Journal of Chemical Health Risks

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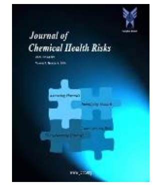
JCHR (2024) 14(1), 2673-2681 | ISSN:2251-6727



Unveiling the phytoconstituents of *Chrysanthemum indicum* L. by GCMS analysis

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(Received:25 January2024 Revised: 20February 2024 Accepted:25 February 2024)

KEYWORDS

Chrysanthemum indicum L., hydroalcoholic extract, GC-MS analysis, Aromatic plants, phytocompounds

ABSTRACT:

Chrysanthemum indicum L is a perennial herb in the Compositae family. The blossoms of *C. indicum* L. have long been utilised in eastern medicine to cure infectious disorders. Studies on medicinal herbs having antioxidant properties have been conducted more often in recent years. By using GC-MS analysis, the current work aims to identify the bioactive components from the hydroalcoholic flowers extract of *Chrysanthemum indicum* L. *Chrysanthemum indicum* L.'s hydroalcoholic extract included 109 phytocompounds, according to GC-MS analysis. The phenol and flavonoid families include the majority of active phytocompounds with antibacterial, antimicrobial, antifungal, antiproliferative, and neuroprotective properties. Natural myricetin and quercitin are thought to be abundant in *Chrysanthemum indicum* L. flowers, which is important for the development of potential medications.

Introduction

Medicinal plants have been used for a long time because of their antiviral, antibacterial, antioxidant, and anticancer properties. These plants provide a broad chemical library of bioactive compounds with a variety of applications. Medicinal herbs are regarded to be the most significant sources of naturally produced antioxidants. Among them, fragrant plants, which include blooming plants, have attracted a lot of attention lately. In order to treat a range of illnesses in both humans and animals, researchers are analysing their chemical composition and attempting to ascertain their pharmacological properties (J.A. Aboyewa et al., 2021). Mums, chrysanths, or chrysanthemums are blooming herbs belonging to the Asteraceae family's genus Chrysanthemum. The genus Chrysanthemum has approximately forty species that are indigenous to Asia, namely China, Japan, Mongolia, and eastern Europe (F.S. Youssef et al., 2020). Typically, chrysanthemum plants are perennial herbs with alternating, lobed leaves that bear colourful blooms (purple, white, yellow, and other colours). For growth and blooming, chrysanthemum need full sun and well-drained soil (M.H. Shahrajabian et al., 2019). One of the most significant flower harvests in terms of commerce and a well-known decorative horticulture plant is chrysanthemum (S.K. Verma et al., 2012). Essential oils (EOs) with a variety of bioactivities that are effective and beneficial for healthcare systems can be found in flowers (P. Ren et al., 2018). Furthermore, a wide variety of phenolic acids, flavonoids, and lignans with substantial biological effects have been demonstrated to be produced by Chrysanthemum flowers (A.R. Han et al., 2019). Quercetin and myricetin, which are important for the development of future medications, are naturally occurring in the C. indicum flower (L.Y. Wu et

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JCHR (2024) 14(1), 2673-2681 | ISSN:2251-6727

al., 2010). *Chrysanthemum indicum* has long been used as a folk treatment for headache, eye irritation, and bone and muscle degradation. Additionally, *Chrysanthemum indicum* tea has been used to alleviate anxiety through the promotion of calm and the treatment of sleeplessness. According to recent research, *Chrysanthemum indicum* may have both in vitro and in vivo anti-inflammatory and anti-apoptotic properties (Hong SA et al., 2012). Chemicals obtained from plants that are physiologically active are called phytochemicals. Beyond the health benefits associated with macronutrients and Chrysanthemum spp., they offer other advantages for human health (Santanu Kumar Hotta et al., 2021). The secondary metabolites of the plant, phenols, serve as antioxidants in the defence mechanisms of the plant. Water-soluble, naturally occurring pigments called anthocyanins give plants their distinct hues. Natural colours are imparted by pigments called carotenoids, which are lipid-soluble and colourful. Polyphenolic substances renowned for their positive effects on health are called flavonoids. Terpenoids are a broad class of biologically active substances with anti-infective effects. Monoterpenes and sesquiterpenes are the two main types of terpenoids (Niharika Sharma et al., 2023). The present study utilises GC-MS analysis to identify the phytocompounds found in hydroalcoholic flower extract of *Chrysanthemum indicum*.

Materials and methods

The fresh *Chrysanthemum indicum* L. flowers were collected from Koyambedu market and has been identified and authenticated by Dr P.Jeyaraman, PhD., Director, Retd Professor, Presidency College, in Plant Anatomy Research Centre. The collected shadow dried and powdered in the herbal grinder. The powdered sample was stored in an airtight container.

Preparation of *Chrysanthemum indicum* L. flower extract

1 kg of dried, powdered flower is extracted with hydro-alcoholic extract (50%) for the maceration periods (24 hours). The extract was filtered through Whatman No.1 filter paper after the maceration period. The extract was concentrated by using the rotary evaporator and the dry weight of the crude extract was weighed and stored at 4°C in a dark place for further analysis.

GC-MS Analysis

GC-MS analysis was carried out on GC-MS - 5975C (AGILENT) under the following conditions. DB-5ms Agilent (30.0 m × 0.25 mm × 0.25 μm) was used. Using helium as carrier gas (99.9995% purity) at a constant flow rate of 1.51 mL/min and an injection volume of 2 μL was employed in a split mode. The injector temperature was maintained at 240°C, and the column temperature was programmed to 70°C (isothermal for 2 min) with increasing temperature of 10°C/min to 300°C (isothermal for 9 min). 200°C for ion source temperature and 240°C for interface temperature were maintained. The mass spectra were obtained through ionization energy of 70 eV in the EI mode. Total 30 min need to run GC-MS. The phytocompounds were identified by comparison of mass spectra with the national libraries (NIST - 11).

Identification of components

The phytocomponents found in the hydroalcoholic extract have been identified by matching the spectrum to the 62,000 patterns in the National Institute of Standards and Technology (NIST) database. Name, molecular formula, structure, and retention time of the chemical were ascertained. Comparing the average peak area of each component to the total areas enabled the estimation of each component's percentage of area. The spectra of the known compound kept in the NIST collection was compared to that of the unknown compound.

Results and discussion

GC-MS is a technique which combines the properties of gas chromatography–mass spectrometry which identifies various substances within the test sample which includes hydrocarbons, alcohols, acids, esters, alkaloids, steroids, amino and nitro compounds, and so on (Saravanan P et al., 2014). GC-MS is also useful for identifying traces in materials. GC-MS is known as the "gold standard" for forensic substance identification due to its capacity to analyse particular tests (Harborne JB, 1984 & Wagner H et al., 1984). The hydroalcoholic extract of

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JCHR (2024) 14(1), 2673-2681 | ISSN:2251-6727

Chrysanthemum indicum L. included 109 components, according to GC-MS analysis. The active principles with their retention time (RT), molecular formula and molecular weight (MW) are presented in Table 1. The chromatogram of the hydro-alcoholic flower extract of *Chrysanthemum indicum* L. was shown in Figure 1.

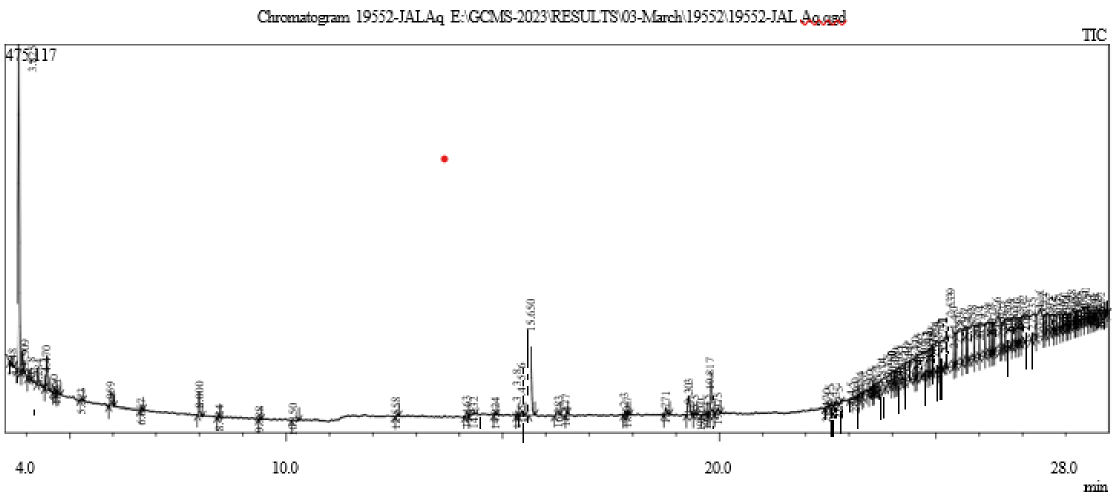

Figure 1: GC-MS chromatogram of hydroalcoholic flower extract of *Chrysanthemum indicum* L.

Peak	R.Time	Name	Molecular formula	Molecular weight
1. 1	3.648	BUTANOIC ACID, ETHYL ESTER	$C_6H_{12}O_2$	116.16
2. 2	3.825	1,1-DIETHOXY ETHANE	$C_6H_{14}O_2$	118.17
3. 3	3.909	Propane, 1-(1-ethoxyethoxy)-	$C_7H_{16}O_2$	132.2
4. 4	4.058	2-PENTANOL, ACETATE	$C_7H_{14}O_2$	130.18
5. 5	4.284	2-PENTANONE, 4-HYDROXY-4-METHYL-	$C_6H_{12}O_2$	116.16
6. 6	4.470	PROPANE, 1,1-DIETHOXY-2-METHYL-	$C_8H_{18}O_2$	146.23
7. 7	4.650	3-Nitropropanoic acid	$C_3H_5NO_4$	119.08
8. 8	4.731	Vinyl ether	C_4H_6O	70.09
9. 9	5.273	3-Buten-2-ol	C_4H_8O	72.11
10. 10	5.959	BUTANE, 1,1-DIETHOXY-3-METHYL-	$C_9H_{20}O_2$	160.25
11. 11	6.657	Butanoic acid, anhydride	$C_8H_{14}O_3$	158.19

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2. 12	8.000	Propane, 1,1,3-triethoxy-	$C_9H_{20}O_3$	176.25
3. 13	8.434	ERYTHRO-2-ETHYL-3-ETHOXYBUTAN-1-OL	$C_8H_{18}O_2$	146.23
4. 14	9.388	BUT-3-YNOIC ACID	$C_4H_4O_2$	84.07
5. 15	10.150	2-PROPENOIC ACID, ETHENYL ESTER	$C_5H_6O_2$	98.1
6. 16	12.558	TRIS(3,5,5-TRIMETHYLHEXYL)AMINE	$C_{27}H_{57}N$	395.8
7. 17	14.163	1,3-DIPHENYL-1-((TRIMETHYLSILYL)OXY)-1(Z)-HEPTENE	$C_{22}H_{27}NOSi$	349.54
8. 18	14.332	1,3-DIOXOLANE	$C_3H_6O_2$	74.08
9. 20	15.338	2-Aminophenol, 2TMS derivative	$C_{12}H_{23}NOSi_2$	253.49
0. 21	15.456	2,4-Dimethylsulfolane	$C_6H_{12}O_2S$	148.23
1. 22	15.650	1,2-BENZENEDICARBOXYLIC ACID, DIETHYL ESTER	$C_{12}H_{14}O_4$	222.24
2. 23	16.283	N-(Trifluoracetyl)-O,O',O''-tris(trimethylsilyl)epinephrine	$C_{20}H_{36}F_3NO_4Si_3$	495.8
3. 24	16.477	Nonanoic acid, 2-oxo-, methyl ester	$C_{10}H_{18}O_3$	186.25
4. 25	17.823	HEPTANE, 1-BROMO-	$C_7H_{15}Br$	179.1
5. 26	17.897	ACETONYL DECYL ETHER	$C_{13}H_{26}O_2$	214.34
6. 27	18.771	3-Hexanone, 2,2-dimethyl-	$C_8H_{16}O$	128.21
7. 28	19.303	Methanediamine, N,N,N',N'-tetraethyl-	$C_9H_{22}N_2$	158.28
8. 29	19.455	1,2,4-Benzenetricarboxylic acid, 1,2-dimethyl ester	$C_{11}H_{10}O_6$	238.19
9. 30	19.600	(E)-1-(PHENYLTHIO)-2-METHYL-3,5-DIOXAHEX-1-ENE	$C_8H_8O_2S$	168.21
0. 31	19.735	SULFOXYLIC DIAMIDE, N,N'-BIS(1,1,3,3-TETRAMETHYLBUTYL)-N,N	$C_{22}H_{52}N_2SSi_2$	432.9
1. 32	19.817	1,2-BENZENEDICARBOXYLIC ACID, DIBUTYL ESTER	$C_{16}H_{22}O_4$	278.34
2. 33	19.975	2-ETHYL-5,9-DIMETHYL-TRANS-4,8-DECADIENAL	$C_{14}H_{24}O$	208.34
3. 34	22.470	3,4,5,6-TETRACHLORO-12,12-DIMETHOXY-(ENDO,ENDO)-TETRACY	$C_{14}H_{14}C_{14}O_3$	372.1
4. 35	22.555	9(10H)-ANTHRACENONE, 10-ETHOXY-, OXIME	$C_{16}H_{14}O_2$	238.28
5. 36	22.732	5-HYDROXY-4-(3-METHYLFURYL)HEPT-4-EN-3-ONE	$C_{12}H_{16}O_3$	208.26

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6. 37	22.775	Isoxazole-5-carbonyl chloride	$C_4H_2ClNO_2$	131.52
7. 38	23.045	4-OXO-.ALPHA.-DAMASCONE	$C_{13}H_{18}O_2$	206.28
8. 39	23.160	(5S)-4,4,5-TRIMETHYLCYCLOHEX-2-EN-1-ONE	$C_9H_{14}O$	138.21
9. 40	23.274	(+-)-CIS-2-(2,5-OCTDIYNYL)-3-UNDECYLOXIRANE	$C_{13}H_{18}O$	190.28
0. 41	23.365	10.BETA.-METHYL-7.BETA.-ISOPROPYL-CIS-2-DECALONE	$C_{14}H_{24}O$	208.18
1. 42	23.490	Trifluoromethanesulfonic anhydride	$C_2F_6O_5S_2$	282.14
2. 43	23.555	1-(BUTYLTHIO)-2-BUTYLCYCLOTRIDECENE	$C_{12}H_{24}S_2$	232.13
3. 44	23.611	1,1,1,3,5,7,9,9,9-NONAMETHYLPENTASILOXANE	$C_9H_{27}O_4Si_5$	339.73
4. 45	23.670	1-HYDROXY-2,6-DI-TERT-BUTYLBIPHENYL	$C_{14}H_{22}O$	206.329
5. 46	23.804	3-Butoxy-1,1,1,5,5,5-hexamethyl-3-(trimethylsiloxy)trisiloxane	$C_{13}H_{36}O_4Si_4$	368.76
6. 47	23.935	Silanol, trimethyl-, phosphite (3:1)	$C_9H_{27}O_3PSi_3$	298.54
7. 48	23.990	1,1,3,3,5,5,7,7,9,9,11,11-DODECAMETHYL	$C_{12}H_{36}Cl_2O_5Si_6$	499.8
8. 49	24.050	2,2,4,4,6,6,8,8-OCTAMETHYL-1,3,5,7,2,4,6,8-TETRAOXATETRASILOCA	$C_8H_{24}O_6Si_5$	356.70
9. 50	24.100	1,1,3,3,5,5,7,7,9,9,11,11-DODECAMETHYL-HEXASILOXANE	$C_{12}H_{38}O_5Si_6$	430.94
50.	24.165	3-Ethoxy-1,1,1,5,5,5-hexamethyl-3-(trimethylsiloxy)trisiloxane	$C_{11}H_{32}O_4Si_4$	340.71
51.	24.250	2-METHYL-3-(METHYLETHENYL)-4-[[TRIS(METHYLETHYL)SILYL]O	$C_{36}H_{56}O_3Si$	248.66
52.	24.340	4H-1-BENZOPYRAN-4-ONE, 5,7-DIHYDROXY-2-(4-METHOXYPHENYL	$C_{16}H_{12}O_5$	284.26
53.	24.440	CYCLOTETRASILOXANE, OCTAMETHYL-	$C_8H_{24}O_4Si_4$	296.61
54.	24.540	3-PYRIDAZINECARBOXAMIDE, 4-[1-[[(1,1-DIMETHYLETHYL)DIMET	$C_5H_5N_3O$	123.11
55.	24.605	2,6-Lutidine 3,5-dichloro-4-dodecylthio-	$C_{19}H_{31}Cl_2NS$	376.4
56.	24.697	OCTADECANOIC ACID, 2-AMINO-, TRIMETHYLSILYL DERIV.	$C_{21}H_{45}NO_2Si$	371.7
57.	24.783	5,5-DIMETHYL-2-(TRIMETHYLSILYL)-1,2,3,4,4A,5,6,7-OCTAHYDRO-2	$C_{15}H_{28}OSi$	252.47

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58.	24.843	Hexanoic acid, 6,6'-diselenodi-	$C_{12}H_{22}O_4Se_2$	388.2
59.	24.900	1,2,3,4-TRIDECANETETROL	$C_{13}H_{28}O_4$	248.36
60.	24.955	1,3-Dioxolane, 4-ethyl-5-hexyl-2,2-bis(trifluoromethyl)-, cis-	$C_{13}H_{20}F_6O_2$	322.29
61.	25.024	Isoxazole-5-carbonyl chloride	$C_4H_2ClNO_2$	131.52
62.	25.130	2-Furanmethanediol, dipropionate	$C_{11}H_{14}O_5$	226.23
63.	25.171	3,14-DIOXA-2,15-DISILAHEXADECANE, 2,2,15,15-TETRAMETHYL-	$C_{16}H_{38}O_2Si_2$	318.64
64.	25.231	CYCLOBUT[5,6]INDENO[3A,4-B]OXIRENE, DECAHYDRO-3,3,5A-TRI	$C_{15}H_{24}O$	0.0
65.	25.339	3-PYRIDAZINECARBOXAMIDE, 4-[1-[[(1,1-DIMETHYLETHYL)DIMET	$C_5H_5N_3O$	123.11
66.	25.440	Silane, diethylpentadecyloxy(2-phenylethoxy)-	$C_{27}H_{50}O_2Si$	434.8
67.	25.559	N-[(DIMETHYLAMINO)(T-BUTYLTHIO)METHYLENE]-BENZAMIDE	$C_{14}H_{20}N_{2O}S$	264.39
68.	25.697	SILANE, TRIMETHYL[5-METHYL-2-(1-METHYLETHYL)PHENOXY]-	$C_{13}H_{22}OSi$	222.4
69.	25.748	Hexanoic acid, 6,6'-diselenodi-	$C_{12}H_{22}O_4Se_2$	388.2
70.	25.977	Glutaric acid, hex-4-en-1-yl dec-2-yl ester	$C_{21}H_{38}O_4$	354.5
71.	26.044	1-METHYLENESPIRO[2.11]TETRADECAN-4-ONE	$C_{15}H_{24}O$	220.35
72.	26.228	Silane, (2-ethoxycyclohexyl)trimethyl-, trans-	$C_{11}H_{24}OSi$	200.39
73.	26.276	alpha.-D-Xylopyranoside, methyl, trimethanesulfonate	$C_9H_{18}O_{11}S_3$	398.4
74.	26.332	Benzilic acid, 2TMS derivative	$C_{20}H_{28}O_3Si_2$	372.6
75.	26.426	1,1,3,3,5,5,7,7,9,9,11,11,13,13,15,15-HEXADECAMETHYLOCTASILOXA	$C_{16}H_{50}O_7Si_8$	79.24
76.	26.525	4-(4-Methyl-2,4-diphenyl-2-pentyl)phenol	$C_{24}H_{26}O$	330.5
77.	26.591	2-(2-Methoxyethoxy)ethyl hydrogen phthalate, TBDMS derivative	$C_{19}H_{30}O_6Si$	382.5
78.	26.680	CIS-6-(OXOMETHYL)-5-(TRIMETHYLSILYL)BICYCLO[4.4.0]DEC-1-EN	$C_{14}H_{22}O_2Si$	250.41
79.	26.739	Silane, diethyl(3,5-dimethylphenoxy)butyloxy-	$C_{16}H_{28}O_2Si$	280.48
80.	26.819	1-Ethoxy-2-propanol, pentafluoropropionate	$C_8H_{11}F_5O_3$	250.16

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81.	26.890	14-Heptadecenal	$C_{17}H_{32}O$	252.4
82.	26.938	Methyl 2-([(furan-2-ylmethyl)carbamoyl]amino)-4H,5H,6H-cyclopenta[b]thio	$C_8H_{10}N_2O_4$	198.18
83.	27.012	DIMETHOXYGLYCEROL DOCOSYL ETHER	$C_{27}H_{56}O_5$	460.7
84.	27.085	1s,2R,3R,4R,7R,11R-1,3,4,7-Tetramethyltricyclo[5.3.1.0(4,11)]undecan-2,3-d	$C_{15}H_{24}O$	220.35
85.	27.235	Hexa(methoxymethyl)melamine	$C_{15}H_{30}N_6O_6$	390.44
86.	27.410	Benzoic acid, 4-(5,5-dimethyl-1,3-dioxan-2-yl)-, methyl ester	$C_{14}H_{18}O_4$	250.29
87.	27.522	Phthalic acid, dodecyl tetrahydrofurfuryl ester	$C_{25}H_{38}O_5$	418.6
88.	27.573	Phthalic acid, 2,2,3,3,4,4,4-heptafluorobutyl hexadecyl ester	$C_{28}H_{39}F_7O_4$	572.6
89.	27.695	1,1,3,3-Tetramethyl-3-(1-methylpropoxy)disiloxan-1-ol	$C_8H_{22}O_3Si_2$	222.43
90.	27.765	2H-PYRAN, 6-(BROMOMETHYL)-2-ETHOXY-2-(ETHOXY-2,2,2-D3)TET	$C_{15}H_{24}O$	220.35
91.	27.815	Phthalic acid, neopentyl 4-(2-phenylprop-2-yl)phenyl ester	$C_{28}H_{30}O_4$	430.5
92.	27.907	2-Propylphenol, TBDMS derivative	$C_{15}H_{26}OSi$	250.45
93.	27.990	2-Methyl-6-tert-butylphenol, TBDMS derivative	$C_{17}H_{30}OSi$	278.5
94.	28.030	2-(2,2-Dimethylpropyl)-1,1-bis-(9H-fluoren-9-yl)-3-vinylsiletane	$C_{36}H_{36}Si$	496.8
95.	28.084	DIMER OF HEXAHYDRO-1H-CYCLOPENTA[C]FURAN-1,6-DIONE	$C_{14}H_{16}O_6$	280.28
96.	28.168	HEPTASILOXANE, 1,1,3,3,5,5,7,7,9,9,11,11,13,13-TETRADECAMETHYL	$C_{14}H_{42}O_6Si_7$	503.07
97.	28.215	METHYL 3-HYDROXYHEXADECANOATE	$C_{17}H_{34}O_3$	286.4
98.	28.261	METHANE, TETRABROMO-	CBr_4	331.63
99.	28.306	[1,3,5]Triazine-2,4-diamine, 6-methoxy-N,N,N',N'-tetramethyl-	$C_8H_{15}N_5O$	197.24
100.	28.403	4(3H)-Pteridinone, 2-amino-5,6-dihydro-5-methyl-6,7-diphenyl-	$C_{19}H_{17}N_5O$	331.4
101.	28.470	3-CYCLOHEXENE-1-PROPANOIC ACID, .BETA.,4-DIMETHYL-1-(2-ME	$C_{17}H_{28}O_3$	280.4
102.	28.535	Malonic acid, 2-(4-ethoxyphenyl)-2-hydroxy-, diisobutyl ester	$C_{19}H_{28}O_6$	352.4
103.	28.580	METHYL 1,2-O-ISOPROPYLIDENE-5,6,7,8-TETRADEOXY-.ALPHA.,D-X	$C_9H_{16}O_6$	220.22
104.	28.644	3-Hexen-1-ol benzoate	$C_{13}H_{16}O_2$	204.26

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105.	28.679	14-PENTADECYNOIC ACID, METHYL ESTER	$C_{16}H_{28}O_2$	252.39
106.	28.769	Glutaric acid, 3-methylbut-2-yl 2,6-dimethylnon-1-en-3-yn-5-yl ester	$C_{21}H_{34}O_4$	350.5
107.	28.869	1-Benzoyl-2-phenyl-3-(tert-butyl)cyclopropane	$C_{20}H_{22}O$	278.39
108.	28.922	1-Chloromethyl-1-cyclohexyloxy-1-silacyclohexane	$C_{12}H_{23}ClOSi$	246.85
109.	28.965	5-ETHYL-2-METHYLOXAZOLE	C_6H_9NO	111.14

GC-MS is highly effective and versatile analytical technique with numerous scientific applications in the field of applied sciences and technology. Gas chromatography (GC) in particular is characterized by sensitivity and reliability of separations and detection of complex sample mixtures. GC-MS analysis of plants is the main research tool commonly employed for determining the composition of complex mixtures (Chauhan *et al.,* 2014). About one hundred and nine compounds are identified in hydroalcoholic extract of *Chrysanthemum indicum* L. flowers. The prevailing compounds are BUTANOIC ACID, ETHYL ESTER, 3-Nitropropanoic acid, Vinyl ether, 2,4-Dimethylsulfolane, Trifluoromethanesulfonic anhydride, Silanol, trimethyl-, phosphite, Glutaric acid, hex-4-en-1-yl dec-2-yl ester, DIMETHOXYGLYCEROL DOCOSYL ETHER, Phthalic acid, 2,2,3,3,4,4,4-heptafluorobutyl hexadecyl ester, Malonic acid, 2-(4-ethoxyphenyl)-2-hydroxy-, diisobutyl ester, 3-Hexen-1-ol benzoate, 1-Chloromethyl-1-cyclohexyloxy-1-silacyclohexane. 3-Nitropropanoic acid are generally antioxidative and revealed its anticancer potential against cervical cancer using HeLa cell line and it shows no significant cytotoxicity to normal human embryonic kidney cell line (HET 293 T) (Madhuree Kumari et al., 2018). 14-Heptadecenal possess antimicrobial activity against pathogenic microorganisms (Vithya Dharmaraj et al., 2021). Hexanoic acid possess antioxidant, analgesic and proapoptotic properties (Siwar Ben Ayache et al., 2020). The *Chrysanthemum indicum* L.'s abundance of bioactive chemicals supports traditional healers' use of the entire plant to treat a range of illnesses. However, isolating certain phytochemical components and exposing them to biological action will undoubtedly have positive outcomes. Because they include proteins (amino acids), carbohydrates, and some volatile substances found in essential oils, chrysanthemum flowers are highly nutritious. Numerous active ingredients in chrysanthemum flowers are believed to have qualities that enhance or control human physiological and metabolic processes. These bioactive substances have a significant role as modulators and stimulants in a number of diseases, including heart disease, osteoporosis, and eye conditions. Several pharmaceutical studies were carried out, and it has been demonstrated that chrysanthemum flowers have a variety of bioactivities, prominent among them being anti-inflammatory, hepatoprotective, and antibacterial properties (S.U. Ponnamma et al., 2012). The benefits of *Chrysanthemum indicum* L., a plant with numerous therapeutic uses that is highly regarded as having phytopharmaceutical significance, are demonstrated in this study. *Chrysanthemum indicum* L. is hence a valuable medicinal herb in traditional medicine.

Conclusion

In the current study, GC-MS analysis was used to identify the bioactive compounds from the hydroalcoholic flower extract of *Chrysanthemum indicum* L. Because chrysanthemum flowers contain a variety of phenolic compounds, flavonoids, and other metabolites, they have strong nutraceutical, phytochemical, and pharmacological/biological properties, which supports the plant's medicinal usage in traditional medicine. *Chrysanthemum indicum* L. may therefore be used to discover new medications; however, more research is required to extract novel bioactive chemicals and determine the toxicity profile using *in vitro* and *in vivo* models.

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