World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(RESEARCH ARTICLE)

Check for updates

Analysis GC-MS (Gas Chromatography-Mass Spectrometry) 96% ethanol extract from turmeric (*Curcuma longa Linn. Syn. Curcuma Domestica Val.*)

Rizka Angrainy *, Asita Elengoe, Rathimalar Ayakannu, Siti Fatimah Hanum, Manisha and Berliana Irianti

University Lincoln, Malaysia, 47301 Petaling Jaya, Malaysia.

World Journal of Advanced Research and Reviews, 2024, 24(02), 2468–2474

Publication history: Received on 19 October 2024; revised on 26 November 2024; accepted on 29 November 2024

Article DOI: https://doi.org/10.30574/wjarr.2024.24.2.3647

Abstract

Background: Turmeric (*Curcuma longa* Linn. syn. Curcuma domestica Val.) is a plant that people believe can cure several diseases. According to a study conducted, it can treat gallbladder disease, colds, coughs, diabetes, hepatic disease, rheumatism and sinusitis, the content of turmeric extract (*Curcuma longa* Linn. syn. Curcuma domestica Val.) that turmeric rhizome (Curcuma domestica val) has antipyretic effects etc.

Objective: This research aims to determine the polar bioactive compounds contained in turmeric (*Curcuma longa* Linn. syn. Curcuma domestica Val.).

Method: The method used is extraction of turmeric (*Curcuma longa* Linn. syn. Curcuma domestica Val.) methanol solvent with a maceration process then analyzed using gas chromatography - mass spectrometry (GC-MS) to obtain information on the content of turmeric (*Curcuma longa* Linn. syn. Curcuma domestica Val.).

Results: The results of GC-MS analysis from this study showed that there were 35 peaks and 105 possible compound components that were successfully extracted from ethanol solvent from turmeric. compounds extracted using methanol solvent. The research results also show that there are three possible polar bioactive compounds in the highest peak of the GC-MS analysis results, namely 2-Methyl-6-(4-methylcyclohexa-1,3-dien-1-yl)hept-2-en-4-one;2-Methyl-6-(4-methyl-1,3-cyclohexadien-1-yl)-2-hepten-4-one; α-Turmerone; Turmerone.

Conclusion: There were 35 peaks and 105 possible compound components that were successfully extracted from ethanol solvent from turmeric. There are three compounds at the highest peak, namely tumerone, tumerone, and Verbenyl angelate, cis.

Keywords: Ethanol extract; Turmeric; *Curcuma longa* Linn. syn. Curcuma domestica Val.; GC-MS

1. Introduction

Gas Chromatography Mass Spectrometry (GC-MS) is a gas chromatography technique used in conjunction with mass spectrometry. Gas chromatography is used to look for compounds that easily evaporate under high vacuum and low pressure when heated. Meanwhile, mass spectrometry is used to determine molecular weight, molecular formula, and produce charged molecules (Darmapatni, K. A. G., A. Basori, 2016).

The turmeric plant is a perennial herb and has rhizomes (rhizomes/tubers) which belong to the ginger family (Zingiberaceae). The turmeric plant is a tropical plant native to Asia and has now spread to subtropical areas throughout the world (Ministry of Health of the Republic of Indonesia, 2017). The dark yellow powder produced from turmeric

* Corresponding author: Rizka Angrainy

rhizomes is known as turmeric powder. In India, China and Asia it has long been widely used for food and medicine (Ministry of Health of the Republic of Indonesia, 2007).

Nowadays, the turmeric plant is widely cultivated because it is traditionally believed to be able to treat various diseases. In India, turmeric powder is used to treat gallbladder disease, colds, coughs, diabetes, hepatic disease, rheumatism and sinusitis (Gupta SC, Patchva S, 2013). Traditional Chinese medicine uses turmeric powder to treat skin diseases, parasitic infections, inflammation, rheumatism, and biliary disorders (Li, S., W. Yuan, G. Deng, P. Wang, P. Yang, 2011).

Much research has been carried out on turmeric for medicinal purposes, one of which is research conducted by Kusuma Dewi which found that there was an effect of giving turmeric rhizome extract on the body temperature of white mice given the DPT vaccine (Kusuma D, 2014). Other research states that turmeric rhizome (curcuma domestica val) has an antipyretic effect on New Zealand male white rabbits (Kusumaningrum, 2018).

2. Methods

2.1. Place and time of research

This research was conducted from December to March 2024 at the Pharmacy Laboratory, Andalas University, Sumatra, Padang

2.2. Tools and materials

2.2.1. Tool

The equipment used in this research was a blender, knife, container, aluminum foil, 60 mesh sieve, centrifuge, vortex and Gas Chromatography-Mass Spectrometry (GC-MS)

2.3. Material

The ingredients used are turmeric (*Curcuma longa* Linn. syn. Curcuma domestica Val.) and methanol solvent.

2.3.1. Research procedure

The sample used was turmeric (*Curcuma longa* Linn. syn. Curcuma domestica Val.) which was obtained from the Riau area. Turmeric (*Curcuma longa* Linn. syn. Curcuma domestica Val.) was cleaned from impurities and washed under running water until clean. After that, the samples were dried in the sun until dry. Next, the dried samples were cut into pieces and ground until they became powder. The powder is then sieved using a mess 60 sieve to obtain a fine and homogeneous powder. Turmeric (*Curcuma longa* Linn. syn. Curcuma domestica Val.) is made using the maceration or soaking method. Then put it in a micro tube containing 0.5 grams of powder and 1.5 ml of methanol solvent, then vortexed for 1 minute, then centrifuged for 3 minutes at a speed of 9000 rpm. The supernatant formed was continued for GC-MS testing. The time was set for 60 minutes with an injector temperature of 260°C, detector 250°C, and column 325°C. The carrier gas used is helium gas as a carrier with a constant flow rate of 1 ml/minute. The identification process using the GC-MS tool produces several bioactive compounds which can be seen from the peaks of the chromatogram as identification data from chromatography and mass spectrometry (MS) results seen from the mass spectrum with each molecular weight of the bioactive compound.

In research conducted on testing the antibacterial effectiveness of turmeric extract on Bacillus sp (Gram positive) and Shigella dysentriae (Gram negative) bacteria, it showed that the inhibition zone for Gram positive bacteria was greater than for Gram negative bacteria. This is due to differences in wall structure between Gram-positive and Gram-negative bacteria (Yuliati Y., 2016). Wijayanto's research (2014) also showed that ethanol extract of white turmeric rhizomes against Staphylococcus aureus (Gram positive) and Escherichia coli (Gram negative) had greater antibacterial activity against the growth of Staphylococcus aureus than Escherichia coli (Wijayanto W., 2014). Research has proven in vitro that turmeric rhizome extraction is able to inhibit the growth of both Gram-positive and Gram-negative bacteria, such as E. coli, K. pneumoniae, P. aeruginosa, and S. Aureus (Hidayati E, July N, 2002).

With gas chromatography and mass spectrometry analysis of turmeric extract (*Curcuma longa* Linn. syn. Curcuma domestica Val.) which was dissolved in methanol solvent using a maceration process. The solvent used in the extraction process greatly determines the results of identifying the components of the extracted bioactive compounds. The methanol solvent is used based on the level of polarity. This solvent has the strongest group than nonpolar and is able

to extract more bioactive components which have higher polar compounds. The aim of this research is to identify the bioactive compounds of turmeric extract (*Curcuma longa* Linn. syn. Curcuma domestica Val.) using GC-MS analysis.

3. Results

3.1. GC-MS analysis

Gas chromatography has wide applications, being able to separate and analyze mixtures of several components. The gas chromatography results show the chromatogram of turmeric (*Curcuma longa* Linn. syn. Curcuma domestica Val.) In addition, identification of each peak in the chromatogram was carried out by matching the MS spectrum of each peak with the Wiley data base to determine the type of compound.

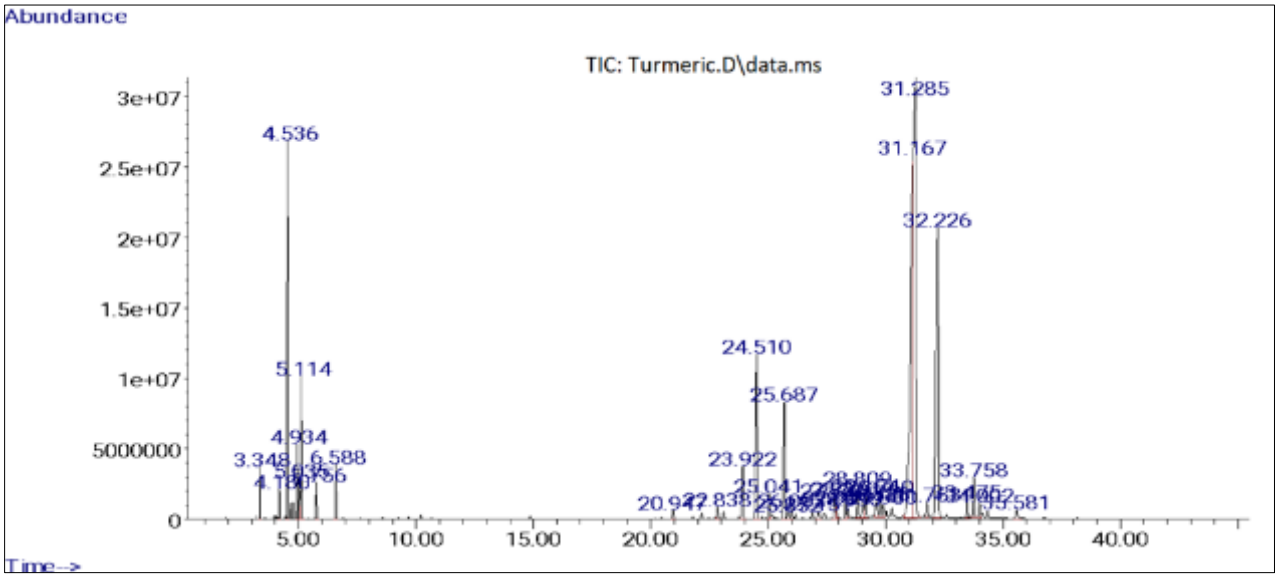

Figure 1 GC-MS Result

Gas chromatography is able to read compounds with the lowest concentrations so that secondary metabolites in plants can be identified with results in the form of chromatograms and mass spectra (Al-Rubaye, A. F., I. H. Hameed, 2017).

The analysis results show that there are 35 peaks and 105 compound components that were successfully extracted from the ethanol solvent with different Similarity Index (SI) (Table 1)

Table 1 Compounds from GC-MS Identification Results from Methanol Extract of Turmeric

Peak	Real Time	Hit 1	Hit 2	Hit 3	Ret. Area (%)
1	3.348	(1S)-2,6,6-Trimethylbicyclo[3.1.1]hept-2-ene	(1R)-2,6,6-Trimethylbicyclo[3.1.1]hept-2-ene	(1R)-2,6,6-Trimethylbicyclo[3.1.1]hept-2-ene	0.093
2	4.18	.beta.-Myrcene	.beta.-Myrcene	Bicyclo[3.1.0]hex-2-ene, 4-methyl-1-(1-methylethyl)-	0.097
3	4.536	.alpha.-Phellandrene	Bicyclo[3.1.0]hex-2-ene, 2-methyl-5-(1-methylethyl)-	.beta.-Phellandrene	0.129
4	4.934	p-Cymene	o-Cymene	o-Cymene	0.1
5	5.035	D-Limonene	D-Limonene	D-Limonene	0.097
6	5.114	Eucalyptol	Eucalyptol	Eucalyptol	0.169

7	5.756	.gamma.-Terpinene	.gamma.-Terpinene	.gamma.-Terpinene	0.151
8	6.588	Cyclohexene, 1-methyl-4-(1-methylethylidene)-	Cyclohexene, 1-methyl-4-(1-methylethylidene)-	(+)-4-Carene	0.194
9	20.947	Caryophyllene	Caryophyllene	Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trimethyl-4-vinyl-	0.19
10	22.838	(1S,5S,6R)-6-Methyl-2-methylene-6-(4-methylpent-3-en-1-yl)bicyclo[3.1.1]heptane	cis-.beta.-Farnesene	(E)-.beta.-Famesene	0.147
11	23.922	Benzene, 1-(1,5-dimethyl-4-hexenyl)-4-methyl-	Benzene, 1-(1,5-dimethyl-4-hexenyl)-4-methyl-	Benzene, 1-(1,5-dimethyl-4-hexenyl)-4-methyl-	0.244
12	24.51	1,3-Cyclohexadiene, 5-(1,5-dimethyl-4-hexenyl)-2-methyl-, [S-(R*,S*)]-	1,3-Cyclohexadiene, 5-(1,5-dimethyl-4-hexenyl)-2-methyl-, [S-(R*,S*)]-	trans-.alpha.-Bergamotene	0.309
13	25.041	.beta.-Bisabolene	.beta.-Bisabolene	(E)-.beta.-Famesene	0.158
14	25.687	Cyclohexene, 3-(1,5-dimethyl-4-hexenyl)-6-methylene-, [S-(R*,S*)]-	Cyclohexene, 3-(1,5-dimethyl-4-hexenyl)-6-methylene-, [S-(R*,S*)]-	Cyclohexene, 3-(1,5-dimethyl-4-hexenyl)-6-methylene-, [S-(R*,S*)]-	0.223
15	25.852	Hexane, 1-chloro-5-methyl-	(1S,5S)-2-Methyl-5-((R)-6-methylhept-5-en-2-yl)bicyclo[3.1.0]hex-2-ene	2,6-Dimethyl-1,3,5,7-octatetraene, E,E-	0.165
16	26.003	(E)-1-Methyl-4-(6-methylhept-5-en-2-ylidene)cyclohex-1-ene	(3S,6R)-3-Hydroperoxy-3-methyl-6-(prop-1-en-2-yl)cyclohex-1-ene	Tricyclo[3.1.0.0(2,4)]hexane, 3,6-diethyl-3,6-dimethyl-, trans-	0.147
17	27.151	2-Cyclohexen-1-one, 3,4,4-trimethyl-	Cyclooctene, 1,2-dimethyl-	3-Cyclohexen-1-carboxaldehyde, 3,4-dimethyl-	0.248
18	27.83	Tumerone	Tumerone	(E)-.gamma.-Atlantone	0.158
19	27.901	Benzene, 1-methyl-3-(1-methylethyl)-	1-Chloro-2-methyl-2-phenylpropane	p-Cymene	0.1
20	28.278	1H-Benzocycloheptene, 2,4a,5,6,7,8-hexahydro-3,5,5,9-tetramethyl-, (R)-	Di-epi-.alpha.-cedrene-(I)	1H-3a,7-Methanoazulene, 2,3,4,7,8,8a-hexahydro-3,6,8,8-tetramethyl-, [3R-(3.alpha.,3a.beta.,7.beta.,8a.alpha.)]-	0.176
21	28.393	Carvyl tiglate, cis-	Cumenyl angelate, o-	3-Methyl-2-butenoic acid, 2,7-dimethyloct-7-en-5-yn-4-yl ester	0.118
22	28.809	Bergamotol, Z-.alpha.-trans-	1H-3a,7-Methanoazulene, 2,3,4,7,8,8a-hexahydro-3,6,8,8-tetramethyl-, [3R-(3.alpha.,3a.beta.,7.beta.,8a.alpha.)]-	trans-.alpha.-Bergamotene	0.194

23	29.043	Cyclohexene, 5,6-diethenyl-1-methyl-	Bicyclo[4.1.0]hept-2-ene	1,3,5-Heptatriene, (E,E)-	0.197
24	29.154	Cyclohexene, 3-(1,5-dimethyl-4-hexenyl)-6-methylene-, [S-(R*,S*)]-	Di-epi-.alpha.-cedrene	Di-epi-.alpha.-cedrene-(I)	0.144
25	29.588	Benzene, 1-methyl-3-(1-methylethyl)-	2-Methyl-6-(p-tolyl)hept-2-en-4-ol	(.+/-.)-Dihydro-ar-turmerone	0.19
26	29.76	1H-3a,7-Methanoazulene, 2,3,4,7,8,8a-hexahydro-3,6,8,8-tetramethyl-, [3R-(3.alpha.,3a.beta.,7.beta.,8a.alpha.)]-	Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4-methyl-3-pentenyl)-	1H-3a,7-Methanoazulene, 2,3,4,7,8,8a-hexahydro-3,6,8,8-tetramethyl-, [3R-(3.alpha.,3a.beta.,7.beta.,8a.alpha.)]-	0.133
27	29.9	Santolina triene	Ethyl 2-[nitroso(phenyl)amino]propanoate	Tricyclo[7.1.0.0[1,3]]decane-2-carbaldehyde	0.162
28	31.167	Tumerone	Tumerone	Verbenyl angelate, cis-	0.38
29	31.285	Tumerone	Tumerone	1,2-Benzenediol, o-(3-chloropropionyl)-o'-cyclohexanecarbonyl-	0.348
30	31.763	cis-p-mentha-1(7),8-dien-2-ol	Phenol, 3-amino-	Phenol, 3-amino-	0.201
31	32.226	2-Methyl-6-(4-methylenecyclohex-2-en-1-yl)hept-2-en-4-one	Curlone	Tumerone	0.37
32	33.475	3-Methyl-6-(6-methylhept-5-en-2-yl)cyclohex-2-enone	(6R,7R)-Bisabolone	(S)-3-Methyl-6-((R)-6-methylhept-5-en-2-yl)cyclohex-2-enone	0.183
33	33.758	Tumerone	(Z)-.gamma.-Atlantone	1,3-Cyclohexadiene, 5,6-dimethyl-	0.269
34	34.002	Phenyl tiglate, 2-(1Z)-propenyl-	Phenyl angelate, 2-(1Z)-propenyl-	Phenyl angelate, 2-allyl-	0.154
35	35.581	2-Butenoic acid, 3-methyl-, methyl ester	2-Butenoic acid, 3-methyl-, methyl ester	aR-Turmerone	0.291

The most common compound component in turmeric in the ethanol extract is located at peak 35 with a retention area value of 0.38 with the three compounds found at peak 35, namely turmerone, turmerone, and Verbenyl angelate, cis-. According to the Pubchem National Center for Biotechnology Information (NCBI) website, the turmerone compound has a synonymous name, namely 2-Methyl-6-(4-methylcyclohexa-1,3-dien-1-yl)hept-2-en-4-one;2 -Methyl-6-(4-methyl-1,3-cyclohexadien-1-yl)-2-hepten-4-one; α-Turmerone; Turmerone. This compound is a class of sesquiterpenoid compounds. The following are some of the benefits of the turmerone compound, namely as an anti-inflammatory, turmeron has anti-inflammatory properties which can help reduce inflammation in the body, which can help reduce the risk of chronic diseases such as arthritis. Then as an antioxidant, this compound also has antioxidant properties, which can help fight cell damage due to free radicals and oxidative processes in the body and as brain protection, several studies show that turmerone can help protect the brain from degenerative diseases such as Alzheimer's and can improve cognitive function. (Goozee, K. G., Shah, T. M., Sohrabi, H. R., Rainey-Smith, S. R., Brown, B., Verdile, G., ... & Martins, 2016).

According to the Pubchem National Center for Biotechnology Information (NCBI) website, the synonymous compound of Verbenyl angelate, cis- is GKKYLCSKLCVAMK-RMKNXTFCSA-N and has the IUPAC name (4,6,6-trimethyl-2-bicyclo[3.1.1]hept-3 -enyl) (E)-2-methylbut-2-enoate. Verbenyl Angelate compound, cis- is a compound found in plant essential oils such as the essential oil of Aloysia citriodora (lemon verbena) leaves and several other species in the Verbena genus. It is a compound with refreshing aroma properties and has attracted research interest regarding its pharmacological properties and potential applications. Several studies have been conducted to explore the biological activity of this compound. Some of these include anticancer potential, antimicrobial activity, and therapeutic effects on inflammatory diseases (Casanova, J., Bighelli, A., & Tomi, 2008).

4. Conclusion

There were 35 peaks and 105 possible compound components that were successfully extracted from ethanol solvent from turmeric. There are three compounds at the highest peak, namely tumerone, tumerone, and Verbenyl angelate, cis.

Compliance with ethical standards

Acknowledgments

We are very grateful to Andalas University because we can carry out various experiments in the Andalas University pharmaceutical laboratory and the publication ethical clearance No.22/UN.16.2/KEP-FK/2024.

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Al-Rubaye, A. F., I. H. Hameed, and M. J. K. (2017). A Review: Uses of Gas Chromatography-Mass Spectrometry (GCMS) Technique for Analysis of Bioactive Natural Compounds of Some Plants. International Journal of Toxicological and Pharmacological Research, 9(1): 81-85.

[2] Casanova, J., Bighelli, A., & Tomi, F. (2008). Composition and chemical variability of the essential oil of Verbena officinalis L. from Corsica (France). Flavor and Fragrance Journal, 23(3), 159–165.

[3] Darmapatni, K. A. G., A. Basori, and N. M. S. (2016). Development of the GCMS Method for Determining Acetaminophen Levels in Human Hair Specimens. Graduate Bioscience Journal.

[4] Goozee, K. G., Shah, T. M., Sohrabi, H. R., Rainey-Smith, S. R., Brown, B., Verdile, G., ... & Martins, R. N. (2016). Examining the potential clinical value of curcumin in the prevention and diagnosis of Alzheimer's disease. British Journal of Nutrition, 115(3), 449–465.

[5] Gupta SC, Patchva S, A. B. (2013). Therapeutic role of curcumin: Lessons learned from clinical trials. The AAPS Journal, 15(1):195-218.

[6] Hidayati E, July N, M. E. (2002). Isolation of pathogenic enterobacteriaceae from foods seasoned and unspiced with turmeric (curcuma domestica val.) and testing the effect of turmeric extract (curcuma domestica val.) on the growth of the isolated bacteria. Journal of Mathematics and Science, 7(2):43–52.

[7] Indonesian Ministry of Health. (2007). Traditional medicine policy.

[8] Indonesian Ministry of Health. (2017). Traditional medicinal herb formulary.

[9] Kusuma D, M. I. T. A. (2014). Antibacterial activity of Majapahit leaf extract (Crescentia cujete) against the growth of the bacteria Ralstonia solanacearum which causes wilt disease. LanteraBio, 3(1).

[10] Kusumaningrum, Y. I. (2018). The Relationship between Mother's Knowledge and Parental Socioeconomic Factors with the Practice of Providing Complementary Breast Milk (MP-ASI) to Babies Aged 6-12 Months in Kemuning Village, Ampel Gading District, Pemalang Regency. (Doctoral Dissertation, Semarang State University).

[11] Li, S., W. Yuan, G. Deng, P. Wang, P. Yang, B. B. A. (2011). Chemical composition and product quality control of turmeric (*Curcuma longa* L.). Pharmaceuti. Crops, 2:28-54.

[12] Wijayanto W. (2014). Test of the antibacterial activity of ethanol extract of white turmeric rhizome (Curcuma mangga Val) against staphylococcus aureus ATCC 6538 and Eschercia coli ATCC 11229 in vitro. [Thesis]. Surakarta: Faculty of Medicine, Muhammadiyah University of Surakarta.

[13] Yuliati Y. (2016). Test the effectiveness of turmeric extract as an antibacterial in the growth of Bacillus sp and Shigella dysentriae in vitro. Journal of the Medical Profession, 10(1):26-32.