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Identification of Chemical Compounds of *Ocimum basilicum* (L.) Essential Oil and *Cymbopogon nardus* (L.) Rendle Essential Oil Using Gas Chromatography- Mass Spectrophotometry (GC-MS)

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ABSTRACT
Essential oils are also commonly known as flying oils which can generally be obtain from roots, plant parts, bark, leaves, stems, seed fruits, and flower by steam distillation. The aim of the research is to determine the chemicals components of essential oils of basil (*Ocimum basilicum* L.) and citronella (*Cymbopogon nardus* (L.) Rendle) leaves obtained from farmers and processors in Karanganyar, Central Java. Essential oil composition was analysis use gas chromatographys-mass spectrophotometry (GC-MS) method. The finding explain namely chemical component of basil leaf essential oil show that the main component were Estragole (55.80%) and Linalool (22.35%), while in citronella essential oil show that the main component were Geraniol (26.49%), Citronellol (14.53%) and Citronellal (10.95%).

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1. INTRODUCTION

Indonesia is one of the countries in the world that has a wealth of essential oils from various aromatic plants (Muchtaridi & Moelyono., 2015). Therefore, it is important to preserve and maintain traditional knowledge and practices related to natural products such as essential oils (Bonita et al., 2023). Essential oil are also commonly know as volatile oils or fly oil. The definition written in the Encyclopedia of Chemical Technology states that essential oils are compounds that are generally in the form of liquids, which are obtain from plants part, skin, roots, leaves, stems, fruits, seeds and flower by distillationt with steam. Despite the fact that to obtain essential oils can also be obtained in other ways such as by extraction using organic solvents or by pressing or felts and enzymatically (Sastrohamidjojo, H., 2021).

Basil leaves (*Ocimum basilicum* L.) are plants from the genus Ocimum which are widely used by the community as essential oil producers (Silalahi, M., 2018). In traditional medice, L. has been use as an preservative, antiseptic, digestive regulator, sedative,diuretic (Unnithan *et al*., 2013). Citronella plant is also one of the plants that has many benefits and is know as Citronela oil (Kumala et al., 2019). One of the main compounds found in citronella oil is citronellal. If this compound has been isolated, its antibacterial properties can be utilized in various dosage forms. Because of the citronellal content, citronella oil has become a popular alternative for both household and medicinal purposes (Agustina & Jamilah., 2021). As not all essential oils have the same content, it is very important to first analyze the essential oil that will be used as the main ingredient of a formulation (Sari *et al*., 2023). One of methods to determine the main components contained in essential oils is by using *Gas Chromatography and Mass Spectrophotometry*. Analytic technique using Gas Chromatography and Mass Spectrophotometry combine the ability of gas-liquid chromatographys to separate compounds with the ability of mass spectrometres to identify various substance in a sample. GC-MS divides analytes for identification by mass, while GC separates volatile and thermally stable compounds in the sample (Chauhan., 2014). Essential oils are identified using GC-MS, because this technique allows the separation of complex components in essential oils and identification based on unique mass spectrum patterns. Therefore, this study aims to identify chemical compound in essential oils of basil and citronella leaves from Wonorejo Village Gondongerjo Karanganyar, Central Java using Gas Chromatography-Mass Spectrophotometry (GC-MS).

2. RESEARCH METHOD

The type of research used is experimental. Experimental research is research conducted to examine the content of essential oils. The materials used in this study were basil leaf essential oil and citronella essential oil taken directly from a distillery in Wonorejo Village, Gondangerjo Karanganyar, Central Java. The essential oils obtained were identified at the BRIN chemical laboratory in Serpong, South Tangerang, Banten using the GC-MS instrument method. The essential oil composition was identified using Gas Chromatography-Mass Spectrophotometry (GC-MS) Aligent 7890B (GC) and 5977A (MSD), with NIST 20 data base system. The mobile phase and stationary phase used in GC-MS were Agilent 19091S-433 type: 93.92873 DB-5MS UI 5% Phenyl Methyl Siloxane and injection volume of 1 mL.

3. RESULT AND DISCUSSION

Chemical Content of Esential Oil of Basil Leaves (*Ocimum basillicum* L.) was show in figure 1.

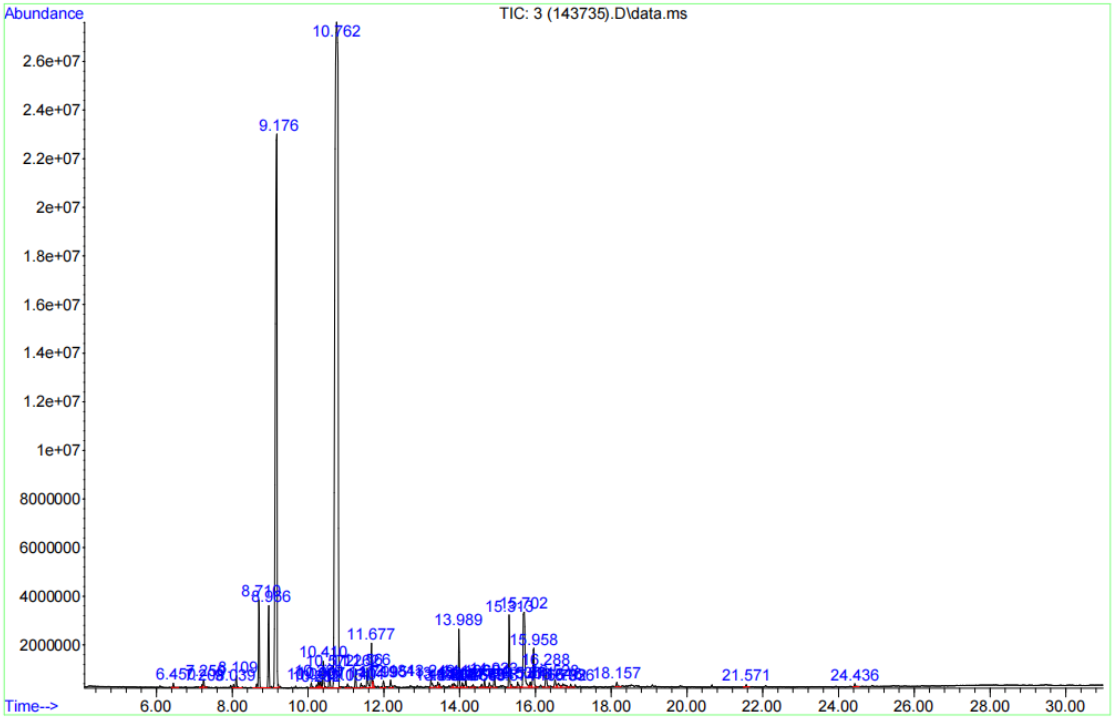

Figure 1. Chromatogram of Basil Leaves (*Ocimum basillicum* L.)

Based on the identification in figure 1, the esential oil of basil leave obtained from local distillation in Wonorejo Gondangrejo village, Karanganyar, Central Java, was identified as containing 50 compounds and 22 compound peaks that have a relatively large content (%) presented in Table 1, where there are 2 compounds that have the highest content marked in red, namely Estragole (55.80%) and Linalool (22.35%).

Table 1. Chemical Compounds of Basil Leaves (*Ocimum basillicum* L.)

No.	Peak	Retention Time (RT)	Area (%)	Compound	Qual
1	1	6.444	0.09	(1s)-2,6,6-Trimethlbicyclo[3.1.1]hept-2-ene	93
2	5	8.108	0.30	Eucalyptol	99
3	6	8.713	2.21	Ethyl 2-(5-methyl-5-vinyltetrahidrofuran-2-yl)propan-2-yl carbonate	91
4	7	8.965	1.91	trans-Linalool oxide (furanoid)	91
5	8	9.179	22.35	Linalool	97
6	11	10.275	0.21	(3R,6S)-2,2,6-Trimethyl-6-vinyltetrahidro-2H-pyran-3-ol	83
7	13	10.414	0.70	Levomenthol	91
8	15	10.767	55.80	Estragole	99
9	17	11.258	0.40	Neral	95
10	18	11.397	0.17	Geraniol	76
11	19	11.561	0.59	Benzaldehyde,4-methoxy-	97

No.	Peak	Retention Time (RT)	Area (%)	Compound	Qual
12	20	11.674	1.03	2,6-Octadienal,3,7-dimethyl-,(E)	97
13	22	11.989	0.26	Anethole	98
14	23	12.178	0.23	Benzene,1-methoxy-4-propyl-	87
15	24	13.250	0.33	5-Heptenal,2,6-dimethyl-	53
16	29	13.993	1.26	trans-.alpha.-Bergamotene	99
17	34	14.661	0.18	(E)-.beta.-Farnesene	97
18	36	14.926	0.27	.beta.-Bisabolene	55
19	37	15.317	1.62	1,3,7-Octatriene,3,7-dimethyl-	70
20	40	15.707	3.76	trans-4-Methoxycinnamaldehyde	99
21	42	15.959	1.36	Caryophyllene oxide	90
22	43	16.287	0.62	(1R,3E,7E,11R)-1,5,5,8-Tetramethyl-12-oxabicyclo[9.1.0]dodeca-3,7-diene	99

Essential Oil Association (EOA) no. 120 is a standard reference for the quality of basil leaf essential oil. According to EOA no. 120 shown in Table 2, basil leaf essential oil has a light yellow color shown in Figure 2. with a distinctive aroma of basil leaves, specific gravity 25ºC/25ºC 0.952-0.973, refractive index 25ºC 1.510-1.5165, optical rotation 0º-2º, solubility in 80% ethanol which is soluble 1:4, acid number max. 1, saponification number 4-10, ester number after 25-45.

Table 2. Comparison of Basil Leaf Essential Oil Examination Results and EOA No 120 Standards

No.	Parameters	Results	EOA No. 120
1	Color	Light yellow	Light yellow
2	Aroma	Characteristic of basil leaves	Characteristic of basil leaves
3	Solubility in 80% ethanol	Soluble	Soluble 1:4

Figure 2. Color of basil leaf essential oil (*Ocimum basilicum* L.)

Estragole and Linalool are the 2 main components in basil essential oil. The identification results in this study can also be supported by other studies which also found that the chemical content contained in the esential oil of basil leaves (L.) is Estragole (85%) and Linalool (12%) (Moura et al., 2021), while in the identification results of this study where the 2 highest compounds are Estragole (55.80%) and Linalool (22.35%). Although both results show the same compounds, namely Estragole and Linalool. There is a difference in the percentage of results obtained with the identification results using basil leaf essential oil samples taken from Brasilia, DF-Brazil with those taken from Karanganyar, Central Java-Indonesia. This difference can occur due to several factor such as soil altitude, type, temperatures, isolation periods, cultivations, dry and storages conditions so that it can affect its composition (Moura et al., 2021). Basil leaves contain compounds that are antibacterial and the antibacterial activity in basil leaves is due to the high content of estragole and linalool in essential oils (Salsabila & Izzaty., 2021). Basil leaf essential oil shows high antibacterial activity against gram-positive and negative bacteria, this is due to the main components, namely phenolic-estragole and monoterpenoid-linalool compounds. The presence of these components can enhance antibacterial activity by disrupting the permeability and integrity of the bacterial membrane, resulting in leakage of intracellular ATP and potassium ions and causing cell death (Zhakipbekov et al., 2024).

Chemical Content of Citronella Essensial Oil (*Cymbopogon nardus* (L.) Rendle) was show in figure 3.

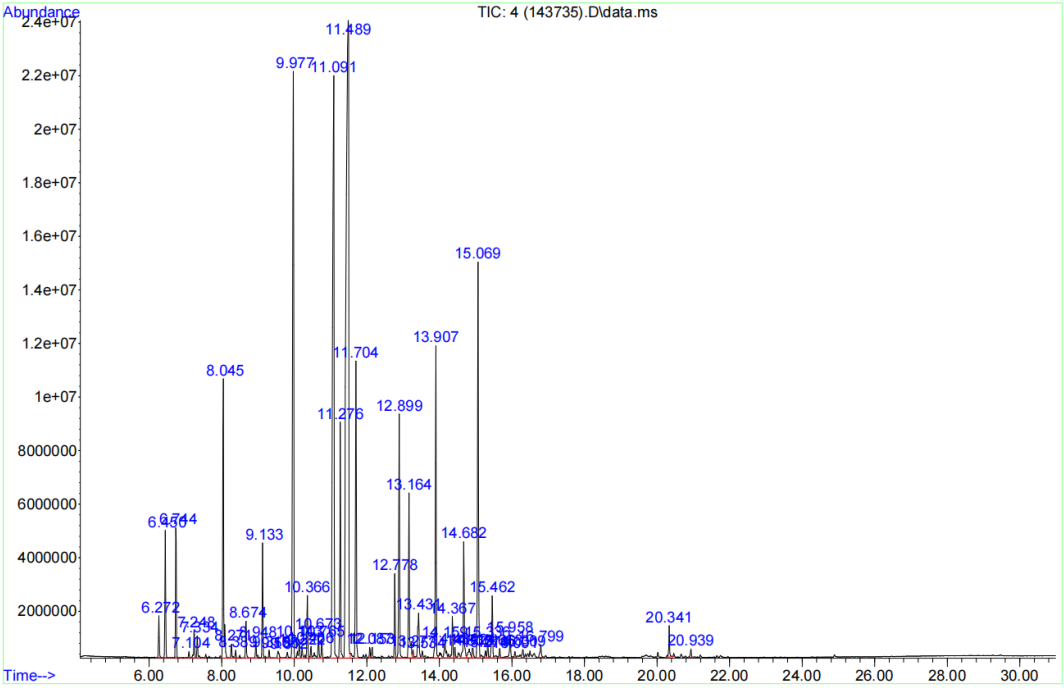

Figure 3. Chromatogram of Citronella Essential Oil (*Cymbopogon nardus* (L.) Rendle)

Based on the identification results using GC-MS, citronella essential oil obtained from local distillation in Wonorejo Village Gondangrejo Karanganyar, Central Java, was identified as containing 52 compounds and 41 compound peaks that have a relatively large content (%) presented in Table 3., where there are 3 compounds that have a fairly high content marked in red, namely Geraniol (26.49%), Sitronellol (14.53%), and Sitronellal (10.95%).

Table 3. Chemical Compounds of Citronella Essential Oil (*Cymbopogon nardus* (L.) Rendle)

No.	Peak	Retention Time (RT)	Area (%)	Compound	Qual
1	1	6.267	0.54	Tricyclo[2.2.1.0(2,6)]heptane,1,7,7-trimethyl-	96
2	2	6.456	1.91	Camphene	97
3	3	6.746	1.91	Camphene	97
4	4	7.099	0.08	Bicyclo[3.1.0]hexane,4-methylene-1-(1-methylethyl)-	95
5	5	7.250	0.42	5-Hepten-2-one,6-methyl-	81
6	6	7.339	0.32	.beta.-Myrcene	96
7	7	8.044	4.36	D-Limonene	98
8	8	8.271	0.23	.beta.-Ocimene	98
9	9	8.385	0.10	5-Heptenal,2,6-dimethyl-	93
10	10	8.675	0.58	4-Nonanone	94
11	11	8.952	0.24	(+)-4-Carene	98
12	12	9.128	1.38	Linalool	96
13	13	9.317	0.11	trans-Rose oxide	86
14	16	9.973	10.95	Citronellal	87
15	18	10.225	0.16	2-((3,3-Dimethyloxiran-2-yl)methyl)-3-methylfuran	96
16	19	10.363	0.90	endo-Borneol	94
17	20	10.464	0.17	Terpinen-4-ol	94
18	21	10.678	0.35	.alpha.-Terpineol	90
19	22	10.767	0.29	Decanal	90
20	23	11.094	14.53	Citronellol	98
21	24	11.271	3.32	Neral	95
22	25	11.485	26.49	Geraniol	96

No.	Peak	Retention Time (RT)	Area (%)	Compound	Qual
23	26	11.699	4.53	Citral	94
24	27	12.090	0.14	Geranyl formate	80
25	28	12.153	0.17	(R)-(+)-Citronellic acid	98
26	29	12.783	1.05	2,6-Octadiene,2,6-dimethyl-	98
27	30	12.897	3.51	Eugenol	98
28	31	13.161	2.48	Geranyl isobutyrate	91
29	32	13.275	0.12	.alpha.-Cubebene	64
30	33	13.426	1.06	Cyclohexane,1-ethenyl-1-methyl-2,4-bis(1-methylethenyl)-,[1S-(1.alpha.,2.beta.,4.beta.)]-	99
31	35	13.905	4.34	Caryophyllene	99
32	36	14.157	0.45	Phenol,2-methoxy-4-(1-propenyl)-	98
33	37	14.371	0.62	Humulene	97
34	38	14.343	0.17	cis-Muurola-4(15),5-diene	98
35	39	14.686	1.85	Germacrene	99
36	40	14.825	0.32	Zonarene	94
37	42	15.064	6.05	Naphthalena,1,2,3,4,4a,5,6,8a-octahydro-7-methyl-4-methylene-1-(1-methylethyl)-,(1.alpha.,4a.beta.,8a.alpha.)-	99
38	44	15.342	0.24	Naphthalena,1,2,4a,5,6,8a-hexahydro-4,7-dimethyl-1-(1-methylethyl)-,[1S-(1.alpha.,4a.alpha.,8a.alpha.)]-	99
39	45	15.468	1.00	Cyclohexanemetanol,4-ethenyl-.alpha.,.alpha.,4-trimethyl-3-(1-methylethenyl)-,[1R-(1.alpha.,3.alpha.,4.beta.)]-	95
40	47	15.959	0.50	Caryphyllene oxide	93
41	50	16.804	0.27	2-Naphthalenemetanol,1,2,3,4,4a,5,6,8a-octahydro-.alpha.,.alpha.,4a,8-tetramethyl-,[2R-(a.alpha.,4a.alpha.,8a.beta.)]-	96

SNI 06-3953-1995 is a special reference for citronella oil quality standards. Based on SNI 06-3953-1995 shown in Table 4, citronella oil has a pale yellow to brownish yellow color with a refractive index of 1.466 - 1.475, a total geraniol content of at least 85%, a citronellal content of at least 35%, and is easily soluble in 80% ethanol in a ratio of 1: 2, looks clear to slightly cloudy, there are no foreign objects such as oil / fat or added alcohol. Citronella oil must have a fresh odor, typical of kitchen Citronella oil, with an optical rotation of -(-6) and a flash point between 76°C - 85°C (Sulaswatty *et al*., 2019).

Table 4. Comparison of Citronella Essential Oil Examination Results and SNI 06-3953-1995 Standard

No.	Parameters	Results	SNI 06-3953-1995
1	Color	Pale yellow	Pale yellow to Brownishyellow
2	Aroma	Fresh, characteristic citronella oil	Fresh, characteristic citronella oil
3	Citronellal	10.95%	min. 35%
4	Geraniol	26.49%	min. 85%

Figure 4. Color of Citronella Essential Oil (*Cymbopogon nardus* (L.) Rendle)

Citronellol, Geraniol, and Citronellal are the 3 main component in citronella essential oil. The identification results in this study can also be supported by other studies which also found that the chemical content contained in citronella essential oil (*Cymbopogon nardus* (L.) Rendle) namely Citronellal (35.72%), Citronellol (15.09%),

and Geraniol (12.89%) (Kumala *et al.*, 2019). Although both results show the same compounds such as Geraniol, Citronellol, and Citronellal. There is a percentage difference in the results obtained with the identification results using lemongrass essential oil samples taken from Manoko - Lembang, Bandung with those taken from Karanganyar, Central Java. These differences can occur due to several factors related to the growth and development of these plants such as genetics, plant age, plant location or season of the plant location. Even so in this study there are differences in the identification results conducted by (Kumala et al., 2019), where the compounds with the highest percentage are Citronellal, Citronellol and Geraniol while the identification results of this study where the 3 highest compounds are Geraniol (26.49%), Citronellol (14.53%) and Citronellal (10.95%). These compounds have a very important role in the pharmaceutical raw materials industry, food industry, perfume raw materials and cosmetics. The compounds in citronella oil not only provide aromatics, but can also be antibacterial (Bota *et al*., 2015).

4. CONCLUSION

Based on the results obtained, *Ocimum basilicum* L. essential oil and *Cymbopogon nardus* (L.) Rendle essential oil obtained from local distillation in Wonorejo village Gondangrejo Karanganyar-Central Java, the dominant essential oil GC-MS results in basil leaf essential oil is Estragole and the dominant citronella essential oil compound is Geraniol. But in this case the percentage value of Geranio and Citronellal l in citronella essential oil has not met the SNI 06-3953-1995 standard, namely Citronellal min. 35% and Geraniol min. 85%. In this case, efforts need to be made to improving efforts of essential oils in order to increase added value.

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