IJP (2018), Vol. 5, Issue 7 **(Research Article)**

Received on 27 March, 2018; received in revised form, 12 June, 2018; accepted, 17 June, 2018; published 01 July, 2018

GC-MS IDENTIFICATION OF ENDEMIC HERB *CURCUMA ALBIFLORA* THW. (SRI LANKA)

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Keywords:

Curcuma albiflora, Retension index, Neocurdione, Mercaptole

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ABSTRACT: *Curcuma albiflora* Thw. is an important anti-inflammatory medicinal plant, which is used in Sri Lankan Traditional Medicine. The plant is endemic to Sri Lanka and unexplored. Therefore it is necessary to conduct proper systematic study to establish chemical profile of *C. albiflora*. Therefore, current study was conducted GC-MS study on various extracts of *C. albiflora*. The whole plant parts of the plant *C. albiflora* were collected from June to October in the flowering season at Sabaragamuwa province, Sri Lanka. Samples were authenticated by National Herbarium, Peradeniya. Hydro-distillation by clevenger's apparatus and continuous extraction by Soxhlet apparatus were carried out on various solvents (petroleum ether, acetone and methanol). GC-MS analyses were performed on various extracts (water, petroleum ether, acetone and methanol) of *C. albiflora*. Retention index was calculated of each compounds based on standard alkane chromatogram. Whole plant of *C. albiflora* essential oil consisted mainly of α-pinene (14.51%), caryophyllene oxide (9.35%), alcanfor (5.12%), aromadendrene oxide-I (4.81%), α-famesene (4.01%) and camphene (3.64%). While petroleum ether extract of *C. albiflora* consisted mainly neocurdione (5.15%), trans-z-α-bisabolene epoxide (4.69%) and caryophyllene oxide (3.9%), acetone extract consisted mainly α-pinene (9.76%), 2,4-octadiyne (6.1%), and (3α,5α) 2-methylene cholestanol (3.73%) and methanol extract consisted mainlycaryophyllene oxide(16.18%), 5α-androstanone, cyclic ethylene-mercaptole (11.04%), acetonyl-di-methyl carbinol (10.29%), aromadendrene oxide-(1) (9.15%), α-pinene (6.52%), neocurdione (5.85%), (e)-α-famesene (4.82%). Current study was first chemical analysis of plant *C. albiflora* and it is suggested to study TLC profile of various extracts, antioxidant bio assays and pharmacological properties in future.

INTRODUCTION: Plants of genus Curcuma are known to have anti-inflammatory, and antioxidant properties and which is given from acute to chronic situations [1, 2, 3]. Among more than 90 species are accounted for Curcuma, 5 species (*C. albiflora*, *C. zedoaria*, *C. longa*, *C. aromatica* and *C. oligantha*) are reported in Sri Lanka [4, 5]. *C. albiflora* is endemic to Sri Lanka and its chemical profile has not being established. Therefore, current GC-MS study was conducted to establish chemical profile of the whole plant of *C. albiflora* on its various extracts.

QUICK RESPONSE CODE

DOI:

10.13040/IJPSR.0975-8232.IJP.5(7).419-425

Article can be accessed online on:
www.ijpjournal.com

DOI link: http://dx.doi.org/10.13040/IJPSR.0975-8232.IJP.5(7).419-25

MATERIALS AND METHODS: Matured whole plants (height 35-50 cm) of *C. albiflora* were collected in the flowering season from 2016 to early 2017 in Sabaragamuwa from June to October in Sabaragamuwa province (Erathna: N 6° 50' 07", E 80° 24' 41", Kitulgala: N 6° 59' 41", E 80° 24' 20" and Bopathella: N 6° 48' 07", E 80° 22' 12"). Since, *C. albiflora* is an endemic threaten specie, approval was taken from Forest department, Sampathpaya, Battaramulla (My ref. R&E/RES/NFSRC/12). Voucher specimens of the plants (herbariums) were authenticated and deposited at the National Herbarium, Peradeniya, Sri Lanka (My ref 6/01/H/03). Collected samples were cleaned by tap water and cut into small pieces (2 cm long). All procedures were carried according to WHO guidelines and other published data [6, 7]. Cut samples were dried under shade to obtain 8-10% moisture content.

Then they were grinded and sieved from 40 mesh size sieve. Powder was kept in proper plastic containers with silica gel sachets to remove atmospheric moisture. Powdered samples (40#) were extracted by hydro-distillation with clevenger's apparatus (6 h), and with Soxhlet apparatus (6 h) by various solvents (200ml petroleum ether, 200 ml acetone and 200ml methanol). Extracts were concentrated by rot evaporator and 2 ml was sent to analyze by GC-MS.GC-MS analysis was carried out on a Thermo Scientific Trace 1300 detector and with RTX WAX capillary column. Mode of operating conditions was split (1:50) and the oven temperature program was 60 ^{o}C (after 10.00 min) to 240 ^{o}C at 5 ^{o}C/min with helium as carrier gas. Identification of constituents was done by matching 1700 eV mass spectra, 250 ^{o}C quad temperature, 250 ^{o}C source temperature, 50 - 450 (amu) scan parameters, and direct matching and reverse matching with NIST library.

Determination of compounds in GC-MS requires matching the retention time of same compounds with standard on two chromatographic columns. Kovat (1958) introduced a retention index scheme. The retention index (I) of particular compound was calculated according to the formulae;

$$I = 100 \left[n + (N-n) \frac{log\ t_u - log\ t_s}{log\ t_L - log\ t_s} \right]$$

Where; n: number of carbon atoms in the smaller alkane, N: number of carbon atoms in larger alkane, t_u: retention time of unknown compound, ts: retention time of smaller carbon atom, and t_L: retention time of larger carbon atom.

Standard alkane series was used number of carbons from 10 to 27 (e.g. 10, 11, 12 …*etc*.). To calculate retention index of unknown compounds for current study, above formulae modified as follows;

$$I = 100 \left[n + \frac{t_u - t_s}{t_L - t_s} \right]$$

Where, n is the number of carbon atoms in the smaller alkane, t_u: retention time of unknown compound, ts: retention time of smaller carbon atom, and t_L: retention time of larger carbon atom.

RESULTS AND DISCUSSION: Volatile compounds of preliminary phytochemical analysis are identified with GC-MS analysis. The *C. albiflora* essential oil was extracted by hydrodistillation and solvent extraction was performed by continuous extraction (Soxhlet apparatus) using petroleum ether, dichloromethane, acetone and methanol as solvents. Extracted fractions were subjected for GC-MS identification. A total of 64 constituents of essential oil were identified by GC-MS. α-pinene (10.87 %), caryophyllene oxide (8.85 %), alcanfor (5.12 %), aromadendrene oxide-(1) (4.81 %), *n*-hexadecanoic acid (4.74 %), α-famesene (3.93 %), camphene (3.52 %) and isoborneol (3.4 %) as major compounds, which were more than 3 %. Identified chemical constituents in essential oil of *C. albiflora* were listed in **Table 1**.

TABLE 1: PERCENTAGE COMPOSITION OF ESSENTIAL OIL OF *C. ALBIFLORA*

Compound	RI calculated	RI reference	Area %	MW
Camphene	1011	1080	3.52	136
α-pinene	1046	1035	10.87	136
α-myrcene	1075	1158	0.03	136
unknown 1	1133	-	0.55	136
1,8 cineol	1141	1222	2.15	154
2-pentyl furan	1162	-	0.07	138
o-cymene	1205	1274	0.21	134
unknown 2	1268	-	0.03	126
2-nonen-1-ol	1324	-	0.03	142
6-camphenol	1400	-	0.12	152
(-)-alcanfor	1450	-	5.12	152
α-linalool	1475	1544	0.69	154
Myrtanal	1485	-	0.11	152
Pinocarvone	1502	1575	0.48	150
(1R)-(+)-nopinon	1514	1573	0.2	138
unknown 3	1521	-	0.99	204
Caryophyllene	1529	1588	2.49	204
4-terpinenol	1533	1616	0.25	154

unknown 4	1564	-	0.69	150
unknown 5	1578	-	0.07	276
unknown 6	1501	-	0.75	152
(E)-α-famesene	1596	-	3.93	204
Isoborneol	1600	1659	3.4	154
cis-verbenol	1609	1659	0.31	152
α-ylangene	1621	1484	0.4	204
Patchoulane	1624	-	0.16	206
α-terpineol	1628	1694	0.64	154
endo-borneol	1633	1699	1.44	154
unknown 7	1643	-	0.07	290
Cedrene	1648	1582	0.07	204
Eremophila-1(10),11-diene	1653	-	0.91	204
Guaia-1(10),11-diene	1658	-	1.07	204
(-)-carvone	1670	1765	0.08	150
α-copaene	1690	-	0.59	204
unknown 8	1696	-	0.07	222
(-)-myrtenol	1726	1790	0.84	152
2-tridecanone	1742	1808	0.15	198
4,5-di-epi-aristolochene	1765	-	0.09	204
trans-Geranylacetone	1789	-	0.15	194
Doconexent	1806	-	0.5	328
Cubebol	1821	-	0.03	222
2,5,8-trimethyl-1,2-dihydro naphthalene	1854	1728	0.07	172
Denderalasin	1872	-	0.6	218
Unknown 9	1897	-	0.02	278
7-epi-cis-sesquisabinene hydrate	1917	-	0.47	222
Caryophyllene oxide	1923	1986	8.85	220
(E)-2-tridecenol	1966	-	0.23	198
Nerolidol	1975	2036	0.17	222
unknown 10	1986	-	0.29	194
7-epi-cis-sesquisabinene	1997	2082	0.3	222
Methyl 2,5-octadecadiynoate	2003	-	0.22	290
Methyl 10,12-pentacosadiynoate	2014	-	0.04	302
(3α,5α) 2-methylenecholestan-3-ol	2128	-	0.26	400
Neocurdione	2142	-	0.42	236
unknown 11	2176	-	1	190
Ledene oxide-(II)	2197	-	1.96	220
5α-Cholestan-3α-ol, 2-methylene	2229	-	0.16	400
Isoaromadendrene epoxide	2236	-	0.69	220
trans-Z-α-bisabolene epoxide	2242	-	0.57	220
Curdione	2267	-	2.83	236
Aromadendrene oxide	2313	-	4.81	220
Retinal	2430	-	0.1	388
Falcarinol	2466	-	0.13	244
n-Hexadecanoic acid	2742	2132	4.74	256

MW- molecular weight, RI: retention index

A total of 26 constituents of petroleum ether extract were identified by GC-MS; Hexadecanoic acid (28.85 %), 2-methylhexadecan-1-ol (5.52 %), neocurdione (5.15 %), trans-Z-α-bisabolene epoxide (4.69 %), m-ethyl toluene, (4.52 %), and caryophyllene oxide (3.9 %) as major compounds. Identified chemical compounds in petrolium-ether extract of *C. albiflora* were listed in **Table 2**.

A total of 11 compounds were found in DCM extract; 1,8 cineol (34.29 %), α-pinene (14.94 %), camphene (12.66 %), caryophyllene oxide (10.19 %), and caryophyllene (4.88 %) were found as major compounds **Table 3**.

A total of 12 compounds were found in acetone extract of *C. albiflora*; 4-hydroxy-4-methylpentan-2-one (15.12%), d-mannose (11.67 %), α-pinene (8.73 %), 2, 4-octadiyne (4.76 %), 2-methylene-(3α,5α)-cholestan-3-ol (3.73 %), as major compounds(>3 %). In preliminary phytochemical analysis, sugar was reported in acetone extract of *C. albiflora*, this

may correlate with d-mannose found. Identified chemical compounds in acetone extract of *C. albiflora* were listed in **Table 4**.

TABLE 2: PERCENTAGE COMPOSITION OF PETROLEUM ETHER EXTRACT OF *C. ALBIFLORA*

Compound	RI cal	RI ref	Area %	MW
2-ethylpentan-3-ol	1028	-	0.14	116
2,4-nonadiyne	1180	-	0.43	120
m-ethyl toluene	1218	-	0.97	120
trans-3-caren-2-ol	1258	-	0.01	152
o-cymene	1302	1310	0.07	134
3-tridecyltrichloroacetic acid	1370	-	0.4	344
(-)-alcanfor	1450	-	1	152
Vinylcyclohexane	1521	1590	0.13	204
10,12-octadecadiynoic acid	1529	-	0.39	276
1-ethyldodecyltrifluoroacetate	1574	-	0.26	310
Isobornylformate	1600	1595	0.86	182
(E)-α-Famesene	1605	-	0.59	204
Methyl 5-methoxy-3-oxovalerate	1633	-	1.15	160
Methyl stearidonate	1653	-	0.12	290
4,5-di-epi-aristolochene	1658	-	0.08	204
Z,Z,Z-1,4,6,9-nonadecatetraene	1726	-	0.01	302
4-trifluoroacetoxypentadecane	1780	-	0.2	324
Methyl 2,5-octadecadiynoate	1912	-	0.14	290
Caryophyllene oxide	1922	1986	3.65	220
Unknown	1980	-	0.19	220
3-trifluoroacetoxypentadecane	1985	-	0.14	324
trans-Z-α-bisabolene epoxide	2257	-	4.69	220
Neocurdione	2267	-	5.15	236
2-methylene 5α-cholestan-3α-ol	2313	-	2.79	400
2-methylhexadecan-1-ol	2540	-	5.52	256
Hexadecanoic acid	2744	2913	28.85	256

MW- molecular weight, R_t- retention time

TABLE 3: PERCENTAGE COMPOSITION OF DCM EXTRACT OF *C. ALBIFLORA* THW

Compound	RI cal	RI ref	Area %	MW
Camphene	1009	1068	12.66	136
α-pinene	1043	1025	14.94	136
4(10)-thujene	1054	1026	0.42	136
5-isopropenyl-1-methyl-1-cyclohexene	1127	-	2.02	136
1,8 cineol	1136	1211	34.29	154
o-cymene	1198	1310	0.87	134
Caryophyllene	1519	1598	4.88	204
(E)-α-famesene	1586	-	2.49	204
Caryophyllene oxide	2016	1986	10.19	220
(hexadecyloxy) methyl oxirane	2053	-	0.57	222
α-bisabolol	2079	2213	1.19	298

MW- molecular weight, R_t- retention time

A total of 29 compounds were found in methanol extract of *C. albiflora*; Caryophyllene oxide (16.18 %), cyclic ethylene mercaptole (11.04 %), acetonyldimethylcarbinol (10.29 %), aromadend-rene oxide-1 (9.15%), α-pinene (6.52 %), neocurdione (5.85 %), (e)-α-famesene (4.82 %), methyl octadecadiynoate (2.34 %), ethyl benzene (2.31 %), (-)-alcanfor (3 %) as major compounds. Identified chemical compounds found in methanol extract of *C. albiflora* were listed in **Table 5**.

TABLE 4: PERCENTAGE COMPOSITION OF ACETONE EXTRACT OF *C. ALBIFLORA*, SRI LANKA

Compound	RI calculated	RI reference	Area %	MW
Camphene	1013	1068	1.45	136
α-pinene	1048	1025	8.73	136
2,4-dimethylpent-2-ene	1073	-	0.78	98
Ethyl benzene	1077	-	2.16	106
2,4-octadiyne	1083	-	4.76	106
d-limonene	1134	1198	1.44	136
1,8 cineol	1142	1186	0.32	154
4-hydroxy-4-methylpentan-2-one	1295	-	15.12	116
7,11-dimethyl-3-methylene 1,6,10-dodecatriene	1594	-	1.67	204
Caryophyllene oxide	1922	1986	2.44	220
d-mannose	2258	-	11.67	180
(3α,5α)2-methylenecholestan-3-ol	2313	-	3.73	373

MW- molecular weight, R_t- retention time

TABLE 5: PERCENTAGE COMPOSITION OF METHANOL EXTRACT OF *C. ALBIFLORA*

Compound	RI cal	RI ref	Area %	MW
Camphene	1000	1068	1.17	136
α-pinene	1050	1025	5.83	136
2,4-dimethyl 2-pentene	1075	-	0.73	98
2,4-octadiyne	1079	-	1	106
Ethyl benzene	1085	-	2.31	106
3-trifluoroacetoxyp entadecane	1172	-	0.06	324
1,2,4-trimethyl benzene	1219	-	0.1	120
Acetonyl dimethyl carbinol	1296	-	10.29	116
3-trifluoroacetoxydodecane	1372	-	0.2	282
(-)-alcanfor	1451	-	3	152
2,4-diisopropenyl-1-methyl-1-vinylcyclohexane	1522	-	0.41	204
Isocaryophyllene	1530	1598	1.58	204
(1R)-(-)-myrtenal	1565	1631	0.12	150
Isopinocarveol	1588	1661	0.17	152
(E)-α-famesene	1596	-	4.82	204
endo-borneol	1600	1699	1.28	154
α-terpineol	1629	1694	0.02	154
Methyl stearidonate	1653	-	0.27	290
cis-α-bisabolene	1658	1727	0.38	204
(-)-myrtenol	1726	1790	0.36	152
Z,Z,Z-4,6,9-nonadecatriene	1860	-	0.24	262
Caryophyllene oxide	1923	1986	16.18	220
6,10,14-trimethylpentadecan -2-one	2064	-	2.95	268
trans-(Z)-bisabolene epoxide	2177	-	1.23	220
cyclic ethylene mercaptole	2260	-	11.04	350
Neocurdione	2267	-	5.85	236
Aromadendrene oxide	2313	-	9.15	220
Methyl octadecadiynoate	2322	-	2.34	290

MW- molecular weight, R_t- retention time

Monoterpenes such as α-myrcene (0.02 %), 1,8 cineol (2.21 %), camphene (3.64 %), (-)-carvone

(0.05 %), pinocarvone (0.46 %) in the essential oil and d-1,8 cineol (0.32 %), camphene (1.45 %), and limonene (1.44 %) were found in acetone extract of *C. albiflora*. These plant constituents are reported to have various pharmacological properties such as toxicant, antibacterial, antioxidant, antimicrobial, antimitogenic, anti-cancer, antiprotozoal, and hepatoprotective properties *etc*. (Makabe *et al*., 2006); Nerolidol (antinociceptive and anti-inflammatory), Caryohylene oxide (analgesic and anti-inflammatory), euclyptol (anti-inflammatory), myrtinol (antinflammatory), bisabalool (anti-nosiceptive and anti-inflammatory), caryophyllene (anti-inflammatory), α-terpineol (anti-inflammatory), D-limonene (anti-inflammatory and antioxidant), α-pinene (anti-inflammatory).

Secondary metabolites of plants are important chemical compounds in medicine. Among them, some compounds have a potent therapeutic value. *Curcuma* species possess phytochemicals which have reported to have medicinal properties; 1, 8 cineole (toxicant, antioxidant, antimicrobial), turmerone (insecticidal, antiplasmodium), bisabolol oxide (antimicrobial mutagenic, genotoxic), borneol (antimicrobial, antioxidant, hyper protective, larvicidal), camphene (antimicrobial, antioxidant), camphor (larvicidal, antioxidant), caryophyllene (anticancer, antioxidant, anti-inflammatory), curdione (hyperprotective, platelet aggregation inhibitor, antimicrobial), curzerene (antimicrobial, antioxidant, antioxidant) *etc*.[1] Falcarinol, mercap-tole and cubedol were reported first time in *C. albiflora* essential oil.

The rhizomes of *C. aromatica* contain phytosterols, alkaloids and saponins [8]. *C. longa* is commercially very popular specie which is used in cookery, cosmetology and medicinally. *C. longa* consists of curcuminoids, glycosides, terpenoids, and flavonoids. These phytochemicals are responsible for its therapeutic effect. Curcumin present in *C. longa*, and *C. aromatica*, an effective anti-inflammatory agent. Inhibited lysosomal enzymes and is effective in inhibiting lipid peroxide formation. It has cytotoxic and antioxidant activities. It reduces cholesterol level and helps control blood sugar [9]. The essential oil of *C. aromatica* rhizome possesses 7–methanoazulene (13.75 %) and curcumene (25.71%). Various extracts of *C. aromatic* posseses 7-methanoazulene and curcumene; hexane extract {7–methanoazulene (21.81 %) and curcumene (30.02%)} and ethyl ecetate extract {7–methanoazulene (35.08 %) and curcumene (13.65%)} [10]. They can be easily differentiated with TLC or gas chromatography (GC) due to the presence of camphene and camphor and a high boiling alcohol in the volatile oil of *C. aromatica* which are absent in *C. longa.*

TABLE 6: GC-MS PROFILE OF *C. OLIGANTHA* (FROM MAHIYANGANAYA)

Compound	RI cal	RI ref	Area%
α Copaene	1409	1491	0.87
α - Bourbonene	1436	1500	0.06
Caryophyllene	1512	1598	15.07
Terpinen-4-ol	1520	1601	1.82
Elemene	1554	1590	0.19
Aromadendrene	1560	1620	0.19
Humulene	1585	1667	8.24
α Terpineol	1616	1694	0.14
cis-sesquisabinene hydrate	1636	-	0.14
Elemene	1649	1639	1.86
unknown 1	1664	-	0.6
unknown 2	1671	-	0.78
unknown 3	1679	-	0.94
unknown 4	1689	-	0.13
unknown 5	1745	1639	6.11
unknown 6	1765	-	0.22
Ionone	1774	1843	0.19
unknown 7	1845	-	0.08
trans-á-Ionone	1861	-	0.2
unknown 8	1890	-	0.52
unknown 9	1896	-	1.69
Caryophyllene oxide	1906	1986	5.82
unknown 10	1916	-	2.85
Andrographolide	1939	-	0.07
unknown 11	1951	-	0.13
unknown 12	1958	-	0.17
Gamolenic Acid	1976	-	0.1
unknown 13	2008	-	2.82
(-)-Spathulenol	2045	2126	1.97
unknown 14	2049	-	0.99
a-Bulnesene	2130	-	0.37
Asarone	2147	-	0.98
Ledene oxide-(II)	2176	-	0.52
Falcarinol	2284	-	0.13
Aromadendrene oxide	2292	-	0.38
trans-Z-à-Bisabolene epoxide	2298	-	0.29
Phthalic acid, butyl undecyl ester	2469	-	0.24
Phytol	2533	2613	13.38
d-Mannose	2624	-	0.08

The rhizome of *C. oligantha* possesses aliphatic constituents, β-sitosterol, curcumin *etc* [11]. *C. oligantha* is a poorly explored plant and Sri Lankan study of the plant has not been found. Therefore, GC-MS profile of *C. oligantha* was obtained and reported in the **Table 6**.

Major chemical constituents found in rhizome of *C. oligantha* are caryophyllene (15.07 %), phytol (13.38 %) and humulene (8.24 %). Phytol and humulene inhibits inflammatory responces by reducing cytokine production [12, 13].

Dry rhizome of *C. zedoaria* under steam distillation shows 1.0-1.5% greenish red colour volatile oil which contains monoterpenes (cineol, borneol, camphene *etc*), sesquiterpenes (d-camphor). Rhizome of *C. zedoaria* contains 1.5% d-α pinene, 3.5% d-camphor, 9.6% cineol, 4.2% d-camphor, 1.5% d-borneol, 10.0% sesquiterpene, 48.0% sesquiterpene-alcohols, 21.0% residue. Classified chemical compounds in five *Curcuma* species were reported in the **Table 7** [14, 15, 16, 17, 18].

TABLE 7: CLASSIFIED CHEMICAL COMPOUNDS OF FIVE *CURCUMA* SPECIES

C. albiflora	**Monoterpenoids:** (-)-Alcanfor, α-Terpineol, α-Myrcene, 1,8 cineol, endo-Borneol, α-Linalool, o-Cymene, Camphene, (-)-Carvone, Isoborneol, Terpinen-4-ol, Pinocarvone, 6-Camphenol, 2-Norpinene-2-carboxaldehyde, 6,6-dimethyl, trans-Geranylacetone, trans-Carvone oxide, 2-Nonen-1-ol. **Diterpenoids:** Phytol. **Sesquiterpenoids:** α Pinene, Caryophyllene oxide, Caryophyllene, Aromadendrene oxide-(1), Curdione, Neocurdione, α-copaene, Guaia-1(10),11-diene, Eremophila-1(10),11-diene, α-Bisabolene epoxide, 7-epi-cis-sesquisabinene hydrate, 2,5,8-Trimethyl-1,2-dihydronaphthalene, Isoaromadendrene epoxide, 3,5,6,7,8,8a-hexahydro-2(1H)-naphthalenone, α-ylangene, 4,5-di-epi-aristolochene, Cedrene **Phenolics Compounds:** 2-pentyl Furan. **Ketone:** (1R)-(+)-Nopinon, Hexahydrofarnesyl acetone, 10-Isopropenyl-3,7-cyclodecadien-1-one, 2-Tridecanone, 1-Hepten-6-one, 2-methyl **Alcohol:** (-)-Myrtenol 2(10)-Pinen-3-ol, (1,5,5-Trimethyl-2-methylenebicyclo[4.1.0]hept-7-yl)methanol, Cholestan-3-ol, 2-methylene-, (3á,5à), 2-Methyl-4-(2,6,6-trimethyl cyclohex-1-enyl)but-2-en-1ol, 2-Tridecen-1-ol, (E)- 6-Isopropenyl-4,8a-dimethyl-, cis-Verbenol, Falcarinol, cubedol. **Alkene:** α-Famesene, cyclohexene, **Alkane:** 5,5-Dimethyl-4-[(1E)-3-methyl-1,3-butadienyl]-1-oxaspiro[2.5]octane, cyclohexane, 1,2-15,16-Diepoxyhexadecane. **Carboxylic Acid:** n-Hexadecanoic acid, Cyclopropanebutanoic acid, cis-5,8,11,14,17-Eicosapentaenoic acid, 10,12-Octadecadiynoic acid, Doconexent. **Miscellaneous Compounds:** Ledene oxide-(II), Denderalasin, Patchoulane, Myrtanal, 17-Hydroxy-3-oxoandrost-4-ene-17-carbonitrile
C. aromatica	**Monoterpene:** α-Pinene, β-Pinene, β-3-Carene, Borneol, p-Cymene, p-Cymene-8-ol, Linalool, 1,8-Cineole. **Sesquiterpenes:** ar-Turmerone, β-Bisabolene, 1,3,5,10-Bisabolatetraene, 1,3,5,11-Bisabolatetraene, Bisacumol, β-Farnesene, α-Curcumene, β-Curcumene, Curdione, germacradien-8-one, β-Elemene, xanthorrhizol, dihydrogermacradien-8-one, Germacrone, Germacrone-4,5-epoxide, germacradien-8-one, Acetoxyneocurdione, Acetoxydehydrocurdione, Bisabola-3,10-diene-2-one, 13-Hydroxydehydrocurdione,13-Hydroxygermacrone, Methyl zedoarondiol, curcumin, demethoxycurcumin, (1β,4β,5β,10β)-Zedoarondiol, 9-Oxo-neoprocurcumenol, Curcumol, CurcumadioneCurmadione, Curzerene, Curzerenone, Isocurcumadione, Isoprocurcumenol, Isozedoarondiol, Neoprocurcumenol, Bis-demethoxycurcumin, Curcumin, Demethoxycurcumin. **Phenolic Compounds**: Carvacrol. **Miscellenius Compounds:** p-Methoxycinnamic acid, Xanthorrhizol, Zederone. Zedoarondiol **Phyto Sterols:** β-sitosterol-3-O-b-Dglucopyranoside
C. longa	**Monoterpenoids:** Camphene, Limonene, Terpinolene, Terpinen-4-ol, β-pinene, α-pinene, 1,8-Cineole, Linalool, BorneolIsoborneol, terpinene, Myrcene. **Diterpenoids:** phytol, (E,E,E)-3,7,11,15-tetramethylhexadeca-1,3,6,10,14-pentaene, 2,6,11,15-tetramethyl-hexadeca-2,6,8,10,14-pentaene, 1,6,10,14-hexadecatetraen-3-ol (3,7,11,15-tetramethyl-, (E,E)). **Sesquiterpenoids:** Turmerone, Ar-turmerone, α-Atlantone, β-Atlantone, β-Bisabolene, Camphor, Curcumin, Cyclocurcumin, Dihydrocurcumin, Germacrone-13-al, ar-Turmerone (dehydroturmerone), α-Turmerone, Turmerone, β−Turmerone, Turmeronol A, Turmeronol B, β-Farnesene, Germacrone-4,5-epoxide, 4-Hydroxybisabola -2,10-dien-9-one, 4-Hydroxy-3-methoxy-2,10-bisaboladien-9-one, 3-Hydroxy-1,10-bisaboladien-9-one, Procurcumadiol, Procurcumenol, 1-Epi-procurcumenol, Isoprocurcumenol, β-caryophyllene, Curdione, Curzerenone, Curcumin, Monodemethoxycurcumin, Didemethoxycurcumin, Euginol, Bis-demethoxycurcumin, 2,10-Bisaboladiene-1,4-diol, Bisabola-3,10-diene-2-one, Bisacumol, α –Curcumene, Curdione, Curlone, Epi-curcumenol, Curzerene, Curzerenone, p-Cymene, Dehydrocurdione, 2,5-Dihydroxybisabola-3,10-diene, 4,5-Dihydroxybisabola-2,10-diene, Eugenol, 4-Methoxy-5-hydroxy-bisabola-2,10-diene-9one, α-Phellandrene, D-Sabinene , Turmerin, Zingiberene. **Triterpenoids:** hopenone I hop-17(21)-en-3-ol, hop-17(21)-en-3-yl acetate **Phyto Sterols:** stigmasterol, β-sitosterol, gitoxigenin. **Miscellanious Compunds:** 2-hydroxymethyle anthraquinone, Syringic acid **Phenolics Compounds:** Calebin A, Caffeic acid, Vanillic. **Carboxylic Acid:** Cinnamic acid, p-Coumaric acid **Polysaccarides:** Ukonans A-D. **Fatty Acids:** linoleic acid, 16 8,11-Octadecadienoic acid, palmitic acid (n-hexadecanoic acid), oleic acid, stearic acid
C. oligantha Synonym *C. cannanorenis*	**Monoterpenes:** α-Pinene**,** Camphene, β- Pinene, Myrcene, p-Cymene, Terpinen-4-ol **Sesquiterpenes:** β-Phellandrene, cis-Ocimene, elemene, copaene, β-caryophyllene, bergamotene, curcumene, β-selinene, α-slinene, ar-Turmerone, β-eudesmol, cardinol, bisabolol oxide, **Alcohol:** n-Pentadecanol, n-octadecanol, n-haxadecanol, **Alkane:** methyl heptadecane, n-Octadecane. **Miscellaneous Compounds:** gurjunene, valencene, cinnamyl-n-valerate, farnesol, amyl anthranilate, ethyl p-methoxycinnamate, isomyl pyruvate, farnesyl acetate, benzyl benzoate, cinnamylcinnamate, ledol
C. zedoaria	**Monoterpenoids:** 1,8-cineol, camphene, borneol, d-α pinene, Citronellol, β-3-Carene, p-Cymene, p-Cymene-8-ol, Isoborneol,Myrcene, α-Pinene, β -Pinene **Sesquiterpenoids:**ar-Turmerone, β-Turmerone, Bisacurone, Bisacumol, Zingiberene, curcuminoids, zingiberine, camphor, curcumin, zedorian, Bis-demethoxycurcumin, Curcumin, Demethoxycurcumin,Dihydrocurcumin, Tetrahydrodemethoxycurcumin, Tetrahydro-bis-demethoxycurcuminAerugidiol, Alismoxide, β-Bisabolene, Borneol, 1,10-Bisaboladiene-3,4-diol, α-Cadinol, Calarene, α –Calacorene, Camphor, β-Caryophyllene, Curcolonol, Curcolone, Curcumadiol, Curcumadione,

	Curcumalactone A, Curcumalactone B, Curcumalactone C, 4-Epi-curcumenol, Curcumanolide A, Curcumanolide B, α-Curcumene, Curcumenol, Curcumenone, Curcurabranol D, Curcumol, Curdione, Curzerene, Curzeone, Curzerenone, Zedoarone, 5-Epi-curzerenone, Dehydrocurdione, S-Dihydrocurcumenone, Ethyl-p-methoxycinnamate, β-Elemene, γ –Elemene, β-Elemenone, Elemol, 7α,11α,-Epoxy-5β-hydroxy-9-guaiaen-8-, β-Eudesmol, β-Farnesene, Farnesol, Germacrone 4,5-epoxide, Glechomanolide, α –Humulene, β-Himachalene, 13-Hydroxygermacrone, 4-Hydroxy-7(11),10(14)-guaiadien-8-one, Isocurcumenol, Neocurcumenol, Neocurdione, Nerol, (E)-β-Ocimene, (Z)-β-Ocimene, 9-Oxo-neoprocurcumenol, α-Phellandrene, β-Phellandrene, Germacrene B, Isoprocurcumenol, IsospathulenolIsozedoarondiol, Procurcumenol, 1-Epi-procurcumenol, Cyclocurcumin, Curcumin, demthoxycurcumin, bis-demethoxycurcumin, Pyrocurzerenone, α-Selinene, β –Selinene, Spathulenol, Zederone, Zedoarol, Zedoarondiol, Zedoalactone B, Zedoarolide A, Zedoarolide B, Terpinen-4-ol, α –Terpineol, Terpinolene, α-Terpinene, γ-Terpinene. **Phyto Sterols:** stigmasterol **Miscellaneous Compounds:** β-Dictyopetrol, FuranodieneFuranodienone, Furanogermenone, Isofuranodienone, Gajutsulactone A, Gajutsulactone B

CONCLUSION: *Curcuma species* grown in Sri Lanka have significant therapeutic value. But *C. albiflora* and *C. oligantha* have not been studied to that extent. To validate medicinal value of *C. albiflora*, detailed pharmacological research has to be conducted.

ACKNOWLEDGEMENT: National Science Foundation (Sri Lanka) for funding facility (Grant Number: NSF/SCH/2018/03.

CONFLICT OF INTEREST: Nil

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How to cite this article:
Herath HMIC, Wijayasiriwardene TDCMK and Premakumara GAS: GC-MS identification of endemic herb *Curcuma albiflora* thw. (Sri Lanka). int j pharmacognosy 2018; 5(7): 419-25. doi link: http://dx.doi.org/10.13040/IJPSR.0975-8232.IJP.5(7).419-25.