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IDENTIFICATION OF THE CHEMICAL COMPOUNDS OF CITRUS HYSTRIX ESSENTIAL OIL, CANANGA ORDORATA ESSENTIAL OIL, AND POGOSTEMON CABLIN BENTH ESSENTIAL OIL USING GAS CHROMATOGRAPHY-MASS SPECTROPHOTOMETRY (GC-MS)

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ABSTRACT

Essential oils, commonly known as etheric oils (essential oil, volatile oil), are produced by plants and can be obtained from the roots, stems, leaves, and flowers of plants. This study aims to determine the chemical components of kaffir lime (Citrus hystix) essential oil, ylang ylang (Cananga ordorata), and patchouli oil (Pogostemon cablin benth) obtained from farmers and refiners in Lembang, West Java. The composition of this essential oil was analyzed using the gas chromatography–mass spectrometry (GC–MS) method. The results of the analysis of the chemical components of the essential oil constituents of kaffir lime showed that the main components included linalyl acetate (20.59%), D-limonene (17.77%), and linalool (15.19%). In ylang-ylang oil, bioactive compounds such as sesquiterpenes, namely caryophyllene, were found in as much as 14.36%, which has anti-inflammatory, anti-bacterial, and local anesthetic properties. Identification of patchouli oil with its main component, namely patchouli alcohol, at 19.27%.

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1. INTRODUCTION

Indonesia's plant diversity has great potential for essential oil production. There are 40 types of essential oils that can be produced in Indonesia, 13 of which have entered the global market (Arifin, 2018). These include patchouli, lemongrass, ginger, nutmeg, pepper, cloves, cinnamon, sandalwood, jasmine, vetiver, cubeb, ylang, and eucalyptus.

Essential oils, commonly known as etheric oils or flying oils (also called essential oil or volatile oil), are produced by plants and can be obtained from the roots, stems, leaves, or flowers of plants. The properties of essential oils are that they evaporate easily at room temperature without decomposing, have a pungent taste, smell good according to the smell of the plant, and are generally soluble in organic solvents and insoluble in water. Essential oils in the industry can be used as cosmetics, perfumes, antiseptics, medicines, and aromatherapy (Sriandila, 2020)

Essential oil is one of the export commodities with quite high yields. Essential oils are now getting more attention because they have many benefits, are relatively safe, and can be widely accepted by society. The benefits and natural activities of this essential oil are related to the chemical content in it. This component determines the commercial value as a raw material in the industry (Pujiarti et al., 2015).

Among the plants that produce essential oils are kaffir lime, ylang ylang, and patchouli. Parts of the leaves, fruit, and peel of oranges are widely used as basic ingredients for cosmetics, perfumes, and natural medicine, as well as preservatives. The number of active compounds contained in kaffir lime essential oil has been determined for their bioactivity. One of these is citronella, which is used as a repellent against mosquitoes, and limonene is used as an anti-termite (Noverita, Jayuska and Alimuddin, 2014).

Ylang-ylang essential oil has antibacterial properties because it contains caryophyllene. Caryophyllene is a sesquiterpene compound that has anti-inflammatory, antibacterial, and mosquito-repellent properties. In addition, ylang-ylang flower oil can be used in the pharmaceutical industry in the manufacture of medicines, the cosmetic industry as a fragrance ingredient, and as a mixture of food ingredients (Setia Budi et al., 2018).

Patchouli oil can be used in industry and health. In the industrial sector, patchouli oil functions as a cosmetic, soap ingredient, and perfume industry ingredient (Idris, Ramajura and Said, 2014), while in the pharmaceutical sector, patchouli oil is used as medicine. Patchouli oil can also be used as a traditional medicine that functions as a wound healer, fever reducer, and can remove scars (Kusuma and Mahfud, 2017).

Identification using GC-MS was used to determine the content of chemical compounds in kaffir lime essential oil, ylang essential oil, and patchouli essential oil. The advantages of the GC-MS method are the fast identification time, high sensitivity, good separation, and the fact that the tool can be used for a long time. Based on the above background, this essential oil analysis study was carried out, which aims to find out in more detail the chemical components contained therein.

2. RESEARCH METHOD

The materials used in this study were 3 types of essential oils obtained from farmers and refiners in Lembang, West Java, namely kaffir lime oil, ylang-ylang oil, and patchouli oil. The composition of essential oils was identified using gas chromatography-mass spectrometry (GC-MS) Aligent 7890B (GC) and 5977A (MSD). injection of 1 mL, with the stationary phase in the form of a polar compound and the mobile phase in the form of a non-polar compound, using helium gas (He) as the carrier gas.

3. RESULT AND DISCUSSION

Following are the Chemical Components of the Essential Oil of Jeruk Purut (Citrus hystrix D.C)

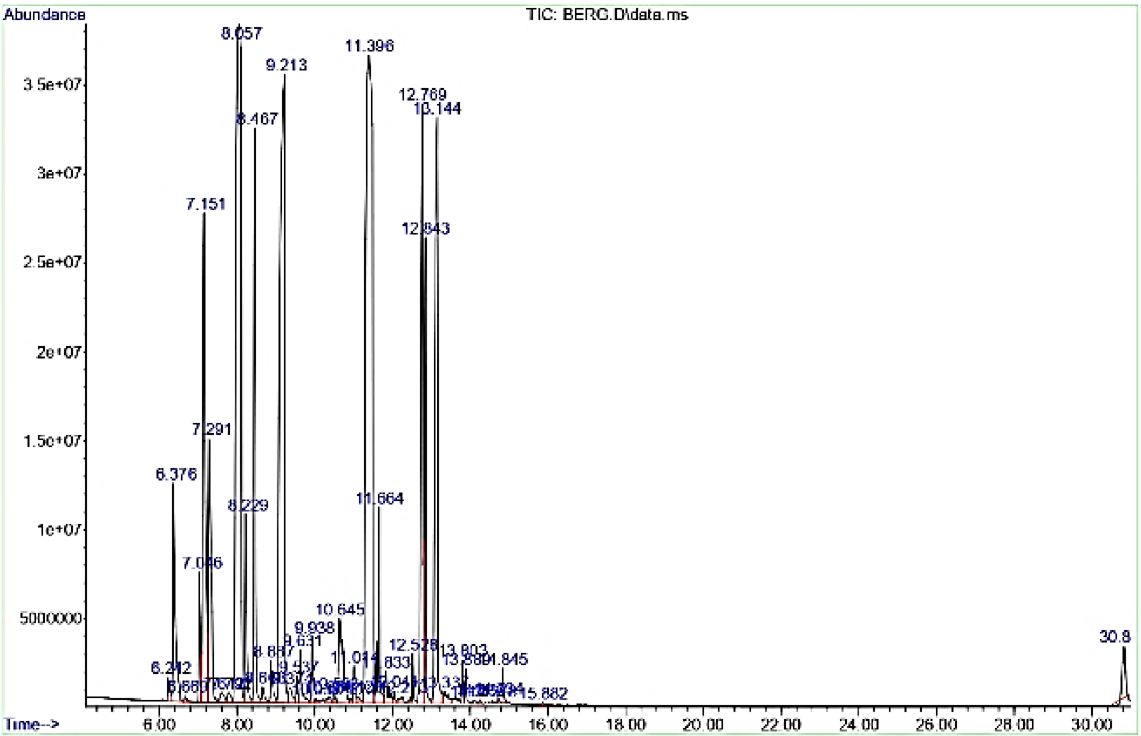

Fig- 1. GC-MS chromatogram of kaffir lime (*Citrus hystrix DC)*

Based on the results of identification with GC-MS, kaffir lime essential oil originating from West Java is known to show the presence of 44 identified components and 10 components with the highest peaks as shown in Figure 1, where five peaks are the dominant component, namely Linalyl acetate (20.59%), D-limonene (17.77%), Linalool (15.19%), Geranyl acetate (7.64%), 1,3-cyclohexadiene, and 1-methyl-4 alpha-terpinyl acetate (6.42%).

Table 1. Chemical components of kaffir lime

Peak	Retention Time (Rt)	Compound	Class of Components	Area (%)	Qual
1	6.242	Bicyclo [3.1.0] hex-2-ene,2 methyl-5-(1-methylethyl)	Monoterpen	0.24	89
2	6.381	(1S) 2,6,6-trimethylbicyclo [3.1.1] hept-2-ene	Monoterpen	2.47	96
3	6.671	Methylene Chloride	Klorometan	0.08	96
4	7.049	Bicyclo [3.1.0] hexane,4 methylene-1-(1-methylethyl)	Monoterpen	1.09	96
5	7.150	β-pinene	Monoterpen	5.96	94
6	7.288	β-Myrcene	Monoterpen	3.98	96
7	7.616	Cyclohexane,1methylene-4-(1 methylethenyl)-	Monoterpen	0.21	74
8	7.793	1,3-cyclohexadiene-1-methyl-4-(1-methyethyl)	Monoterpen	0.16	95
9	8.057	D-Limonene	Monoterpen	17.77	99
10	8.234	Beta.-ocimene	Monoterpen	1.47	97
11	8.473	γ-Terpinene	Monoterpen	4.44	95
12	8.662	cis-Linaloloxide	Monoterpen	0.21	38
13	8.889	Cyclohexane,1-methyl-4-(1-methylethylidene)-	Monoterpen	0.48	98
14	9.217	Linalool	Monoterpen	15.19	97
15	9.380	2-heptanone,6-methyl-,o- methyloxime	Monoterpen	0.28	35
16	9.532	2,4,6-Octatriene,2,6- (dimethyl-,E,Z)-	Monoterpen	0.18	98
17	9.633	1,2-Dihydrolinalool	Monoterpen	0.54	80
18	9.935	Camphor	Monoterpen	0.38	98
19	10.036	1-Menthone	Monoterpen	0.06	90
20	10.364	Methylene Chloride	Klorometan	0.13	55
21	10.502	Benzemethanol,alpha-methyl-acetat	Monoterpen	0.09	98
22	10.641	Alpha-terpineol	Monoterpen	1.90	90
23	10.981	1,2-Dihydropyridine	Monoterpen	0.04	45
24	11.019	Cyclohexanol,1-methyl-4-	Monoterpen	0.38	52
25	11.120	2,6-octadien-1-ol,3,7-dimethyl-(Z)-	Monoterpen	0.10	42
26	11.397	Linalyl acetat	Monoterpen	20.59	91
27	11.662	Citral	Monoterpen	1.48	97
28	11.838	Bicyclo[4.1.0]heptan-3ol,4,7,7 trimethyl-,[1R (1.alpha.,3.beta.,4.beta.,6.alpha) [1]	Monoterpen	0.47	87
29	12.040	Cyclohexanol,1-methyl-4-	Monoterpen	0.08	90

The dominant compounds in kaffir lime essential oil are linalyl acetate, D-limonene, and linalool, which belong to the group of monoterpenes. When viewed from their main components, compounds *Linalyl acetat is the* main compound contained in kaffir lime oil from this West Java distillery. *Lynalyl acetat was* identified at peak-26, retention time 11,397, with a percentage of 20.59%. D-limonene was identified at peak-9, at a retention time of 8,057 with a percentage of 17.77%, while linalool was identified at peak-14, at a retention time of 9,217 with a percentage of 15.19%.

These findings differ slightly from those of Syarifah's 2017 research in the Tulung Agung area of East Java, which found only 14 chemical components, with citronellal accounting for 72.4%.Other compounds found in other kaffir lime oils that are similar to Linalyl acetat include Limonene, Linalool, β-Myrcene,terpinene, β-Pinene, and several others, but in a higher percentage (Syarifah, 2017).

Meanwhile, according to T.T. Hian's research, 2020 is from Vietnam and contains 20 chemical components, with citronellal accounting for 85.436% of the total. Besides that, other components exist such as citronellol (6.8%), linalool (1.9%), and citronelil acetate (1.7%). Also in the research of Fan Siew Loh et al. (2011) in 5 regions in Peninsular Malaysia, *citronellal* is still the main component in kaffir lime (81%), with other components such as linalool, citronelyl propionate, and nerolidol (Hien *et al.*, 2020).

The difference in chemical composition in the oil will cause differences in quality and aroma. Basically, the higher the *content of geraniol, citronellal, hydroxy citronellal, linalool, and linal asetat*, the smoother and softer the aroma will be. The differences in these components can be influenced by differences such as climate, soil where they grow, harvesting age, how to store oil, and type of plant (Kawiji *et al.*, 2015).

Table 2. Orange oil quality requirements

Parameter	Test result	Condition (ISO 3140-2011)
Color	Yellow	Colorless - yellow
Aroma	Fresh citrus	Standard
Specific Weight (g/mL)	0,88	0,830-0,910
Linalool	15,19%,	3,5-5,5%

The organoleptic test results of the West Javan kaffir lime essential oil indicated a yellow color, a characteristic citrus scent, and a specific gravity of 0.88 g/mL with a linalool concentration of 15.19%; these results met the ISO 3140-2011 quality requirements.

Following are the Chemical Components of the Essential Oil of Ylang-ylang

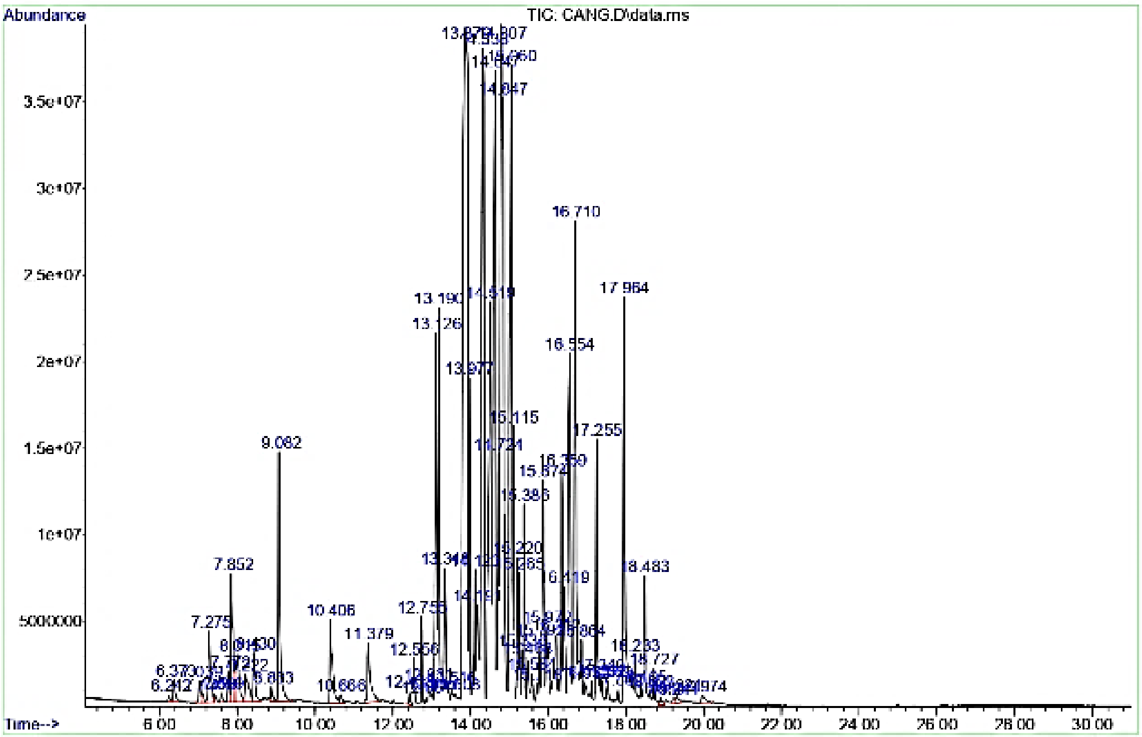

Fig- 2. GC-MS chromatogram of Ylang oil (*Cananga ordorata).*

The GC-MS results showed that there were 73 identified components belonging to the group of monoterpenes, oxygenated sesquiterpenes, hydrocarbon sesquiterpenes, and other compounds. In general, the most abundant components in this study were the sesquiterpene hydrocarbons and oxygenated sesquiterpene groups. The chemical components of ylang-ylang oil included in the sesquiterpene hydrocarbon compounds in this study were *caryophyllene* (14.36%) and *germacrene D* (6.55%) (Pujiarti *et al.*, 2015).

Table 3. Chemical components of Cananga essential oil

Peak	Retention Time (Rt)	Compound	Class of Components	Area (%)	Qual
1	6.242	Methylene chloride	Klorometan	0.05	83
2	6.368	(1S)-2,6,6-Trimethylbicyclo [3.1.1] hept-2-ene	Monoterpen	0.19	95
3	7.036	Bycylo[3.1.0] hexane-4-methylene-1-(1-methylethyl)-	Monoterpen	0.18	96
4	7.125	Methylene chloride	Klorometan	0.06	64
5	7.276	Beta-mycrene	Monoterpen	0.68	96
6	7.427	Methylene chloride	Klorometan	0.08	76
7	7.603	Methylene chloride	Klorometan	0.07	70
8	7.767	1,3-Cyclohexadiene,1-methyl-4-(1-methylethyl)-	Monoterpen	0.20	98
9	7.856	Benzene,-1-methoxy-4-methyl-	-	1.18	97
10	8.019	Tricyclo [2.2.1.0(2,6)] heptane,1,3,3-trimethyl	Monoterpen	0.71	55
11	8.221	1,8-Nonadien-3-ol	-	0.43	14
12	8.435	Gamma-terpinene	Monoterpen	0.37	96
13	8.876	Cyclohexane,1-methyl-4-(1 methylenthylidene)-	Monoterpen	0.13	97
14	9.078	Linalool	Monoterpen	1.71	97
15	10.401	Terpinene-4-ol	Monoterpen	0.91	97
16	10.666	Alpha-terpineol	Monoterpen	0.09	91
17	11.384	Geraniol	Monoterpen	0.72	97
18	12.443	Aromandendrene	Sesquiterpen	0.08	92
19	12.556	Gamma-elemene	Sesquiterpen	0.32	97
20	12.758	Alpha-cubene	Sesquiterpen	0.44	97
21	12.859	2,6-octadien-1-ol-3,7-dimethyl-acetate	Monoterpen	0.07	53
22	12.935	Eugenol	Monoterpen	0.23	97
23	13.010	Eugenol	Monoterpen	0.09	94
24	13.124	Geranyl acetat	Monoterpen	2.40	91
25	13.187	Alpha-cubene	Sesquiterpen	2.29	99
26	13.350	8-Isoprenephyl-1,5-dimethyl-cyclodeca-1,5-diene	Sesquiterpen	1.40	95
27	13.514	Methyleugenol	Fenilpropena	0.23	97
28	13.603	Aromandendrene	Sesquiterpen	0.23	89
29	13.880	Caryophyllene	Sesquiterpen	14.36	99
30	13.981	Lemnalol	Sesquiterpen	1.23	98
31	14.119	Gamma-muurolene	Sesquiterpen	1.10	95
32	14.195	(1S,4S,4sS)-1-Isoprophyl-4,7- dimethyl-1,2,3,4,4a,5-hexaxhydronapthalene	Sesquiterpen	0.98	98
33	14.334	1,4,7-cycloundecatriene	Sesquiterpen	7.31	98
34	14.523	gamma-Muurolene	Sesquiterpen	4.28	98
35	14.649	Germacrene D	Sesquiterpen	6.55	98
36	14.724	Gamma-Muurolene	Sesquiterpen	4.28	98
37	14.812	1-methyl-4-(6-methylhept-5-en-2-ylidene)cyclohex-1-ene	Sesquiterpen	6.66	90
38	14.850	Bicyclo 3.1.1 hept-2-ene, 2,6-dimethyl-6-(4-methyl-3-pentenyl)	Sesquiterpen	3.57	90
39	15.064	Napthalene	Monoterpen	6.62	95
40	15.115	Cis-calamene	Sesquiterpen	1.32	95

According to the table above, the main component of ylang ylang oil occurs in large quantities at peak 29, and a percentage of more than 5% is found at peaks 33 to 39.

From the table above, the main components of ylang oil are: caryophyllene (14.36%) identified at peak-29 at retention time 13,880; and other main components (chemical presentations of more than 5%) include: 1,4,7-cycloundecatriene (7.31%) identified at peak-33 at retention time 14,334, 1-methyl-4-cyclohex-1-ene (6.66%) identified at peak-37 at retention time 14,812; germacrene D (6.5%).

This study shows that the resulting ylang oil contains bioactive compounds such as sesquiterpenes (example: caryophyllene), which have properties as anti-inflammatory, anti-bacterial, and as a local anesthetic (Rulita Maulidya, Yuliani Aisyah, 2016).
The amount of this chemical composition is different from the research of Pujiarti et al., 2015, from Boyolali, where there were 13 components identified, with the main *component, caryophyllene,* with a relative percentage of 29.60% at a retention time of 11.031 minutes. Besides *caryophyllene* Other compounds exist in other ylang flower oils that have similar *characteristics, such as linalool* and *germacren,* where linalool is an effective compound as a mosquito repellent (Pujiarti *et al.*, 2015).

According to Phan Minh Giang and Phan Tong Son (2016), ylang oil collected in Hanoi, Vietnam, showed 43 chemical components, with caryophyllene (26.8%), *p-methylanisole* (0.6%), and *linalool* (8.7%) as the main components (Phan Minh Giang, 2016). *According to Syarifah et al., 2020, there are 40 components in Ylang Ylang oil obtained from Alor Setar, Kedah Darul Aman, Malaysia, with the main components being Linalool (21.78%), Acetic Acid (15.77%), β-Ocimene (13.53%), Piperonal (10.02%), and Eugenol (7.42%) (Syarifah Nursyimi, Rosmawati, 2020).*

Table 4. Ylang oil quality requirements

Parameter	Test result	Condition (SNI 3949:2021)
Color	Light yellow	Light yellow-dark yellow
Aroma	fresh typical ylang	fresh typical ylang
Specific Weight (g/mL)	0,906	0,904-0,9209

From the table above, the quality of ylang ylang oil is limited only to oragoleptic tests and specific gravity. The results obtained met the requirements; the organoleptic test for the smell and aroma detected was appropriate, namely a light yellow in color with a distinctive ylang odor. The specific gravity test result obtained was 0.906 g/mL, in accordance with the requirements of 0.904-0.92. This shows that the ylang ylang oil obtained from West Java has met the quality requirements.

The chemical components of patchouli essential oil (Pogostemon cablin Bent) can be seen in Figure 3 below:

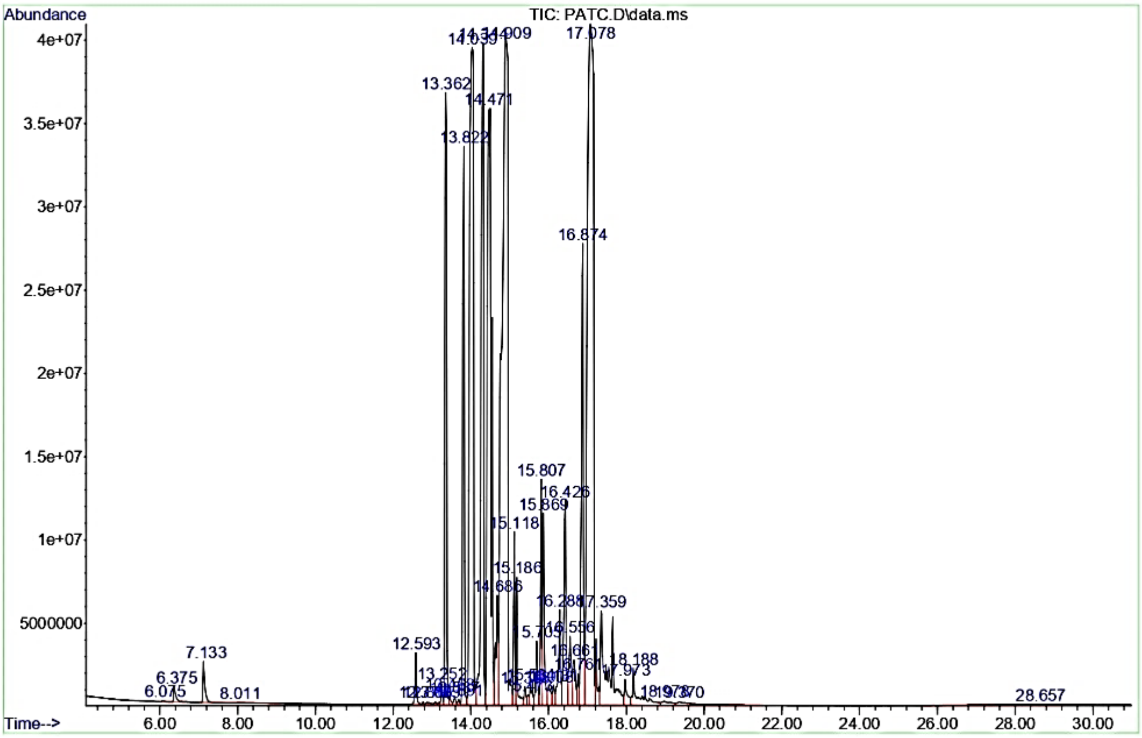

Fig-3. GC-MS chromatogram of patchouli oil (Pogostemon cablin Bent).

The main component of patchouli essential oil is patchouli alcohol (PA), which is the compound that determines the characteristic odor of patchouli.

Table 5. Chemical components of Patchaouli essential oil

Peak	Retention Time (Rt)	Compound	Class of Components	Area (%)	Qual
1	6.078	Methylene Choride	Klorometan	0.01	95
2	6.381	(1R)-2,6,6-Trimethylbicyclo [3.1.1] hept-2-ene	Monoterpen	0.16	95
3	7.137	Beta pinene	Monoterpen	0.34	95
4	8.007	Methylene Chloride	Klorometan	0.03	96
5	12.594	Cyclohexane,4-ethenyl-4- methyl-3-(1-methylethenyl)-1- 1(1-methylethyl)-(3R-trans)	Sesquiterpen	0.37	98
6	12.771	Benzene,1-ethyl-4-(2-methylprophyl)	-	0.02	38
7	12.884	Methylene Chloride	Klorometan	0.05	55
8	13.098	Ylangene	Sesquiterpen	0.03	91
9	13.249	Cyclohexane,-1-ethenyl-1-methyl	Sesquiterpen	0.15	99
10	13.363	4,7-Methanoazulene, 1,2,3,4,5,6,7,8-	Sesquiterpen	5.16	98
11	13.464	4,7-Methanoazulene, 1,2,3,4,5,6,7,8-	Sesquiterpen	0.08	99
12	13.590	Bicyclo [7.2.0] undec-4-ene,4,11,11-trimethyl-8-methylene, [1R-(1R*,4Z,9S*)	Sesquiterpen	0.07	98
13	13.691	Napthalene,1,2,3,4-tetrahydro-1,1,6-trimethyl-	-	0.04	60
14	13.817	Caryophyllene	Sesquiterpen	4.85	99
15	14.043	α-Guaiene	Sesquiterpen	11.98	99
16	14.308	Seychellene	Sesquiterpen	8.30	98
17	14.472	1H-3a,7-Methanoazulene	Sesquiterpen	10.74	98
18	14.686	Guaia-9,11-diene	Sesquiterpen	1.11	93
19	14.913	Azulene, 1,2,3,5,6,7,8,8a-octahydro-	Sesquiterpen	18.46	99
20	15.115	(2S,4Ar,8aR)-4a,8-dimethyl-2-(prop-1-en-2-yl)-1,2,3,4,4a,5,6,8a-octa-hydronapthalene	Sesquiterpen	0.75	95
21	15.190	Acetotrile,(3,5,5-trimethyl-2-c-cyclohexene-1-ylidene)	Monoterpen	0.75	50
22	15.392	2-(4-Ethylcyclohexyl)propan-2-ol Cyclohexanemethanol, 4-ethyl-α,α-dimethyl-	Monoterpen	0.16	93
23	15.468	Cycloheptane,4-methylene-1-methyl-2-(2-methyl-1-propen-1-yl)-1-vinyl	Sesquiterpen	0.09	91
24	15.531	Alloaromadendrene	Sesquiterpen	0.23	96
25	15.707	3,3-Dimethyl-6-methylenecyclohexen Phenol,-3-ethyl	Monoterpen	0.54	25
27	15.871	Caryophyllene oxide	Sesquiterpen	1.54	70
28	16.010	Nepthalene,1,2,3,4,4a,5,6,8a- octahydro-4a,8-dimethyl-2-(1-methylethenyl)-	Sesquiterpen	0.30	90
29	16.136	Spathulenol	Sesquiterpen	0.21	70
30	16.287	Valerenol	Sesquiterpen	0.95	66
31	16.425	1H-Cycloprop[e] azulene-4 Azulene,1,2,3,5,6,7,8,8a-	Sesquiterpen	2.08	93

Peak	Retention Time (Rt)	Compound	Class of Components	Area (%)	Qual
32	16.551	octahydro-1,4-dimethyl-7-(1-methylethenyl)	Sesquiterpen	0.78	92
33	16.665	Nepthalene,1,2,3,4,4a,5,6,8a- octahydro-4a,8-dimethyl-2-(1-methylethenyl)-	Sesquiterpen	0.57	95
34	16.776	4Ah-Cycloprop [e] azulene-4a- ol-decahydro-1,1,4,7-tetramethyl, -	Sesquiterpen	0.24	90
35	16.879	7.beta-isopropenyl-1	Sesquiterpen	3.83	90
36	17.081	Patchaoli alcohol	Sesquiterpen	19.27	91
37	17.358	4-Hydroxy-6-methyl-3-(4-methyl penthanoyl)-2H-pyran-2-one	Monoterpen	2.83	95
38	17.976	4-Hydroxy-6-methyl-3-(4-methyl penthanoyl)-2H-pyran-2-one	Monoterpen	0.34	92
39	18.190	1,4-Dimethyladamantane	Monoterpen	0.83	42
40	18.984	4-Hydroxy-6-methyl-3-(4-methyl penthanoyl)-2H-pyran-2-one	Monoterpen	0.16	60
41	19.375	4-Hydroxy-6-methyl-3-(4-methyl penthanoyl)-2H-pyran-2-one	Monoterpen	0.26	90
42	28.663	Tris(tert-butyldimethylsylyloxy) arsane	Sesquiterpen	0.09	52

The GC-MS results for patchouli oil showed that there were 42 identified components, with 5 peaks of the dominant components, namely patchouli alcohol (19.27%), azulene 1,2,3,5,6,7,8,8a-octahedron (18.46%), and guaiene (11.98%). The high content of patchouli alcohol makes patchouli oil useful in the cosmetic industry. The main component of patchouli essential oil is patchouli alcohol (PA), which is the compound that determines the characteristic odor of patchouli.

Based on the table above, the component with the largest percentage occurs in peak-36 with the main component, Patchaoli alcohol, with a retention time of 17,081 and a percentage of 19.27%. Other components identified as 10.74% included azulene, 1,2,3,5,6,7,8,8a-octahydro at peak-19 with retention time 14.913, guaiene (11.98%) at retention time 14.043, and compound 1H-3a,7-Methanoazulene at peak-17 with retention time 14.472.

The patcholi alcohol compound produced by oil from West Java is quite small when compared to the results of other studies, which have met the standard patchouli oil quality requirements with a minimum range of 30%.

According to SNI 06-2385-2006, the patchouli alcohol content in patchouli oil is at least 30%, or based on ISO 3757:2002, the PA content is at least 27–35%. This shows that patchouli oil obtained from West Java is not in accordance with quality standards. Similar to research by Ela Daniati, Mastura, 2021 from Peunaron, East Aceh, it showed levels of patchaoli alcohol that did not meet SNI standards, namely (3.65%), while another study by Khairurrasyidin et al., 2019 from Beutong, South Aceh, showed the patchaoli alcohol content was according to the SNI quality standard, namely (32.60%).

According to Santos et.al, 2019 patchouli oil was obtained from Macapa Municipality, in the State of Amapa, Brazil which showed the presence of 29 identified components including sesquiterpene compounds and oxygenated terpenes. Its main components are Seyshellene (6.12%), α-bulnesene (4.11%), Norpatchoulenol (5.72%), Pogostol (6.33%), and Patchouli alcohol (33.25%) (Santos *et al.*, 2019). In another study by Yi-Xi Feng et.al, 2019 essential oils obtained from an Anguo Chinese drugstore showed the main components patchoulol (51.1%), phloroacetophenone (23.5%), and β-patchouli (7.3%). Moreover, γpatchoulene (3.2%), 2,3,3-trimethyl-2-(3-methyl-buta-1,3-dienyl)-cyclohexanone (3.0%), epiglobulol (2.7%), γ-Gurjunene (1.5%), and anethol (1.4%) (Feng *et al.*, 2019).

Table 6. Patcholi oil quality requirements

Parameter	Test result	Condition (SNI 3949:2021)
Color	Light yellow	Light yellow – reddish brown
Specific Weight (g/mL)	0,95	0,950-0,975
Patcholi alcohol	19,27%	Minimum 30%

Based on the table above, the quality requirements for patchouli oil are limited to color oragoleptic testing, testing of specific gravity, and percentage *content of patchouli alcohol* identified. The patchouli oil produced has a light yellow color. According to Ardianto and Humaida (2020), the difference in color is influenced by the method of distillation and storage used by the distillers.

While the specific gravity of the patchouli oil produced was 0.95 g/mL, this result met the specific gravity requirements of patchouli oil based on SNI 2006 standards. *Patchaoli alcohol does not meet quality standards.*Several factors cause the patchouli oil produced to be below standard quality. This is because it is influenced by the soil and climate, the place of planting, the method of handling raw materials, and the distillation process.

According to SNI 06-2385-2006, which rates patchaoli alcohol in patchouli oil at least 30%, or ISO 3757:2002 levels of patchaoli alcohol at least 27-35%, patchouli oil obtained from West Java does not meet quality standards, with only 19.27% identified.Similar to research by Ela Daniati, Mastura, 2021 from Peunaron, East Aceh shows *levels of chaphaoli alcohol* that did not meet the SNI standard, namely only 3.65%, while according to another study by Khairurrasyidin et al., 2019 from Beutong, South Aceh showed *levels of chaphaoli alcohol* according to SNI quality standards, namely 32.60%.

The amount of patchouli alcohol in patchouli oil is affected by the altitude at which the patchouli is grown. Planting patchouli in the highlands will produce oil with a higher alcohol patchouli content, and conversely, patchouli grown in the lowlands will produce a lower alcohol patchouli content (Ardianto and Humaida, 2020).

4. CONCLUSION

Based on the results of this study, we obtained results that met the quality standards of each essential oil, with a specific gravity of 0.88 g/mL for orange oil, 0.906 g/mL for ylang ylang oil, and 0.95 g/mL for patchouli oil. While based on the results of GC-MS The dominant essential oils in kaffir lime essential oil are linalyl acetate, D-limonene, and linalool, which belong to the class of monoterpene compounds. The dominant essential oil compound in ylang-ylang essential oil is caryophyllene; D-germacren belongs to the group of sesquiterpenes; and the main component of patchouli oil is patchouli alcohol. but in this case, the percentage of patchouli alcohol still does not meet the requirements of SNI 06-2385-2006 with levels less than 30%. In this case, it is necessary to make efforts to improve the quality of essential oils in order to increase their added value

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