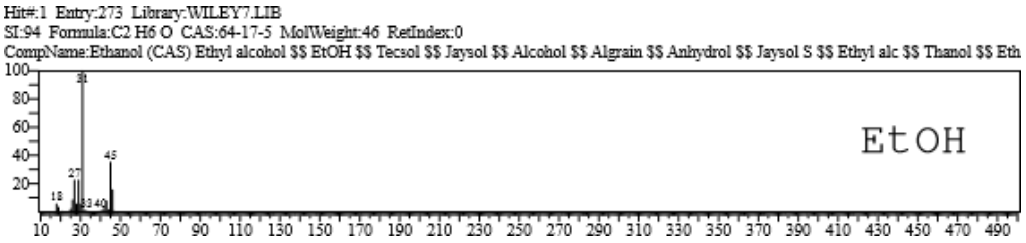

Figure 2. Results of the identification of bioactive compounds using GC-MS - Ethanol

Caffeine

Caffeine is one of the main compound components in the GCMS results of coffee in the K_1B_2 treatment. The molecular formula of this compound is $C_8H_{10}N_4O_2$, with a molecular weight of 194.19 g/mol and produces a concentration of 15.018%. The caffeine compound is one of the highest compounds in coffee, which can have a positive impact. Coffee is used to increase lung capacity in people with bronchial asthma. Caffeine has clinically beneficial pharmacological effects such as stimulating the central nervous system, muscle relaxation, and heart muscle stimulation (Rahayu et al., 2007).

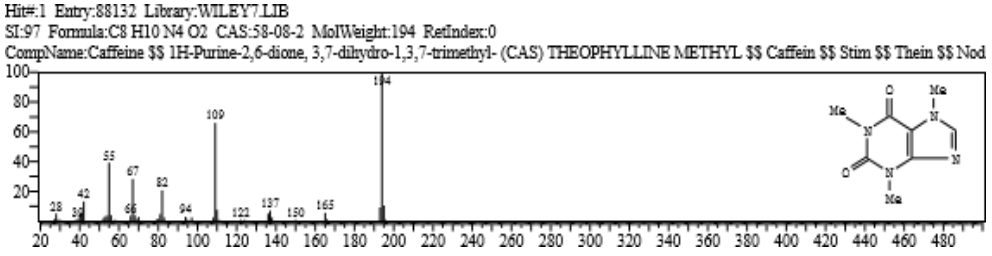

Figure 3. Results of the identification of bioactive compounds using GC-MS - Caffeine

Hexadecenoic Acid

Hexadecenoic acid is one of the main compound components in the GCMS results of coffee in the K_1B_2 treatment. The molecular formula of this compound is $C_{16}H_{32}O_2$, with a molecular weight of 256.4 g/mol and producing a concentration of 21.959%. Hexadecenoic acid or palmitic acid has important benefits for the body, namely that it can improve the blood fat profile by increasing HDL levels in the blood (Yuhana, 2019)

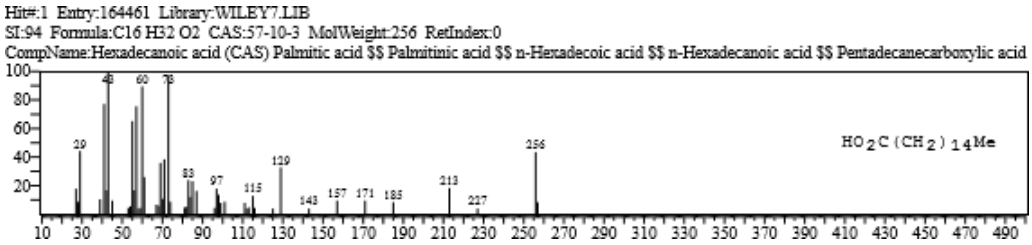

Figure 4. Results of the identification of bioactive compounds using GC-MS - Hexadecenoic Acid

Octadec-9-Enoic Acid

Octadec-9-enoic acid is one of the main compound components in the GCMS results of coffee in the K_1B_2 treatment. The molecular formula of this compound is $C_{18}H_{34}O_2$, with a molecular weight of 282.47 g/mol and produces a concentration of 36.467%. Octadec-9-enoic acid or oleic acid is an omega-9 unsaturated fatty acid and a natural component of fat that comes from either vegetable oils or animal fats. Oleic acid can soften and moisturize the skin. Because of its properties, topical treatment with oleic acid has benefits and long-term effects on skin papilloma. The use of oleic acid as an enhancer, either alone or in combination, can increase the amount of active drug substances that penetrate the skin (Lotta et al., 2004).

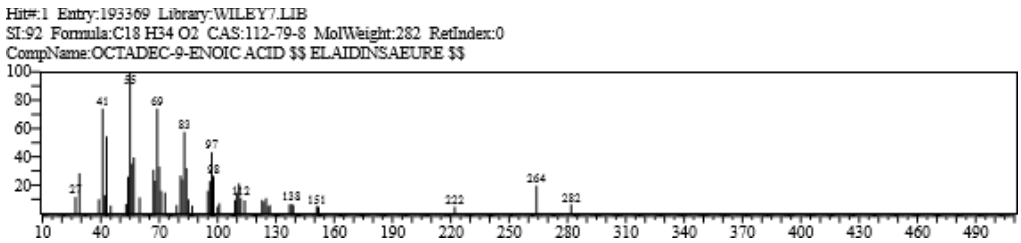

Figure 5. Results of the identification of bioactive compounds using GC-MS - Octadec-9-Enoic Acid

Octadecanoic Acid

Octadecanoic acid is one of the main compound components in the GCMS results of coffee in the K_1B_2 treatment. The molecular formula of this compound is $C_{18}H_{36}O_2$, with a molecular weight of 284.48 g/mol and produces a concentration of 4,340%. Octadecanoic acid (CAS) stearic acid functions as an ingredient in making candles, soap, plastics, and cosmetics. (Teoh et al., 2014).

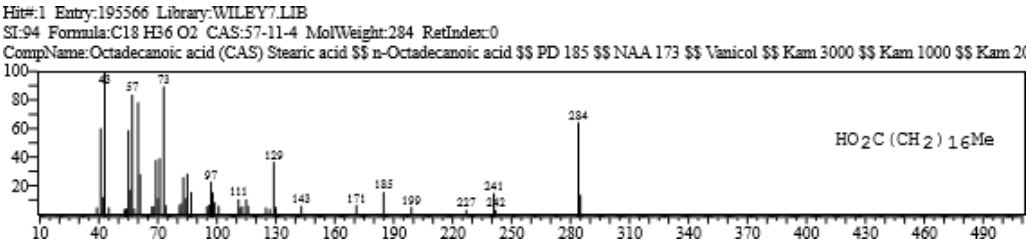

Figure 6. Results of the identification of bioactive compounds using GC-MS - Octadecanoic Acid

Octadecanoic Acid, Ethyl Ester

Octadecanoic acid and ethyl ester are among the main compound components in the GCMS results of coffee in the L_1B_2 treatment. The molecular formula of this compound is $C_{20}H_{40}O_2$, with a molecular weight of 312.53 g/mol and produces a concentration of 0.982%. Octadecanoic acid, ethyl ester (CAS) ethyl or acid arachidate is a saturated fatty acid with a 20-carbon chain. Arachidic acid itself functions as an enzyme and receptor that plays a role in the process of cell death and the stability of cell membrane fluid (Syahputra et al., 2014).

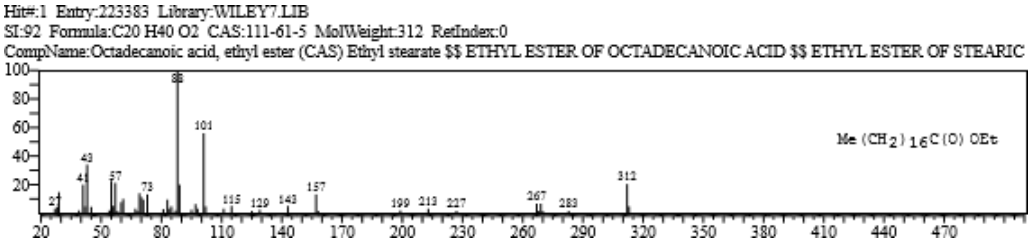

Figure 7. Results of the identification of bioactive compounds using GC-MS - Octadecanoic Acid, Ethyl

Octadeca-9,12-Dienoic Acid Methyl

Octadeca-9,12-dienoic acid methyl is one of the main compound components in the GCMS results of coffee in the L_1B_2 treatment. The molecular formula of this compound is $C_{19}H_{34}O_2$, with a molecular weight of 294 g/mol and produces a concentration of 16.395%. octadeca-9,12-dienoic acid methyl or sterculic acid is a fatty acid that also contains a cyclopropenoid group like malvalic acid. This compound also plays a role in the process of cell production, regulation of the nervous system, and strengthening of the cardiovascular system (Wahyuni et al., 2016).

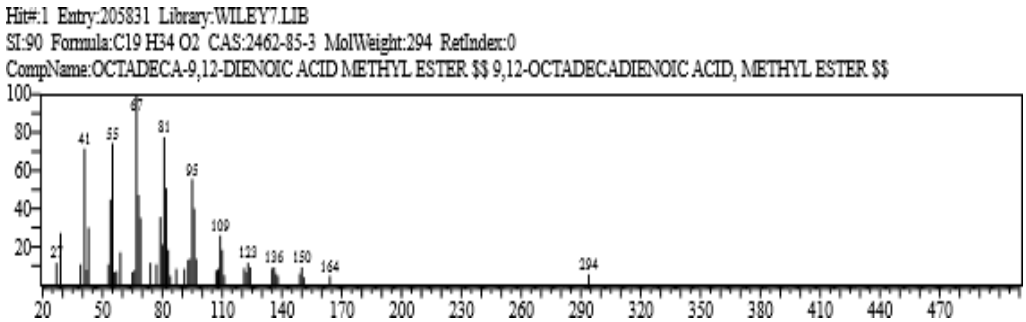

Figure 8. Results of the identification of bioactive compounds using GC-MS - Octadeca-9,12-Dienoic Acid Methyl

9,12-Octadecadienoic Acid

9,12-octadecadienoic acid is one of the main compound components in the GCMS results of coffee in the K_1B_2 treatment. The molecular formula of this compound is $C_{18}H_{32}O_2$, with a molecular weight of 294 g/mol and produces a concentration of 16.395%. 9,12-octadecadienoic acid or linoleic

acid is a long-chain unsaturated fatty acid and is classified as an essential fatty acid. Linoleic acid is very important for the body because it can help cure diseases such as dermatitis, decreased reproductive ability, growth disorders, liver degeneration, and osteoporosis against infection (Isa, 2011).

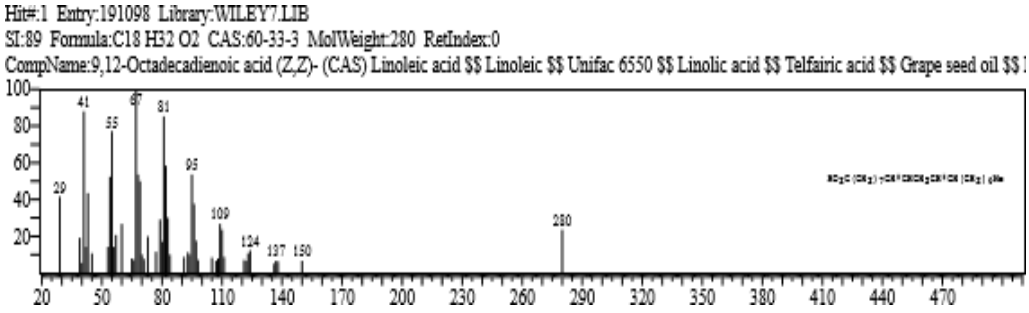

Figure 9. Results of the identification of bioactive compounds using GC-MS - 9,12-Octadecadienoic Acid

Ethyl Linoleate

Ethyl linoleate is one of the main compound components in the GCMS results of coffee in the K_1B_2 treatment. The molecular formula of this compound is $C_{20}H_{36}O_2$, with a molecular weight of 308.5 g/mol and produces a concentration of 1,513%. Ethyl linoleate functions as an antioxidant in the body by normalizing fat levels in the blood, which is used for treatment. Ethyl linoleate is an unsaturated fatty acid not synthesized by the body and is beneficial for health, especially in preventing heart disease (Sudaryatiningsih et al. 2009).

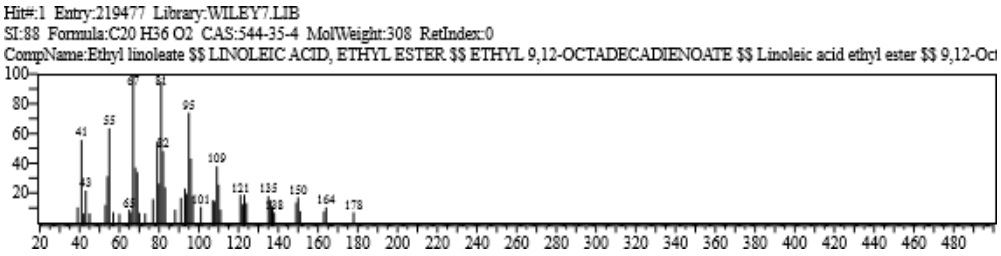

Figure 10. Ethyl Linoleate

4. CONCLUSIONS

The results of this analysis showed that 8 main components were seen based on peak, content, and biological activity, namely Ethanol with a molecular weight of 46.07 g/mol and a concentration of 1.626%, caffeine with a molecular weight of 194.19 g/mol and produces a concentration of 15.018%, Hexadecenoic acid with a molecular weight of 256.4 g/mol and produces a concentration of 21.959%, Octadecanoic acid with a molecular weight of 284.48 g/mol and produces a concentration of 4,340%, Octadecanoic acid, ethyl ester with a molecular weight of 312.53 g/mol and produces a concentration of 0.982%, Octadeca-9,12-dienoic acid methyl with a molecular weight of 294 g/mol and produces a concentration of 16.395% and Ethyl linoleate with a molecular weight of 308.5 g/mol and produces a concentration of 1,513%. It is recommended that further research be carried out regarding the bioactive content of Liberica and Bajakah coffee as herbal medicine.

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