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GC- MS ANALYSIS OF LEAVES AND FLOWERS OF *POGOSTEMON QUADRIFOLIUS* (BENTH.) F.MUELL. (LAMIACEAE)

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ABSTRACT

The aim of the present study is to determine the phytoconstituents present in the petroleum ether, acetone and methanol extracts of leaves and flowers of *Pogostemon quadrifolius* using GC –MS. The shade dried powdered leaves and flowers of *Pogostemon quadrifolius* were extracted sequentially using petroleum ether, acetone and methanol in increasing order of polarity using soxhlet apparatus. GC- MS analysis were performed using Thermo Scientific Trace 1300 Gas chromatograph equipped with ISQ- QD Mass spectrometer. GC MS analysis revealed 37 phytochemical compounds in the petroleum ether extract, 30 compounds in the acetone extract and 6 compounds in the methanol extract of leaves. 2,4,6 Trimethoxy acetophenone was the major phytoconstituent in petroleum ether (25.95%) and acetone extracts (77.96%) of leaves where 1-Methoxy-4,4a,5,6,7,8-hexahydro-2(3H)-naphthalenone (66.65%) was the major constituent in methanol extract of leaves. 44 phytochemical compounds were found present in the petroleum ether extract, 12 compounds in the acetone extract and 24 compounds in the methanol extract of flowers of *Pogostemon quadrifolius*. 3 methyl pentane (57.39%) was the major phytoconstituent in petroleum ether extract of flowers, where n – butane (53.26%) and geranyl vinyl ether (44.64%) were the major compounds in acetone and methanol extracts.

KEYWORDS: *Pogostemon quadrifolius*, phytoconstituents, GC MS analysis, leaves, flowers.

INTRODUCTION

Pogostemon quadrifolius (Benth.) is a shrub distributed in India, Bangladesh and Myanmar[1,2] The plant is used as folk medicine in India and Bangladesh for the treatment against chicken pox worms and also as a blood purifier.[3,4,5,6,7] The plant also exhibits mosquito larvicidal and antimicrobial property.[8,9,10] The leaf extracts of *P. quadrifolius* (Benth.) exhibited antiproliferative property due to the presence of a new compound (Z)-ethylidene-4,6-dimethoxycoumaran-3-one and it induces apoptosis in cancer cell line.[11,12,13] *P. quadrifolius* (Benth.) leaf methanol extract showed DPPH radical scavenging property due to the presence of phenolic compounds.[14] The present study deals with GC MS analysis of various leaf and flower extracts of *Pogostemon quadrifolius* (Benth.).

MATERIALS AND METHODS

Collection of plant materials and preparation

Pogostemon quadrifolius (Benth.) was collected from Panakkad, Karimbam, Taliparamba and authenticated by Dr. A.K. Pradeep, Department of Botany, University of Calicut. The leaves and flowers were washed thoroughly and dried in shade. The dried leaves and flowers were then powdered using a mixer grinder and the powder was kept in small airtight bottles with proper labeling. The powdered leaves and flowers were extracted sequentially using petroleum ether, acetone, methanol and water in increasing order of polarity using soxhlet apparatus until all the constituents were completely eluted. The extracts were then filtered and evaporated to dry. The dried solvent extracts were used for further studies.

GC MS analysis

The GC-MS analysis of leaf and flower extracts of *Pogostemon quadrifolius* (Benth.) were performed using Thermo Scientific Trace 1300 Gas chromatograph equipped with ISQ- QD Mass spectrometer with TG-5MS column (30 m × 0.25 mm ×0.25 µm). Helium gas (99.99%) was used as the carrier gas at constant flow rate 1ml/minute and an injection volume of 1µl was employed (Split ratio 1:8). An injection port temperature of 280ºC and an ion-source temperature of 200ºC was set. The oven temperature was programmed from 70ºC for 3 minutes with an increase of 10ºC / minute to 200ºC with a hold time of 2 minutes. Then temperature was increased at a rate of 5ºC/min till 240ºC with a hold time of 5 minutes. Total GC running time was 30 minutes. Oven temperature and GC running time was adjusted accordingly in each extraction. The components in the extract were identified based on the mass spectra of latest NIST library data.

RESULTS AND DISCUSSION

The GC MS analysis of petroleum ether, acetone and methanol extracts of leaves and flowers of *Pogostemon quadrifolius* (Benth.) indicated the presence of 37 phytochemical compounds in the petroleum ether extract, 30 compounds in the acetone extract and 6 compounds in the methanol extract of leaves. 2,4,6 Trimethoxy acetophenone was the major phytoconstituent in petroleum ether (25.95%) and acetone extracts (77.96%) of leaves where 1-Methoxy-4,4a,5,6,7,8-hexahydro-2(3H)-naphthalenone (66.65%) was the major constituent in methanol extract of leaves. 44 phytochemical compounds were found present in the petroleum ether extract, 12 compounds in the acetone extract and 24 compounds in the methanol extract of flowers of *Pogostemon quadrifolius* . 3 methyl pentane (57.39%) was the major phytoconstituent in petroleum ether extract of flowers, where n – butane (53.26%) and geranyl vinyl ether (44.64%) were the major compounds in acetone and methanol extracts. The details of phytoconstituents in each extracts of leaves and flowers are given in the tables along with the chromatograms. The biological activities of major compounds in each extracts of leaves and flowers are also provided in the respective tables.

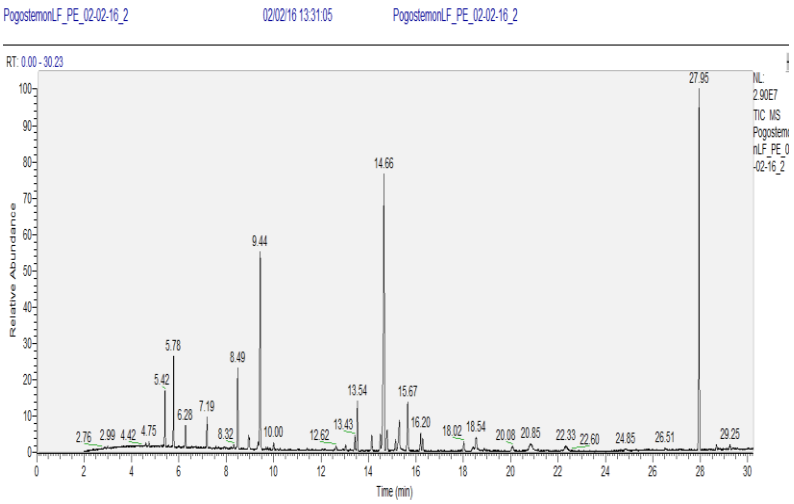

Figure 1. GC MS Chromatogram of Petroleum ether extract of leaves of *Pogostemon quadrifolius*

Table 1. Phytocompounds identified in the Petroleum ether extract of leaves of *Pogostemon quadrifolius* by GC MS

No	RT	Name of Compound	Molecular Formula	MW	Peak area %
1.	4.61	4 Methyloctanoic acid	C9H18O2	158	0.1 %
2	4.75	Isoeugenol	C10H12O2	164	0.14%
3.	5.42	Phloroglucinol trimethyl ether	C9H12 O3	168	2.97%
4.	5.78	1-(1-Ethylvinyl)-1-(2-methylene-3-	C12H18	162	4.94%

		butenyl) cyclopropane			
5.	6.28	trans-á-Ocimene	C10 H16	136	1.26 %
6.	7.19	Germacrene D	C15H24	204	1.73%
7.	7.57	5,9-Tetradecadiyne	C14H22	190	0 .03%
8.	8.32	1,9-Decadiyne	C10H14	134	0.11%
9.	8.49	Caryophyllene oxide	C15H24O	220	5.00%
10.	8.95	Dihydromyrcene	C10H18	138	1.47%
11.	9.44	.tau.-Cadinol	C15H26O	222	14.02%
12.	9.68	(3-tert-Butyl-5-hydroxymethyl-cyclohex-2-enyl)-methanol	C12H22O2	198	0.03%
13.	9.75	Longipinene epoxide	C15H24O	220	0.02%
14.	10.0	Patchoulane	C15H26	206	0.36%
15.	12.62	cis-Z-à-Bisabolene epoxide	C15H24O	220	0.17%
16.	13.04	2-Isopropyl-5,9-dimethylcyclodecanone	C15H28O	224	0.25%
17.	13.43	4,6-Dimethoxycoumaranone	C10H10O4	194	0.96%
18.	13.53	1-(2,4,5-Trimethoxyphenyl)butan-1-one	C13H18O4	238	3.46%
19.	14.14	3-Hydroxy-5-isopropyl-2-methylbenzo-1,4-quinone	C10H12O3	180	1.02%
20.	14.51	Isolongifolan-8-ol	C15H26O	222	0.96%
21.	14.66	2,4,6-Trimethoxyacetophenone	C11H14O4	210	25.95%
22.	14.79	3-Hydroxy-2-isopropyl-5-methylbenzo-1,4-quinone	C10H12O3	180	1.88%
23.	15.14	6,7-dimethoxy-4-methyl- coumarin	C12H12O4	220	0.64%
24.	15.31	n- Hexadecanoic acid	C16H32O2	256	3.03%
25.	15.67	Aromadendrene oxide-(1)	C15H24O	220	4.00%
26.	16.20	2,2,2-Trifluoro-1-(2,4,6-trimethoxy-phenyl)-ethanone	C11H11F3O4	264	1.12%
27.	16.29	1-[2-Oxo-2-(3,4,5-trimethoxyphenyl)ethyl]-2(1H)-pyridinone	C16H17NO5	303	0.76%
28.	18.02	1-(4-Bromobutyl)-2-piperidinone	C9H16BrNO	233	0.57%
29.	18.42	10-Undecyn-1-ol	C11H20O	168	0.13%
30.	18.54	2,4-Undecadienol	C11H20O	168	1.28%
31.	20.08	5,9-Dimethyl-2-(1-methylethyl)-1-cyclodecanone	C15H28O	224	0.35%
32.	20.85	1b,5,5,6a-Tetramethyl-octahydro-1-oxa-cyclopropa[a]inden-6-one	C13H20O2	208	0.49%
33.	22.33	3,7-Dimethyl-2,6-nonadienal	C11H18O	166	0.26%
34.	26.51	Oxalic acid, allyl nonyl ester	C14H24O4	256	0.01%
35.	27.95	6,11-Dimethyl-2,6,10-dodecatrien-1-ol	C14H24O	208	20.12%
36.	28.68	Tetradecyl iodide	C14H29I	324	0.20%
37.	29.25	(Z,E)-Farnesol	C15H26O	222	0.20%

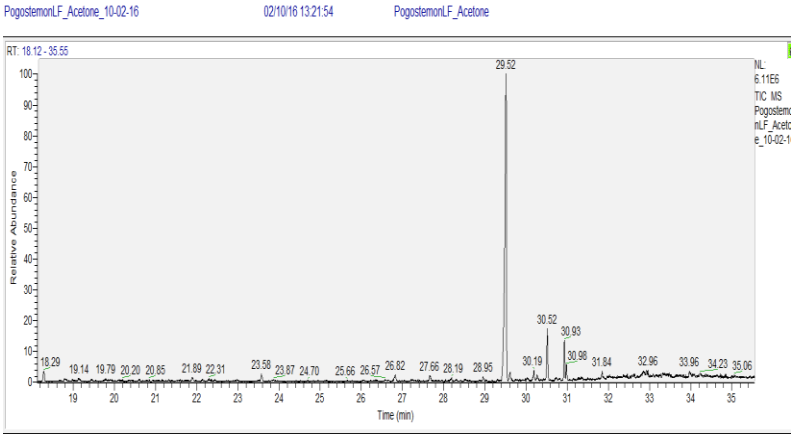

Figure 2.GC MS Chromatogram of Acetone extract of leaves of *Pogostemon quadrifolius*

Table 2. Phytocompounds identified in the Acetone extract of leaves of *Pogostemon quadrifolius* by GC MS

No	RT	Name of the compound	Molecular formula	MW	Peak area %
1.	5.63	à,á-Isopropylideneglycerol	C6H12O3	132	1.16%
2.	6.25	(3-Methyl-2-oxiranyl) methanol	C4H8O2	88	0.08%
3.	6.95	Glycerin	C3H8O3	92	0.10%
4.	18.29	1,11-Dodecadiyne	C12H18	162	1.47%
5.	21.89	3,6-Octadecadiynoic acid, methyl ester	C19H30O2	290	0.03%
6.	23.58	Tetracyclo[6.1.0.0(2,4).0(5,7)]nonane, 3,3,6,6,9,9-hexamethyl-, cis,cis,trans--	C15H24	204	0.75%
7.	26.82	(2Z)-2-Octenoic acid	C8H14O2	142	0.31%
8.	27.66	trans-3-Decen-1-ol	C10H20O	156	0.43%
9.	28.19	3-(3-Bromophenyl)-7-chloro-10-hydroxy-3,4-dihydro-1,9(2H,10H)-acridinedione	C19H13BrClNO3	417	0.05%
10.	28.95	Dihydroxanthin	C17H24O5	308	0.11%
11.	29.52	2,4,6-Trimethoxyacetophenone	C11H14O4	210	77.96%
12.	29.61	3-Hydroxy-5-isopropyl-2-methylbenzo-1,4-quinone	C10H12O3	180	0.74%
13.	30.19	(2S,3S)-(-)-3-Propyloxiranemethanol	C6H12O2	116	0.74%
14.	30.27	Veratraldehyde oxime	C9H11NO3	181	0.23%
15.	30.52	5,8,11,14,17-Eicosapentaenoic acid	C20H30O2	302	7.17%
16.	30.93	2,2,2-Trifluoro-1-(2,4,6-trimethoxy-phenyl)-ethanone	C11H11F3O4	264	4.86%
17.	30.98	Benzaldehyde, 3,4-dimethoxy-, o-methyloxime	C10H13NO3	195	1.56
18.	31.84	2,4,6,8-Tetramethyl-1-undecene	C15H30	210	0.44%
19.	32.46	{Methanediylbis[(3,4,6-trichlorobenzene-2,1-diyl)oxy]}bis(trimethylsilane)	C19H22Cl6O2Si2	548	0.08%
20.	32.62	Hexadecanoic acid, 1-(hydroxymethyl)-1,2-ethanediyl ester	C35H68O5	568	0.03%
21.	32.86	Methyl 2,3,4-tri-O-(9-borabicyclo[3.3.1]non-9-yl) pentopyranoside	C30H51B3O5	524	0.25%
22.	32.96	2-(4,7-Dimethoxy-2H-1,3-benzodioxol-5-	C11H15NO4	225	0.35%

		yl)ethan-1-amine			
23.	33.32	3H-Cyclodeca[b]furan-2-one, 4,9-dihydroxy-6-methyl-3,10-dimethylene-3a,4,7,8,9,10,11,11a-octahydro-	C15H20O4	264	0.06%
24.	33.37	R-Limonene	C10H16O3	184	0.07%
25.	33.96	3-Methoxymethoxy-3,7,16,20-tetramethyl-heneicosa-1,7,11,15,19-pentaene	C27H46O2	402	0.41%
26.	34.23	2-(Cholest-5-en-3-yloxy)ethyl acetate	C31H52O3	472	0.03%
27.	34.86	Methyl 3-(acetyloxy)-12-oxours-9(11)-en-28-oate	C33H50O5	526	0.05%
28.	36.57	3,4-Dimethyl-1,6-heptadiene (1,5-Heptadiene, 3,4-dimethyl-)	C9H16	124	0.28%
29.	37.02	.psi.,.psi.-Carotene, 3,4-didehydro-1,2,7',8'-tetrahydro-1-methoxy-2-oxo-	C41H58O2	582	0.09%
30.	37.17	8,12-Di-O-acetylingol 7-(4'-methoxy)phenylacetate	C33H42O10	598	0.11%

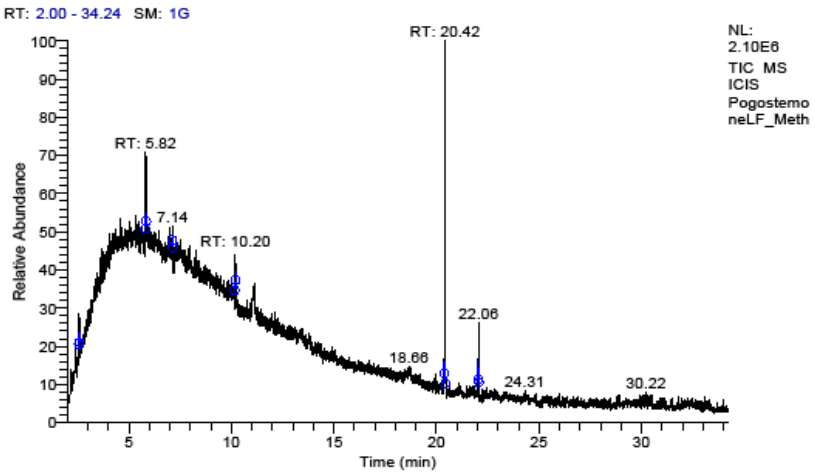

Figure 3. GC MS Chromatogram of Methanol extract of leaves of *Pogostemon quadrifolius*

Table3. Phytocompounds identified in the Methanol extract of leaves of *Pogostemon quadrifolius* by GC MS

No	RT	Name of compound	Molecular formula	MW	Peak area %
1.	2.57	dl- Glyceraldehyde dimer	C3H6O3	180	3.01%
2.	5.82	2-Butyn-1- ol	C4H6O	70	14.10%
3.	7.14	1-Methoxymethoxy-hexa-2,4-diene	C8H14O2	142	0.51%
4.	10.20	4-Hydroxymethylbenzaldehyde	C8H8O2	136	4.91%
5.	20.42	2(3H)-Naphthalenone, 4,4a,5,6,7,8-hexahydro-1-methoxy-	C11H16O2	105	66.65%
6.	22.06	2,4,6-Trimethoxyacetophenone	C11H14O4	210	10.83%

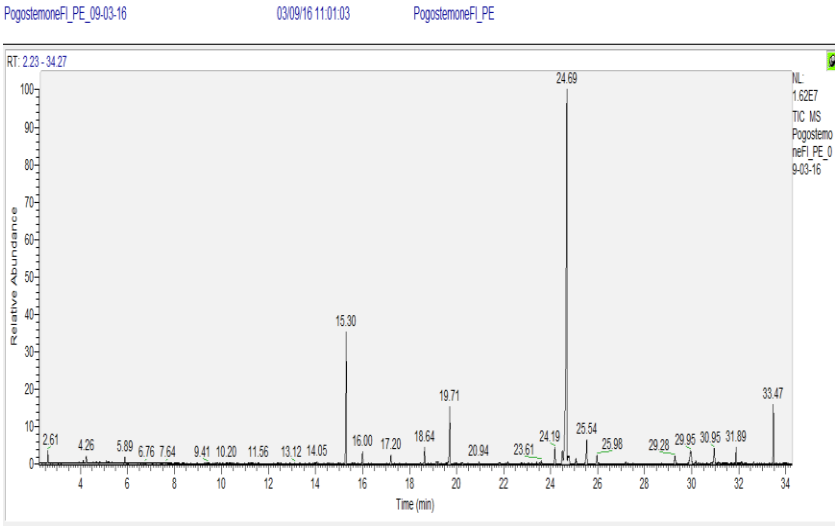

Figure 4. GC MS Chromatogram of Petroleum ether extract of flowers of *Pogostemon quadrifolius*

Table4. Phytocompounds identified in the Petroleum ether extract of flowers of *Pogostemon quadrifolius* by GC MS

No	RT	Name of the compound	Molecular formula	MW	Peak area %
1.	1.42	Hydroxy acetaldehyde	C2H4O2	60	0.01%
2.	1.5	n pentane	C5H12	72	28.81%
3.	1.57	2,2 dimethyl butane	C6H14	86	0.66%
4.	1.65	3 methyl pentane	C6H14	86	57.39%
5.	1.7	n hexane	C6H14	86	12.32%
6.	1.81	2 Butene	C4H8	56	0.04%
7.	2.61	2-p-Nitrobenzoyl-1,3,5-tribenzyl-à-d-ribose	C33H31NO8	569	0.01%
8.	4.12	Butane	C4H10	58	t
9.	4.26	o-n- propyl hydroxylamine	C3H9NO	75	t
10.	5.11	n propane	C3H8	44	t
11.	5.89	pentyl hydroperoxide	C5H12O2	104	t
12.	14.05	à-Propylene chlorohydrin	C3H7ClO	94	t
13.	15.3	1,11-Dodecadiyne	C12H18	162	0.1%
14.	16.0	1,2-Dicyclopropylcyclobutane	C10H16	136	0.01%
15.	17.2	3,6-Octadecadiynoic acid, methyl ester	C19H30O2	290	0.01%
16.	18.47	2 Butene	C4H8	56	t
17.	18.64	3,5-Dimethyl-1,6-heptadien-4-ol	C9H16O	140	0.01%
18.	19.15	Vinylcyclopentane	C7H12	96	t
19.	19.21	Oxalic acid, allyl pentyl ester	C10H16O4	200	t
20.	19.71	Z,Z,Z-4,6,9-Nonadecatriene	C19H34	262	0.04%
21.	20.94	9-Octadecen-12-ynoic acid, methyl ester	C19H32O2	290	t
22.	21.80	Butyraldehyde, 4-(methylenecyclopropyl)-	C8H12O	124	t
23.	22.17	1,1-Cyclopropanedicarbonitrile, 2-ethyl-2-methyl-	C8H10N2	134	t
24.	23.40	Oxalic acid, diallyl ester	C8H10O4	170	t
25.	23.61	Propane, 2-methyl-	C4H10	58	t
26.	24.19	5 Bromo 1 pentene	C5H9Br	148	0.01%

27.	24.50	2-Propenoic acid, 2-methyl-, 2-propynyl ester	C7H8O2	124	0.01%
28.	24.69	2(3H)-Naphthalenone, 4,4a,5,6,7,8-hexahydro-1-methoxy-	C11H16O2	180	0.41%
29.	24.78	Oxirane, ethenyl-	C4H6O	70	0.01%
30.	25.08	3-Nitro-2-methyl propene	C4H7NO2	101	t
31.	25.54	2H-Pyran, 2-(2,5-hexadiynyloxy)tetrahydro-	C11H14O2	178	0.03%
32.	25.98	Hexane, 1-(ethenyloxy)-	C8H16O	128	0.01%
33.	27.19	8-Nonynoic acid, methyl ester	C10H16O2	168	t
34.	29.28	3-Bromoheptane	C7H15Br	178	0.01%
35.	29.95	3-Methyl-3-nitrobut-1-ene	C5H9NO2	115	0.02%
36.	30.17	2H-Thiopyran, tetrahydro-, 1,1-dioxide	C5H10O2S	134	t
37.	30.95	4-Nonene, 5-nitro-	C9H17NO2	171	0.02%
38.	31.14	2,4,6-Trimethyl-1-nonene	C12H24	168	t
39.	31.89	Oxalic acid, allyl nonyl ester	C14H24O4	256	0.01%
40.	32.11	Ethanone, 1-(2-methylcyclopropyl)-	C6H10O	98	t
41.	32.64	2,4,6,8-Tetramethyl-1-undecene	C15H30	210	t
42.	33.47	1-Iodo-2-methylnonane	C10H21I	268	0.03
43.	34.38	Oxalic acid, allyl hexyl ester	C11H18O4	214	t
44.	35.51	Octadecane, 6-methyl-	C19H40	268	0.03

t: trace (<0.01%).

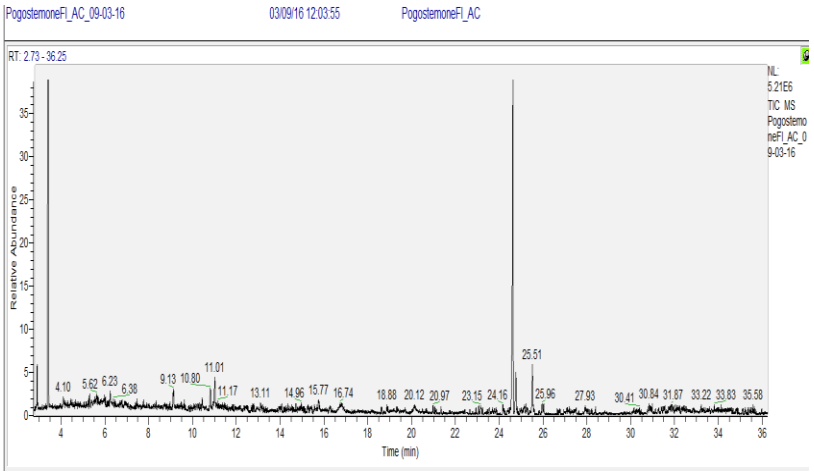

Figure 5. GC MS Chromatogram of Acetone extract of flowers of *Pogostemon quadrifolius*

Table 5. Phytocompounds identified in the Acetone extract of flowers of *Pogostemon quadrifolius* by GC MS

No	RT	Name of the compound	Molecular formula	MW	Peak area %
1.	2.12	Glycolaldehyde dimer	C4H8O4	120	2.10%
2.	2.91	Allylacetone	C6H10O	98	1.61%
3.	3.41	n-Butane	C4H10	58	53.26%
4.	5.29	à-Methylpropargyl alcohol	C4H6O	70	0.12%
5.	6.23	Ethylene	C2H4	28	0.36%
6.	9.13	Oxirane, 2,3-dimethyl-, cis-	C4H8O	72	0.92%

7.	10.44	1-(8'-Methylquinolin-2'-yl)-2,3,4-tri(methoxycarbonyl)-6-(1",2"-di(methoxycarbonyl)vinyloxy)benzene	C30H29NO11	579	0.07%
8.	10.8	2,4 Hexadiyne-1,6 diol	C6H6O2	110	0.90 %
9.	11.01	2-Butyne-1,4-diol, diformate	C6H6O4	142	1.88%
10.	24.63	2-Propenoic acid, 2-methyl-, 2-propynyl ester	C7H8O2	124	31.98%
11.	24.75	Oxirane, ethenyl-	C4H6O	70	3.67%
12.	25.51	2-(2,5-Hexadiynyloxy)tetrahydro-2H-pyran	C11H14O2	178	3.12%

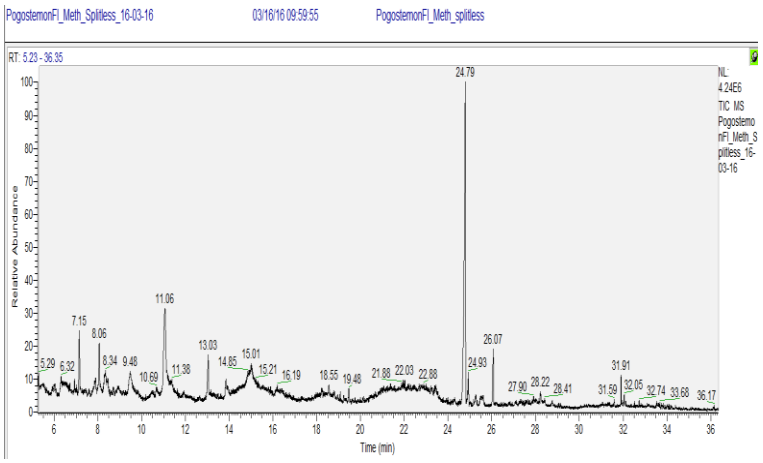

Figure6. GC MS Chromatogram of Methanol extract of flowers of *Pogostemon quadrifolius*

Table 6. Phytocompounds identified in the Methanol extract of flowers of *Pogostemon quadrifolius* by GC MS

No	RT	Name of the compound	Molecular formula	MW	Peak area %
1.	4.11	2-Butyne-1,4-diol, diformate	C6H6O4	142	1.89%
2.	4.2	2-Oxetanone, 4-methyl-	C4H6O2	86	0.14%
3.	4.74	Hydroperoxide, pentyl	C5H12O2	104	2.64 %
4.	4.93	n- propane	C3H8	44	6.99%
5.	5.17	2(3H)-Furanone, dihydro-4,5-dimethyl-	C6H10O2	114	12.96%
6.	5.29	Oxirane, (ethoxymethyl)-	C5H10O2	102	0.13%
7.	6.32	Cyclopentanone, 2,3-epoxy-	C5H6O2	98	0.28%
8.	6.93	1-[(2E)-2-Butenyl]aziridine	C6H11N	97	0.06%
9.	7.15	2-Nitro-1-propanol	C7H7NO3	105	0.03%
10.	7.89	Propargyl acetate	C5H6O2	98	0.17%
11.	8.06	Oxirane, 2,3-dimethyl-, cis-	C4H8O	72	0.03%
12.	8.34	2-Nitro-1-propanol	C3H7NO3	105	0.41%
13.	8.45	Oxirane, 2,3-dimethyl-, trans-	C4H8O	103	0.03%
14.	9.48	Glycidol	C3H6O2	74	0.20%
15.	11.06	2-p-Nitrobenzoyl-1,3,5-tribenzyl-à-d-ribose	C33H31NO8	569	12.25%
16.	13.03	2-(2,5-Hexadiynyloxy)tetrahydro-2H-pyran	C11H14O2	178	2.77%
17.	13.84	2-Butynylene formate	C6H6O4	142	0.06%
18.	14.85	1-Methyl-1-(2-propynyl)hydrazine	C4H8N2	72	0.04%
19.	14.92	3-Methyl-2-heptanol	C8H18O	130	0.02%

20.	15.01	2-Hydroxy-3-pentanone	C5H10O2	102	0.85%
21.	24.79	Geranyl vinyl ether	C12H20O	180	44.64%
22.	24.93	Oxirane, ethenyl-	C4H6O	70	1.43%
23.	26.07	Oxirane, 3-ethyl-2,2-dimethyl-	C6H12O	100	3.89%
24.	31.91	Cyclopentaneundecanoic acid	C16H30O2	254	0.83%

Table 7. Activity of Bioactive compounds identified in the Petroleum ether extract of leaves of *Pogostemon quadrifolius*

No.	Name of compound	Molecular formula	Compound nature	*Activity
1.	4 methyloctanoic acid	C9H18O2	Fatty acid	Flavouring agent, Aggregration pheromone[15]
2.	Isoeugenol	C10H12O2	Terpenes	Flavouring agent, defense compounds against animals and microorganisms, floral attractants of pollinators[16]
3.	Phloroglucinol trimethyl ether	C9H12O3	Phenolic ether	Cosmetic agent, antispasmodic agent
4.	trans-á-Ocimene	C10H16	Terpenes	Not known
5.	Germacrene D	C15H24	Sesquiterpenes	Pesticide, pheromone
6.	Caryophyllene oxide	C15H24O	Sesquiterpenes	Antiedemic, antifeedant, anti-inflammatory, antifeedant, Calcium antagonist,fungicide, insecticide, pesticide
7.	Dihydromyrcene	C10H18	Terpenes	Flavouring agent, Insect pheromone synthesis
8.	.tau.-Cadinol	C15H26O	Sesquiterpenoid alcohol	Not known
9.	Longipinene epoxide	C15H24O	Sesquiterpenes	Not known
10.	Patchoulane	C15H26	Sesquiterpenes	Antimicrobial, anti-inflammatory, Antihyperlipidemic
11.	cis-Z-à-Bisabolene epoxide	C15H24O	Sesquiterpenes	To increase sex hormone activity[17]
12.	4,6- Dimethoxy coumaranone	C10H10O4	Ketone compound	Not known
13.	Isolongifolan-8-ol	C15H26O	Sesquiterpenoid alcohol	Insect repellent
15.	Aromadendrene oxide-(1)	C15H24O	Sesquiterpenes	Not known
16.	1-[2-Oxo-2-(3,4,5-trimethoxyphenyl)ethyl]-2(1H)-pyridinone	C16H17NO5	Alkaloid	Not known
17.	1-(4-Bromobutyl)-2-piperidinone	C9H16BrNO	Alkaloid	Not known
18.	10-Undecyn-1-ol	C11H20O	Unsaturated alcohol	Antiinflammatory, antimicrobial
19.	1b,5,5,6a-Tetramethyl-	C13H20O2	Ketone compound	No activity

	octahydro-1-oxa-cyclopropa[a]inden-6-one			
20.	6,11-Dimethyl-2,6,10-dodecatrien-1-ol	C14H24O	Sesquiterpenoid alcohol	Antimicrobial
21.	(Z,E)-Farnesol	C15H26O	Sesquiterpenoid alcohol	Antimicrobial, Antiinflammatory, Antihyperlipidemic, Analgesic, Sedative, Fungicide
22.	n- Hexadecanoic acid	C16H32O2	Saturated fatty acid	Antiinflammatory[18], Antioxidant, Hypocholesterolemic, Nematicide, Pesticide, Lubricant, Antiandrogenic, Hemolytic 5-Alpha reductase Inhibitor, antipsychotic.[19]

Table 8. Activity of Bioactive compounds identified in the Acetone extract of leaves of *Pogostemon quadrifolius*

No.	Name of compound	Molecular formula	Compound nature	*Activity
1.	(3-Methyl-2-oxiranyl) methanol	C4H8O2	Alcohol compound	Catechol – O- Methyl transferase inhibitor, Methyl guanidine inhibitor, Methyl donor
2.	Glycerine	C3H8O3	Alcohol	Antimicrobial , Preservative, Anticataract, antiketotic, Antineuralgic, Antimeniere, Emollient, Hyperglycemic
3.	3,6-Octadecadiynoic acid, methyl ester	C19H30O2	Fatty acid ester	Acidifier, acidulant, Arachidonic acid inhibitor
4.	(2Z)-2-Octenoic acid	C8H14O2	Fatty acid	Acidifier, acidulant, Arachidonic acid inhibitor
5.	3-Decen-1-ol, (E)-	C10H20O	Alcohol compound	Reverse transcriptase inhibitor, Catechol – O- Methyl transferase inhibitor, Glucosyl transferase inhibitor, Transdermal
6.	3-(3-Bromophenyl)-7-chloro-10-hydroxy-3,4-dihydro-1,9(2H,10H)-acridinedione	C19H13BrClNO3	Alkaloid	Anti HIVintegrase, Hallucinogen, hematopoietic, Hepatostimulant, hepatocarcinogenic, Herbicide, Histaminic, HIV RT inhibitor, Hormone.
7.	5,8,11,14,17-Eicosapentaenoic acid	C20H30O2	Fatty acid	Acidulant, acidifier, arachidonic acid inhibitor

8.	Benzaldehyde, 3,4-dimethoxy-, o-methyloxime	C10H13NO3	Oxime compound	Anticancer, Antitumour, Ovicide, Oviposition (Stimulant), Ovulation (Stimulant), Oxidant, Ozone scavenger
9.	Hexadecanoic acid, 1-(hydroxymethyl)-1,2-ethanediyl ester	C35H68O5	Fatty acid ester	Diuretic, Disinfectant
10.	R-Limonene	C10H16O3	Monoterpene	Acaricide, Antibacterial,Anticancer, Antiacetyl cholinesterase, Antiadenomic, Pesticide Antiinflammatory,Antiseptic, antimutagenic, Antispasmodic, Antiviral, Insecticide, Nematicide,

Table 9. Activity of Bioactive compounds identified in the Methanol extract of leaves of *Pogostemon quadrifolius*

No.	Name of compound	Molecular formula	Compound nature	* Activity
1.	2(3H)-Naphthalenone, 4,4a,5,6,7,8-hexahydro-1-methoxy-	C11H16O2	Ketone compound	Anti HIV integrase, Hallucinogenic, Hepatostimulant, Hepatoprotective , Herbicide, Hirudicide, Hormone, Acaricide,Adrenergic, Aggressant, Algicide,Allelochemic,Amebicide, Analgesic,Aphrodisiac,Anesthetic, Anti repellent, antacid, anti helminthic, Antiallergic, Antibacterial, Anticancer, Antidengue, Antidepressant, antidiabetic, Antidiuretic, antidote, Anti HIV, Antimalarial, Antimicrobial, Antioxidant,Antiparasitic, Antiproliferative, antipyretic,antiseptic, antitumour

Table 10. Activity of Bioactive compounds identified in the Petroleum ether extract of flowers of *Pogostemon quadrifolius*

No.	Name of compound	Molecular formula	Compound nature	*Activity
1.	n pentane	C5H12	Alkane	Anaphylactic, antitumour, Narcotic, natriuretic, Nematicide, Neurogenic, Neurotoxic
2.	n hexane	C6H14	Alkane	Anaphylactic, antitumour, Narcotic, Nematicide, Neurotoxic
3.	1-Iodo-2-methylnonane	C10H21I	Iodo Compound	Antimicrobial

Table 11. Activity of Bioactive compounds identified in the Acetone extract of flowers of *Pogostemon quadrifolius*

No.	Name of compound	Molecular formula	Compound nature	* Activity
1.	n butane	C4H10	Alkane	Antitumour, Narcotic, Natriuretic, Nematicide, Neurotoxic,
2.	2-(2,5-Hexadiynyloxy)tetrahydro-2H-pyran	C11H14O2	Flavonoid fraction	Anti HIV integrase, Hallucinogenic Herbicide, Hirudicide, Hormone

Table 12. Activity of Bioactive compounds identified in the Methanol extract of flowers *of Pogostemon quadrifolius*

No.	Name of compound	Molecular formula	Compound nature	*Activity
1.	n propane	C3H8	Alkane	Antitumour, Narcotic, Natriuretic, Nematicide, Neurotoxic,
2.	2(3H)-Furanone, dihydro-4,5-dimethyl-	C6H10O2	Ketone compound	Anti HIV integrase, Hallucinogenic Herbicide, Hirudicide, Hormone
3.	Geranyl vinyl ether	C12H20O	Ether compound	Antimicrobial, antifungal, anticancer, antimalaria

*** Source: Dr. Duke's phytochemical and ethnobotanical databases [Online database].**

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