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

Marisa Tamara Sari[1], Yelfi Anwar[1], Andrianopsyah Mas Jaya Putra[2]
[1]Fakultas Farmasi, Universitas 17 Agustus 1945 Jakarta Utara, Indonesia
[2] Institut Sains dan Teknologi Al-Kamal (ISTA), Jakarta Barat, Indonesia

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ABSTRACT
The fragrant Citronella oil derived from *Cymbopogon nardus* (L.) Rendle has many benefits, one of which is as an antibacterial. This research aims to identify the chemical compounds present in the essential oil Citronella obtained from a local distillery in Anding Village, Suliki District, Gunung Mas 50 Kota Regency, Province West Sumatra. The essential oil Citronella was identified using Gas Chromatography-Mass Spectrophotometry (GC-MS) at the BRIN (National Research and Innovation Agency) chemistry laboratory in Serpong, South Tangerang, Banten. The results showed that the essential oil Citronella met the requirements of SNI 06-3953-1995, and after being identified with GC-MS, 39 chemical compounds were found, with 3 compounds having high concentrations in the essential oil: Citronellal (24.57%), Citronellol (11.69%), and Geraniol (15.59%).

Corresponding Author:
Yelfi Anwar
Faculty of Pharmacy, University of 17 August 1945 Jakarta
Jakarta, Nort Jakarta, Indonesia
Email: yelfi.anwar@uta45jakarta.ac.id

1. INTRODUCTION

Indonesia is very rich in culture and history, so it is very important to preserve traditional knowledge and practices related to natural products such as essential oils which can be obtained from the roots, stems, leaves or flowers of plants. Essential oil, often called finite oil, is a kind of substance that has obvious characteristics, such as being highly volatile at room temperature without degradation, having a unique aroma, and often soluble in organic solvents but insoluble in water. Therefore, it is very important to preserve and safeguard the traditional practices and knowledge associated with these natural products (Bonita et al., 2023).

Essential oils have been used for medical and health purposes by many cultures for thousands of years. Currently, essential oils are increasingly popular as a natural therapy that is safe and affordable for various health problems because of their benefits as antidepressants, stimulants, detox, antibacterial, antiviral, and sedatives (Herman et al., 2019) .One of the essential oils that is currently being studied for its potential as the main ingredient in the formulation of antibacterial mouthwash is citronella essential oil.

Cymbopogon nardus (L.) Rendle, commonly known as citronella, is a plant of the Panicodiae family of Graminales and is renowned for its use in traditional medicine. It usually has green or purplish-red stems, with elongated flat leaves that resemble reeds. This plant also has adventitious roots and grows in groups. The color of the leaves can vary from green to bluish green (Saputra et al., 2020).

Various compounds in citronella essential oil are sought after in the pharmaceutical, perfume and food industries. 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. Due to the presence of citronellal, citronella oil has become a popular alternative for both household and medicinal uses (Agustina & Jamilah, 2021).

Several studies have proven the benefits of citronella essential oil, In a study using an emulsion-based nano formulation, it was found that a mixture of 1% alginate, 1.5% citronella essential oil, and 1% Tween 80 supports the inhibitory effect of citronella essential oil (*Cymbopogon nardus* (L.) Rendle) against Rhyzopus spp., Penicillium expansum, and Aspergillus niger for at least 10 days of incubation (Cofelice et al., 2021).

Citronella contains three main components, namely geraniol, citronellol, and citronellal (Anwar et al., 2020). One method to determine the main components contained in citronella oil is to use Gas Chromatography

and Mass Spectrometry. The analytical technique using Gas Chromatography and Mass Spectrometry combines the ability of gas-liquid chromatography to separate compounds with the ability of mass spectrometry to identify various substances in a sample. GC-MS divides the analytes to be identified by mass, with GC separating the volatile and thermally stable compounds in the sample (Chauhan, 2014).

Because 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 in a formulation. Therefore, this study aims to identify the chemical compounds in citronella essential oil using *Gas Chromatography-Mass Spectrophotometry* (GC-MS).

2. RESEARCH METHOD

The material used in this study was citronella essential oil obtained from a local refinery in Anding Village, Suliki District, Gunung Mas, 50 Kota District, West Sumatra. The obtained essential oils were identified at the BRIN chemical laboratory (National Research and Innovation Agency) in Serpong, South Tangerang, Banten using the GC-MS instrument. The composition of essential oils was identified using *Chromatography-Mass Spectrophotometry* (GC-MS) Aligent 7890B (GC) and 5977A (MSD). The mobile and stationary phases used in GC-MS were type Agilent 19091S-433:93.92873 DB-5MS UI 5% Phenyl Methyl siloxane and the injection volume was 1 mL.

3. RESULT AND DISCUSSION

The following are chemical compounds that have been identified from essential oils obtained from local distillers in Anding Village, Suliki District, Gunung Mas Regency, West Sumatra Province.

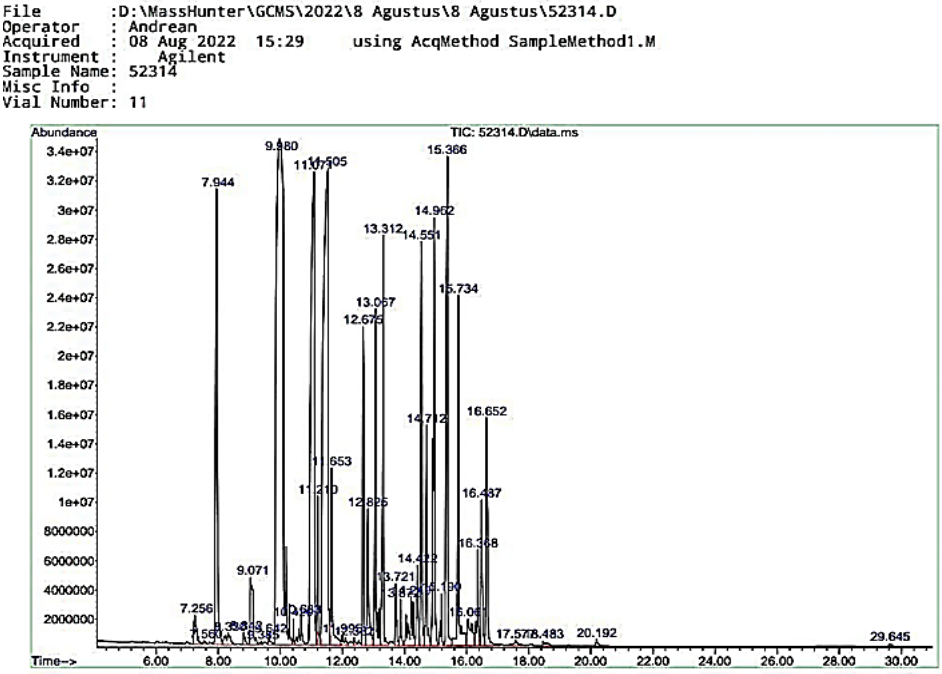

Figure 1. Chromatogram of *Cymbopogon nardus* (L.) Rendle

Based on the results of identification using GC-MS, the essential oil obtained from a local refinery in Anding Village, Suliki District, Gunung Mas, West Sumatra, was identified to contain 39 compounds, of which there were 3 compounds with high content, namely citronellal (24.57%) , citronellol (11.69%), and geraniol (15.59%).

Table 1. Chemical compounds of *Cymbopogon nardus* (L.) Rendle

Peak	Retention Time (RT)	Area	Compound	Qual
1	7.251	0.50	Beta myrcene	96
2	7.566	0.05	Methylene chloride	93
3	7.944	5.33	D-Limonene	99
4	8.335	0.40	5-Heptenal, 2,6-dimethyl-	50
5	8.839	0.14	Cyclohexene,1-methyl-4-(1-methylethylidene)-	96
6	9.065	1.32	Linalool	96

7	9.381	0.04	Methylene chloride	81
8	9.645	0.12	5-Hepten-1-ol, 2,6-dimethyl-	96
9	**9.986**	**24.57**	**Citronellal**	**97**
10	10.414	0.14	3-Cyclohexen-1-ol,4-methyl-1-(1methylethyl), (R)-	58
11	10.679	0.50	Decanal	98
12	**11.069**	**11.69**	**Citronellol**	**98**
13	11.208	0.96	Neral	95
14	**11.510**	**15.59**	**Geraniol**	**96**
15	11.649	1.74	Citral	95
16	11.989	0.18	Geraniol	72
17	12.380	0.09	Cyclohexene, 1-ethyl-	43
18	12.670	2.33	6-Octen-1-ol, 3,7-dimethyl-, acetate	98
19	12.821	1.42	Eugenol	98
20	13.073	2.88	Geranyl acetate	91
21	13.313	3.22	Cyclohexane, 1 – ethenyl - 1- methyl-2, 4-bis(1-methylethenyl)	91
22	13.716	0.50	Tricyclo[4.4.0.0(2,7)]decane, 1 – methyl – 3 –methylene -8 - (1-methylethyl) -, stereoisomer	99
23	13.867	0.34	(1R,2S,6S,7S,8S)-8-Isopropyl-1-methyl-3-methylenetricyclo[4.4.0.02,7]decane-rel-	99
24	14.220	1.11	1,4,7,-Cycloundecatriene, 1,5,9,9-tetramethyl-, Z,Z,Z-	98
25	14.422	0.71	Gamma Muurolene	99
26	14.548	3.36	Germacrene D	98
27	14.712	1.63	alpha.-Muurolene	98
28	14.964	4.34	Naphthalene, 1, 2, 3, 5, 6, 8a-hexahydro-4, 7-dimethyl-1-(1-methylethyl)-, (1S-cis)-	95
29	15.191	0.42	Naphthalene,1, 2, 4a, 5, 6, 8a – hexahydro - 4, 7 dimethyl–1-(1-methylethyl)-,[1S(1.alpha., 4a.beta., 8a.alpha.)]-	99
30	15.367	5.05	Cyclohexanemethanol, 4 – ethenyl - .alpha., .alpha.,4-trimethyl-3-(1-meth ylethenyl)-, [1R-(1.alpha.,3.alpha .,4.beta.)]-	91
31	15.732	3.25	(2E,4S,7E)-4-Isopropyl-1,7dimethylcyclodeca-2,7-dienol	99
32	16.060	0.80	Cyclohexanemethanol,4-ethenyl-.alpha.,.alpha.,4-trimethyl-3-(1-meth ylethenyl)-, [1R-(1.alpha.,3.alpha .,4.beta.)]-	87
33	16.363	0.86	2-Naphthalenemethanol, 1, 2, 3, 4, 4a, 5, 6, 7- octahydro-.alpha.,.alpha.,4a,8-tetramethyl-, (2R-cis)-	99
34	16.489	1.63	tau.-Muurolol	98
35	16.653	2.30	Spirojatamol	94
36	17.573	0.17	1-((1S,3aR,4R,7S,7aS)-4-Hydroxy-7-isopropyl-4-methyloctahydro-1H-inden-1-yl)ethanone	97
37	18.480	0.13	Neophytadiene	99
38	20.194	0.15	6,11-Dimethyl-2,6,10-dodecatrien-1-ol	53
39	29.646	0.05	Quercetin 3'-methyl ether Cinnamoylferrocene	38

SNI 06-3953-1995 is a specific reference for citronella oil quality standards. According to SNI 06-3953-1995, citronella oil has a light yellow to yellow-brown color with a refractive index of 1.466 - 1.475, a minimum total geraniol content of 85%, a minimum citronellal content of 35%, and easily soluble in 80% ethanol with a ratio of 1:2, looks clear to slightly cloudy, without foreign matter such as oil/fat or added alcohol. Fragrant citronella oil must have a distinct and fresh odor, with an optical rotation of –(-6) and a flash point between 76°C - 85°C. (Sulaswatty & Adilina, 2019).

Table 2. Comparison of inspection results of citronella essential oil and SNI 06-3953-1995 standards

No	Parameters	Results	SNI 06-3953-1995
1	Color	Brown - Yellowish	Bright yellow – Yellow with a hint of brown
2	Aroma	Specific aroma of citronella	Specific aroma of citronella
3	Solubility in alcohol	Solute	80% solute in alcohol
4	Citronellal	24,57%	Minimum 35%
5	Geraniol	15,59%	Minimum 85%

The chemical compounds Geraniol, Citronellal and Citronellol are the 3 compounds that make up most of the essential oils. The identification results in this study can also be supported by other studies which also found that of the many compounds in the essential oil of *Cymbopogon nardus* (L.) Rendle Citronellal (35.72%), Citronellol (15.09%), and Geraniol (12.89%) (Kumala et al., 2019). Although the two identification results showed citronellol, citronellal and geraniol compounds as substances that make up almost all of citronella essential oil. Even so, there is a percentage difference in the results obtained with the results of identification using citronella essential oil samples from villages in West Sumatra. This difference can be explained by comparing several factors related to the growth and development of these plants such as genetics, plant age, season or location of these plants in planting. Citronella essential oil tested by (Kumala S, et al. 2019) was grown in the Manoko experimental garden, Lembang Bandung, while citronella essential oil in this study was planted in Anding Village, West Sumatra. Differences and similarities can also be found in other studies where citronellal was found to be one of the compounds with a high percentage value (33.06%) (Bayala et al., 2020). Even so, in this study there were differences in the identification results where the compounds with the 3 highest percentages were citronellal, geraniol and nerol. These results are very different from what was found in the identification results of this study where one of the 3 chemical compounds that are the main constituents of citronella essential oil is citronellol.

These types of compounds are indispensable in the pharmaceutical raw material, perfume and food industries. Citronellal compounds are monoterpene compounds that have a distinctive aroma, until now citronellal compounds have been isolated and used for antibacterial purposes. So that the presence of citronella makes citronella oil an alternative for medicines and household needs.

4. CONCLUSION

Based on the results obtained, *Cymbopogon nardus* (L.) Rendle essential oil obtained from local distillation in Anding Village, Suliki District, Gunung Mas, District 50 City of West Sumatra has not fulfilled the requirements of SNI 06-3953-1995 and contained 39 chemical compounds, of which Citronellal, Geraniol, and Citronellol are the main constituents, with Citronellal providing the largest percentage area, namely 24.57%.

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