

## ANALYSIS OF ESSENTIAL OIL COMPOUND CONTENT OF LEMONGRASS (*Cymbopogon nardus L. Rendle*) AND LAVENDER (*Lavandula angustifolia*) USING THE GC-MS METHOD

Fatonah, Bangkit Riska Permata, Anna Fitriawati

Bachelor of Pharmacy, Faculty of Health Sciences, Duta Bangsa University, Surakarta, Indonesia  
Email: [fatolahfat29@gmail.com](mailto:fatolahfat29@gmail.com)

### ABSTRACT

Essential oils are volatile compounds that are widely used in the fields of health, pharmaceuticals, cosmetics, and aromatherapy because they have various biological activities. Lemongrass (*Cymbopogon nardus L. Rendle*) and lavender (*Lavandula angustifolia*) is an aromatic plant that produces essential oils with potential relaxant, anti-inflammatory, antimicrobial, and insect repellent activities. This study aims to obtain essential oils from citronella and lavender through steam distillation and identify their chemical compound profiles using the Gas Chromatography-Mass Spectrometry (GC-MS) method. 6000 g of citronella and lavender simplicia were distilled for  $\pm 7$  hours. The essential oil yield obtained was then calculated and analyzed using GC-MS. The results showed that the yield of lavender essential oil was 0.51%, higher than the yield of citronella essential oil of 0.44%. GC-MS analysis identified 27 compounds in citronella essential oil, with the main components being 2,6-octadien-1-ol, 3,7-dimethyl-, (Z)- (31.73%), citronellol (27.78%), E-citral (9.60%), neral (7.61%), and citronellal (2.18%). Meanwhile, lavender essential oil contains 39 compounds, with the dominant components being eucalyptol (34.41%), bicyclo[2.2.1]heptan-2-one, 1,7,7-trimethyl- (14.10%),  $\alpha$ -bisabolol (12.19%), linalool (10.85%) and Bicyclo 3.1.1heptane,6,6-dimethyl-2-methyle (5.26%). The results of the study indicate that steam distillation is effective in obtaining essential oils from citronella and lavender, while GC-MS analysis can comprehensively identify their volatile components. These findings can serve as a basis for characterizing and controlling the quality of essential oils, which have the potential to be developed as raw materials for pharmaceuticals, cosmetics, and aromatherapy

**Kata kunci** 1; *Cymbopogon nardus* 2; Essential Oil 3; GC-MS 4; *Lavandula angustifolia* 5; Steam distillation

## INTRODUCTION

Indonesia is one of the world's largest producers of essential oils due to its abundant biodiversity. Essential oils are volatile secondary metabolites with distinctive aromas and are widely used in pharmaceuticals, cosmetics, health, and aromatherapy. Various types of essential oil-producing plants have been widely used as raw materials for health products because they contain active compounds with biological activities such as antibacterial, anti-inflammatory, antioxidant, relaxant, and insect repellent (Afrizal *et al.*, 2024).

Lemongrass (*Cymbopogon nardus L. Rendle*) is one of the essential oil-producing plants widely cultivated in Indonesia. Citronella essential oil is known to contain the main compounds citronellal, citronellol, and geraniol, which act as antimicrobials, antiinflammatories, aromatherapy, and natural insecticides. In addition, citronella oil is widely used in health product formulations such as massage oil, mosquito repellent lotion, inhalers, and aromatherapy preparations (Dewi *et al.*, 2021).

Lavender (*Lavandula angustifolia*) is a source of essential oils widely used in aromatherapy because they have relaxing and anxiolytic effects and can help improve sleep quality. These activities are mainly due to the content of linalool and linalyl acetate as the main components of lavender essential oil, which are supported by other compounds such as terpinen-4-ol and eucalyptol. Therefore, lavender essential oil is widely used in the pharmaceutical, cosmetic, and health fields (Fatmawati *et al.*, 2021).

To obtain essential oils from plant materials, one of the most commonly used methods is steam distillation. This method utilizes water vapor to remove volatile compounds from plant tissue. Then, the mixture of water vapor and oil is condensed to obtain a distillate which is then separated into essential oil and water phases. Steam distillation was chosen because it can extract volatile compounds without using organic solvents, is relatively safe, easy to apply, and is widely used on a laboratory and industrial scale. In addition, the distillation method affects the yield and chemical composition of the resulting essential oil, because temperature, distillation time, material size, and equipment conditions can determine the amount of volatile components that are evaporated (Suyono *et al.*, 2024).

Characterizing the components of distilled essential oils is a crucial step in raw material quality control. One widely used analytical method is Gas Chromatography Mass Spectrometry (GC-MS). This method is capable of separating, identifying, and describing the profile of volatile compounds based on retention time and mass spectrum. Through GC-MS analysis, the dominant components of essential oils can be identified, thus explaining their aroma characteristics, biological activity, and potential use in aromatherapy preparations or health products (Ramadhan *et al.*, 2026).

This study aims to obtain essential oils from citronella and lavender through steam distillation, then identify the chemical compounds of both essential oils using the GC-MS method. The results are expected to provide information on the compound profiles of citronella and lavender essential oils as a basis for quality control and the development of natural-based aromatherapy products.

## METHODS

This research is a laboratory experiment, with the production of essential oils conducted at the Tawangmangu Traditional Health Service Unit and the identification of the compounds contained in citronella and lavender essential oils using a Gas Chromatography-Mass Spectrometry (GC-MS) instrument at the Organic Chemistry Laboratory, Faculty of Mathematics and Natural Sciences, Gadjah Mada University. The equipment used in this research includes a set of water vapor distillation equipment consisting of a condenser, gas stove, thermometer, and separating funnel. In addition, the instrument Gas Chromatography-Mass It used measuring cups, beakers, Erlenmeyer flasks, dropper pipettes, micropipettes, sample

vials, and a Shimadzu QP2010 SE Gas Chromatography-Mass Spectrometry (GC-MS) instrument which was used to identify the compounds that make up essential oils.

A total of 6000 grams of fresh lemongrass and fresh lavender were each placed into a distillation kettle. Next, add distilled water to the distillation apparatus. After ensuring the sample and solvent were in the kettle, close the distillation apparatus. The distillation process continued until the essential oil was visible after evaporation. The extraction results were then calculated using the following formula:

$$\% \text{ yield} = \frac{\text{essential oil produced (ml)}}{\text{weight of raw materials used (grams)}} \times 100\%$$

Distilled samples of citronella and lavender essential oils were placed into GC-MS vials and analyzed using a Shimadzu GC-MS instrument. The samples were injected into a gas chromatography system to separate volatile compounds based on their boiling point differences and interactions with the column's stationary phase. The separated compounds then entered a mass spectrometer detector to produce fragmentation patterns. Compound identification was performed by comparing the obtained mass spectra with the mass spectrum library on the GCMS system. The relative concentration of each component was expressed as a percentage of the peak area (% area) in the chromatogram.

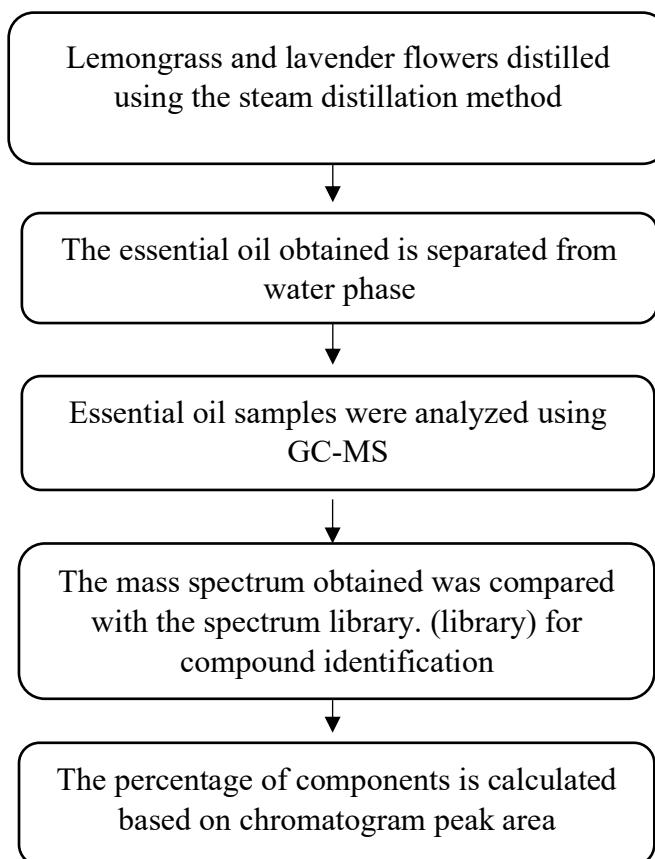
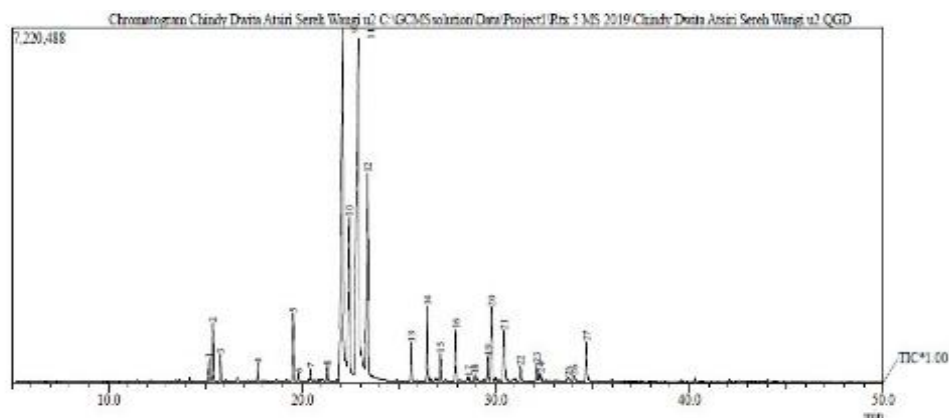


Figure 1. research flow

## RESULTS

Table 1. Result of essential oil yield

sampel	Sample weight (grams)	Oil volume (ml)	Yield (%)
lemongrass	6000 grams	26,4 ml	0,44 %
Lavender	6000 grams	30,8 ml	0,51 %



Peak#	R. Time	I. Time	F. Time	Area	Area%	Height	Name
1	15.184	15.100	15.275	1385375	0.68	452482	1-LIMONENE
2	15.388	15.275	15.500	4111485	1.76	1179699	CIS-OCIMENE
3	15.775	15.683	15.875	1823905	0.78	562534	TRANS-BETA-OCIMENE
4	17.706	17.608	17.808	1232278	0.53	361867	LINALOOL
5	19.527	19.335	19.642	5105304	2.18	1386373	6-Octenal, 3,7-dimethyl-, (R)-
6	19.812	19.642	19.917	618558	0.26	166597	Bicyclo 3.1.1 hept-3-en-2-ol, 4,6,6-trimethyl-,
7	20.435	20.367	20.525	792507	0.34	236317	3-Cyclohexene-1-carboxaldehyde, 1,3,4-trimethyl-
8	21.297	21.217	21.425	1103315	0.47	299336	Decanal
9	22.106	22.850	22.308	64916957	27.78	7153329	CITRONELLOL
10	22.430	22.308	22.617	17793140	7.61	3304155	neral
11	22.923	22.617	23.225	74153942	31.73	6911405	2,6-Octadien-1-ol, 3,7-dimethyl-, (Z)-
12	23.371	23.225	23.600	22421603	9.60	4144219	E-Citral
13	25.619	25.508	25.733	2722307	1.16	784154	6-Octen-1-ol, 3,7-dimethyl-, acetate
14	26.438	26.350	26.542	5519674	2.36	1328761	Geranyl acetate
15	27.130	27.025	27.250	2234859	0.96	569425	Benzene, 1,2-dimethoxy-4-(2-propenyl)- (CAS
16	27.923	27.800	28.025	4171479	1.78	1049723	Caryophyllene
17	28.598	28.467	28.692	581612	0.25	88105	ANISYL ACETONE
18	28.914	28.808	28.992	521473	0.22	125356	alpha-Caryophyllene
19	29.592	29.492	29.675	1980768	0.85	515874	GERMACRENE-D
20	29.779	29.675	29.892	6066871	2.78	1504421	ANISYL ACETONE
21	30.419	30.300	30.592	5158598	2.21	1054291	alpha-terpinene
22	31.264	31.100	31.425	1232689	0.53	304408	GERANYL BUTYRATE
23	32.109	31.975	32.225	1736406	0.74	367469	endo-1-bourbonol
24	32.315	32.225	32.400	764825	0.33	161684	CARYOPHYLLENE OXIDE
25	33.731	33.625	33.892	553139	0.24	73255	Torneyol
26	34.047	33.892	34.192	568599	0.24	106752	alpha-cadinol
27	34.682	34.550	34.925	3775640	1.62	800811	alpha-Bisabolol

Figure 2. GC-MS analysis results of lemongrass essential oil

Table 1. the highest peaks in the GC-MS result of lemongrass essential oil

Peak	R. Time	Compound	Area (%)
11	22.923	2,6-Octadien-1-ol, 3, 7-dimethyl-, (Z)-	31,73
9	22.106	Citronellol	27,78
12	23.371	E-Citral	9,60
10	22.430	Neral	7,61
5	19.527	6-octena,3,7-dimethyl-,(R)-	2,18

The GC-MS analysis results showed that citronella essential oil contained 27 compounds detected based on the chromatogram. The highest peak identified was geraniol with an area percentage of (31,73%).

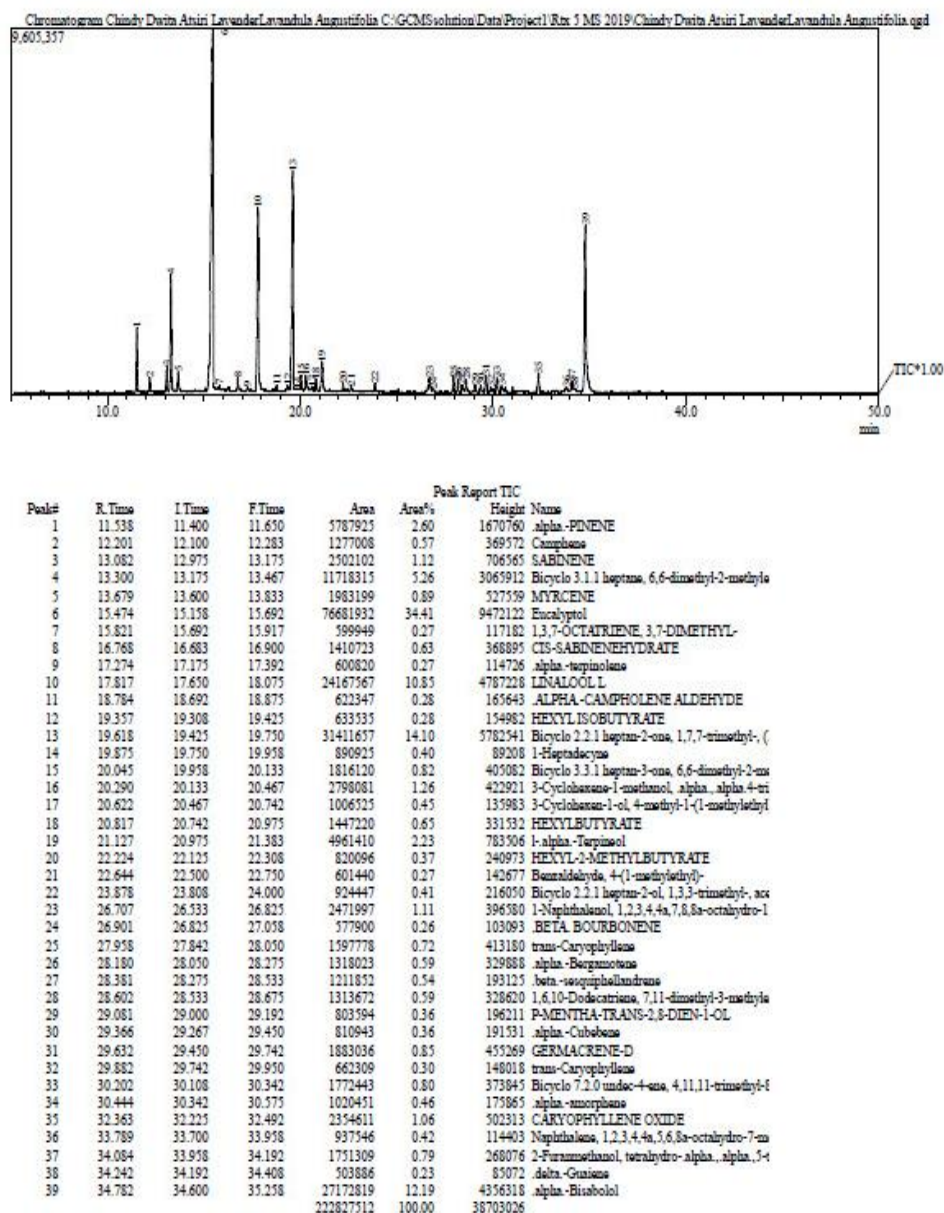


Figure 3. GC-MS results of lavender essential oil

Table 2. highest peaks of GC-MS results of Lavender essential oil

peak	R.Time	Compound	Area (%)
6	15.474	Eucalyptol	34,41
13	19.618	Bicyclo 2.2.1 heptan -2-one,1,7,7-trimethyl-,	14,10
39	34.782	α-Bisabolol	12,19
10	17.817	Linalool	10,85
4	13.300	Bicyclo 3.1.1heptane,6,6-dimethyl-2-methyl-	5,26

GC-MS analysis results showed that lavender essential oil contained 39 compounds detected based on the chromatogram. The highest peak identified was eucalyptol with an area percentage of 34.41%.

## DISCUSSION

In this study, the distillation results showed that the yield of lavender essential oil (0.51%) was higher than that of citronella (0.44%). This difference in yield indicates that the amount of essential oil successfully obtained from each material is influenced by the characteristics of the plant material and the efficiency of the distillation process. The yield of essential oil can be influenced by several factors, such as the type of plant, the part of the plant used, water content, material size, distillation time, and temperature and pressure during the distillation process. Thus, the difference in yield in this study indicates the variation in the ability of each material to produce essential oil through the steam distillation method.

Citronella and lavender essential oils were obtained through steam distillation, an extraction technique that utilizes hot steam to evaporate volatile components from plant tissue and then condenses them into a distillate consisting of a mixture of essential oil and water. This method was chosen because it is effective in isolating volatile compounds from aromatic plants without the need for organic solvents. The application of steam distillation to citronella and lavender was deemed appropriate because both plants contain volatile components, especially monoterpenes and sesquiterpenes, which are easily carried away by the steam flow. The distillation process was carried out for approximately 7 hours to optimize essential oil recovery, although its efficiency is still influenced by material size, water content, temperature, pressure, material density in the kettle, and condensation effectiveness. Thus, the distillation process not only determines the amount of essential oil produced but also influences the profile of chemical compounds identified in the GC-MS analysis.

GC-MS analysis results show that citronella and lavender essential oils have distinct chemical profiles. These differences in composition are influenced by plant species, growing conditions, extraction methods, and geographic location.

In citronella essential oil, the dominant compounds identified are 2,6-Octadien-1-ol, 3, 7-dimethyl-, (Z)- (31.73%) and citronellol (27.78%). Both compounds belong to the monoterpene alcohol group which contributes to the distinctive aroma of citronella and its biological activity. Geraniol is known to have antimicrobial, antioxidant, and anti-inflammatory activities. Meanwhile, citronellol functions as a natural insect repellent and is widely used in mosquito repellent product formulations. The presence of 6-octene,3,7-dimethyl-, (R)- (2.18%), neral (7.61%), and E-citral (9.60%) also supports the fresh aroma characteristics and pharmacological activity of citronella oil.

In lavender essential oil, the main components identified are eucalyptol (34.41%), followed by bicyclo(2.2.1)heptan-2-one, 1,7,7-trimethyl (14.10%),  $\alpha$ -bisabolol (12.19%), linalool (10.85%) and Bicyclo 3.1.1heptane,6,6-dimethyl-2-methyle (5.26%). Eucalyptol is known to have anti-inflammatory and expectorant activity, and provides a fresh sensation to the respiratory system. Linalool is an important component in lavender oil that plays a role in the relaxation effect, calming the nervous system, and improving sleep quality. The  $\alpha$ -bisabolol compound is also known to have anti-inflammatory and skin-soothing activities. Overall, the GC-MS method proved effective in identifying volatile compounds.

contained in essential oils. The resulting chromatograms were able to display the number of components and their relative proportions based on peak area, thus providing a comprehensive picture of the chemical composition of citronella and lavender essential oils.

## CONCLUSION

Citronella essential oil (*Cymbopogon nardus* L. Rendle) and lavender (*Lavandula angustifolia*) was successfully obtained through the steam distillation method, which allows

the compound Volatiles in plant material are isolated with water vapor and separated as essential oils. The distillation process is an important stage in this study because it determines the success of the extraction of volatile components which are then analyzed using GC-MS analysis using the Gas Chromatography-Mass Spectrometry (GC-MS) method, citronella essential oil (*Cymbopogon nardus* L. Rendle) contains 27 compounds with dominant components in the form of geraniol (31.73%), citronellol (27.78%), E-citral (9.60%), neral (7.61%), and 6-octene,3,7-dimethyl-,(R)- (2.18%). Meanwhile, lavender essential oil (*Lavandula angustifolia*) contains 39 compounds with dominant components in the form of eucalyptol (34.41%), bicyclo(2.2.1)heptan-2-one, 1,7,7-trimethyl- (14.10%),  $\alpha$ -bisabolol (12.19%), linalool (10.85%) and Bicyclo 3.1.1heptane,6,6-dimethyl-2-methyle (5.26%). These compounds are known to contribute to the distinctive aroma and biological activities of each essential oil, such as aromatherapy, relaxant, anti-inflammatory, antimicrobial, and insect repellent. The results of this study indicate that the GC-MS method is effective in identifying volatile components in citronella and lavender essential oils, so it can be used as a basis for characterization, standardization, and quality control of essential oil raw materials. The limitation of this study is that the analysis only focused on the identification of chemical compounds without testing biological activity and quantitative determination of compound levels. Therefore, further research is needed to evaluate the pharmacological activity and potential use of these two essential oils in various health and industrial fields..

## REFERENCES

1. Afrizal, Defitriani, A., & Efdi, M. (2024). Minyak Atsiri Serai Wangi (*Cymbopogon nardus* L. Rendle): Diisolasi dengan Dua Metode Berbeda, Kualitas dan Aktivitas Antibakterinya. *Jurnal Riset Kimia*, 15(1), 99–111. <https://doi.org/10.25077/jrk.v15i1.653>
2. Dewi, S. R., Nur, D., & Hanifa, C. (2021). Karakterisasi dan Aktivitas Antibakteri Minyak Serai Wangi (*Cymbopogon nardus* (L.) Rendle) terhadap *Propionibacterium acnes* Characterization. *Pharmaceutical Journal of Indonesia*, 18(02), 371–379. <https://doi.org/10.30595/pharmacy.v18i2.7564>
3. Dika, D. R. (2020). *Perancangan alat penyulingan minyak nilam kondensor dan separator*. 09(1). <https://doi.org/10.22441/jtm.v9i1.6815>
4. Dwiutami, A., & Indrayani, D. (2022). aromaterapi lavender untuk mengurangi nyeri persalinan: evidence based case report. *Jurnal Kesehatan Siliwangi*, 2(3), 771–778. <https://doi.org/https://doi.org/10.34011/jks.v2i3.760>
5. Fatmawati, A., Zuliyati, I. C., & Sundari, M. (2021). Formulasi dan Evaluasi Sediaan Roll On Aromaterapi Blended Peppermint, Lavender dan Lemon sebagai Antiemetika. *Indonesian Pharmacy and Natural Medicine Journal*, 5(2), 8–16. <https://doi.org/10.21927/inpharmmed.v5i2.1904>
6. Hasanah, A., Aisyah, D., Aeni, F. N., Megia, K., Safitri, N. A., & Fikayuniar, L. (2022). Review Artikel Perbandingan Hasil Rendemen Minyak Atsiri Dan Kadar Citronellal Tanaman Serai Wangi (*Cymbopogon Nardus*) Menggunakan Berbagai Metode. *Jurnal Pendidikan Dan Konseling*, 4, 12330–12335.
7. Mualimin, L., Arum, mentari sekar, & Alfarizi, muhammad ihsan. (2026). Pengaruh Perlakuan Pengeringan Kulit Jeruk Manis ( *Citrus sinensis* ) terhadap Rendemen , Konsumsi Energi , dan Karakteristik Fisik Minyak Atsiri Hasil Destilasi Uap Effect of Drying Treatment of Sweet Orange ( *Citrus sinensis* ) Peel on Yield , Energy Cons. *Jurnal Teknik Pertanian Terapan*, 3(2), 60–71. <https://doi.org/10.25047/jtpt.v3i2.6896>
8. Putriyanti, al fira, Mulyani, Y., Yunita, S., Ernawati, Wilis, H., Rinaldi, M., Ulfah, R., Jungjunan, R., Septiani, Y., & Budiana, W. (2024). *review jurnal: pemanfaatan lavender (lavandula angustifolia mill.) sebagai aromaterapi*. 22, 396–406. <https://doi.org/10.24198/farmaka.v22i3.55655.g26037>
9. Ramadhan, dwi sapri, Warsito, Silvianti, R., Cahayo, M., & Azzahra, vina octavia. (2026). *Indonesian Journal of Chemical Science and Technology ( IJCST )*. 09(1), 150–157. <https://doi.org/10.24114/ijcst.v9i1.72493>
10. Samang, T. K., & Aktawan, A. (2025). *Analisis Komparatif Metode Ekstraksi Minyak Atsiri Sereh ( Cymbopogon sp .): Review Comparative Analysis of Lemongrass ( Cymbopogon sp .) Essential Oil Extraction Methods : A Review*. 2(2), 117–125. <https://orcid.org/0000-0001-5401-6647>
11. Suyono, A., Pranowo, D., & Suprayogi. (2024). *Proses Ekstraksi Minyak Atsiri pada Kunyit ( Curcuma Domestica Val .) TALENTA Conference Series Proses Ekstraksi Minyak Atsiri pada Kunyit ( Curcuma Domestica Val .)*. 7(1). <https://doi.org/10.32734/ee.v7i1.2183>