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GC-MS and HR-LCMS fingerprinting of various parts of *Oroxylum indicum* (L.)Vent. A comparative phytochemical study based on plant part substitution approach

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Abstract
Oroxylum indicum, popularly known as '*Syonaka*', is one of the *Dasamoola* root species and an ingredient of many other herbal formulations. With a concern to conservation, the present study focuses on chromatographic analysis of phytocompounds present in various parts of this tree for finding possibilities to substitute aerial parts for root. In GC-MS analysis, 10, 12 and 18 bioactive compounds were identified respectively from root, stem and leaves. The abundance of the principal compound oroxylin and chrysin did not show much variation in root and stem. In LCMS analysis100 different compounds were identified from various parts. Majority of the bioactive compound like cosmosin, quercitrin, ginkolide J, rhapontin, leuteoline, hesperetin, naringenin, eriodictyol, S-4 nitrobenzyl glutathione, lecanoric acid, sennidin B, chlortetracycline, kanamycin etc. were detected in all parts. The study recommends for the use of young stem in herbal formulations instead of root, as an effective conservation strategy for this tree.

Keywords: *Oroxylum iniducm*, Plant part substitution, GC-MS analysis, HR-LCMS analysis.

Introduction
Plant based formulations are used world-wide for decades, due to their better healing power and immune modulatory activity. Our traditional and modern healing therapies exploit the wide range of secondary metabolites produced by plants, which in turn lead to indiscriminate harvesting of raw drug from natural sources. This has ultimately rendered many indigenous medicinal plant species endangered. *Oroxylum indicum* (L) Vent. is an important medicinal tree of Bignoniaceae family, whose root is highly demanded in the Indian and Chinese drug market. The root of this tree is one among the 10 roots used in the top selling Ayurvedic formulation- *Dasamoolarishta* [1]. It was estimated that the yearly consumption of *Dasamoola* raw drugs in Indian herbal drug market is more than 10,000 million tonnes [2]. The root of this tree is also used in other Ayurvedic preparations like *Dhanwanthara ghrita, Dhanwanthararishta, Brahma rasayana, Narayana taila etc.* [3, 4]. Compounds like ellagic acid, Oroxylin, Chrysin, Baicalin, were reported to be present in this tree [5, 6]. Unscientific harvesting of roots, added with poor fruit set and seed abortion has resulted in the drastic decline and disappearance of this tree in natural population [7]. It was reported that this tree has fallen under the RET (Rare Endangered Threatened) listed plants of Western Ghats of India [8]. Unavailability or scarcity of authentic medicinal plants were often coped with substituting or adulterating the original one with plant parts of inferior quality [9]. But substituting the medicinally important part with other parts of the same plant was often recommended as a sustainable harvesting strategy for slow growing species like trees so as to protect the valuable medicinal plants form destructive harvesting of underground parts. But the potential of plant part substitution varies according to the species [10]. Therefore the equivalency of the substituted part should be proved in terms of bioactivity and phytochemistry to ensure the efficacy and reliability of herbal medicines. Integration and incorporation of modern analytical methods like chromatographic and spectral techniques are authentic tools for generating finger prints of active compounds present in crude herbal drugs. In the present study the detailed phytochemistry of root bark, young stem and leaves of *O. indicum* were unravelled using Gas chromatographic-Mass spectrometric (GC-MS) analysis and High resolution Liquid chromatographic and Mass spectrometric (HR-LCMS) analysis.
The various compounds in root stem and leaves were critically compared seeking scientific reasons for using aerial parts instead of root.

Materials and methods

Collection of plant material and preparation of extract

Root, young stem and leaves of *O. indicum* were collected form medicinal plant resource garden Kanjirapuzha, Palakkad District. The plant materials were thoroughly washed, shade dried and coarsely powdered using a mixer grinder. About 5 grams of powdered plant parts were macerated separately with 100 ml of methanol in a conical flask kept in a rotary shaker for 18 hours [11]. The extract was filtered using whatman filter paper No.1 and collected in a petri dish. The solvent was evaporated to dryness by placing the extract inside the oven at 60 °C for 4 hour. The concentrated crude extracts were collected and stored in air tight borosil vials for further study.

GCMS analysis- Instrument specification and Operational conditions

GCMS analysis was carried out using a *Schimadzu* GC-MS Model No. QP 2010 S nonpolar chromatographic column with 30 meter length, 0.25 mm internal diameter and 0.25 µm thickness. The column operates in an electron impact mode at 70eV with helium as carrier gas. The oven was set with an initial temperature of 80 ºC and final temperature 260 ºC. and the ion source temperature was maintained at 200 ºC. A volume of 1 µl sample was injected to the injection port in split mode with a total flow of 24 ml/ min, column flow 1 ml/ min, purge flow 3 ml/ min and a linear velocity of 36.8 cm/sec under 65 k Pa pressure. The sample was run for a total duration of 50 minutes. The mass/ charge ratio value was initially set at 50 and a final value of 500. The compounds were identified based on their mass to charge ratio and matched with standards in NIST (National institute of standards and technology) library.

HR-LCMS - Instrument specification and Operational conditions

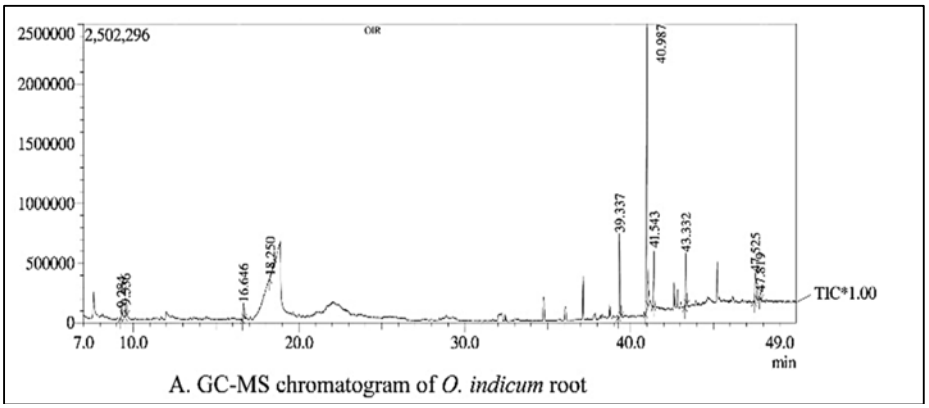
HRLC-MS analysis was performed with a Thermo fisher Scientific (Q-TOF) High resolution Orbitrap Liquid chromatogram equiped with Q extractive plus Mass spectrometer and proteome discoverer analyst version 1.42 software system. It has a Hypersil GOLD C18 column of dimension 100 x 2.1mm-3µ and dual AJS ESI (electro spray ionization) source. The instrument combines the analytical separation of HPLC and powerful detection technique of mass spectrometry and can provide high performance chromatographic separation of compounds with an m/z ratio ranging from 50 to 8000 amu, resolution 280000, scan speed of 12 Hz and mas accuracy less than 1 ppm.

The instrument was operated in a stop time mode for 30 minutes, with a gradient elution flow of 0.3 ml/minute and a pressure of 1200 bar. 95% water and 5% acetonitrile were used as solvents with a sample injection volume of 5 µl. The mass spectra of the compounds were obtained with a scan rate of 1.00 and m/z ratio ranging from 103- 1000. The LCMS data was obtained using proteome discoverer analyst version 1.42 software system. The obtained data was sorted manually to list out the parameters of various compounds.

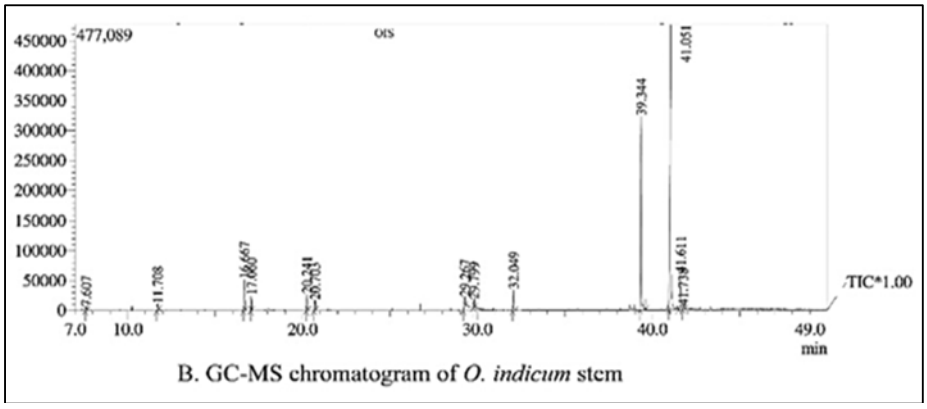
Results and discussion

GC-MS analysis

The chromatogram pattern was almost similar for root and stem (Figure 1). But the name of compounds differed according to the variation in fragmentation pattern of compounds. The highest peak area was achieved by the principal compound oroxylin (55.61% in root and 51.65% in stem). But the quantity of oroxylin in leaf was only 4.78%. Another important flavonoid compound chrysin has a peak area of 8.85% and 6.59% in root and stem respectively, but in leaf it was below detectable level.



A. GC-MS chromatogram of *O. indicum* root



B. GC-MS chromatogram of *O. indicum* stem

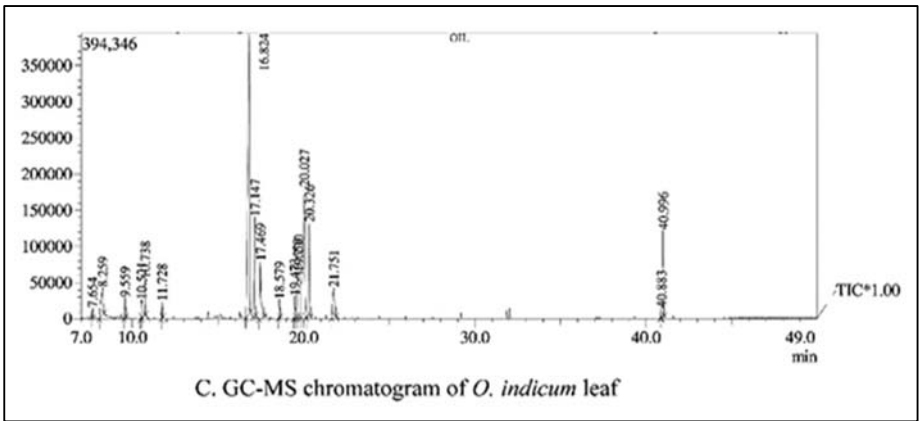


Fig 1: GC-MS chromatogram of methanolic extracts of various parts of *O. indicum*
A. root, B. stem, C. leaf

GC-MS analysis of the root of *O. indicum* revealed the presence of 10 compounds *viz*-Methylisopropyl nitrosamine, Pyranone, Methyl 3-Ethyl-3-Pentenoate, 1,5-Anhydro-d-talitol, Silikonfett SE 30, Oroxylin, Chrysin, Heptasilosane hexadecamethyl, Cyclononasiloxane octadecamethyl and β-sitosterol.

Stem revealed the presence of 13 compounds which include Methylpiperidine-(R)-MTPA amide, 4-vinylphenol, 2-Cyclohexen-1-one, 3methyl-, 1-Heptanol-2,4-dimethyl-(R,R)-(+)-, Cyclobutanecarboxylic acid- octyl ester, Decanoic acid, Hexadecanoic acid, Ethyl pelargonate, Tetradecanal, 1,2-benzenedicarboxylic acid, Oroxylin, Chrysin and D,L-Phenylalanine amide.

The 18 compounds identified from leaf include 5-methyluracil, 4-methyloxazole, 2,3-Dihydro-3,5-dihydroxy-6-methyl-4H-pyran-4-one, Benzoic acid, 5-Methoxypyrrolidin-2-one, 4-Vinylphenol, Seudenone, 1,10-decane-1,1,10,10-d4-dio, Benzene-ethanol, 4-hydroxy-, Tetrahydrofuran-2-one, 5-[1-hydroxyhexyl]-, Trans-1,2-d2-1,2-dihydroxy-cyclopentane, Phenol, 4-amino-, 2-(2',2',2'-d3-ethyl)pyridine, 2-d,2-pentadecyl-1,3-dioxepane, Cyclobutanecarboxylic acid, decyl ester, 1,4-Dioxin, 2,3-dihydro-, (-)-β-caryophyllene epoxide and the principle compound Oroxylin. The details of these compounds are summarised in table 1.

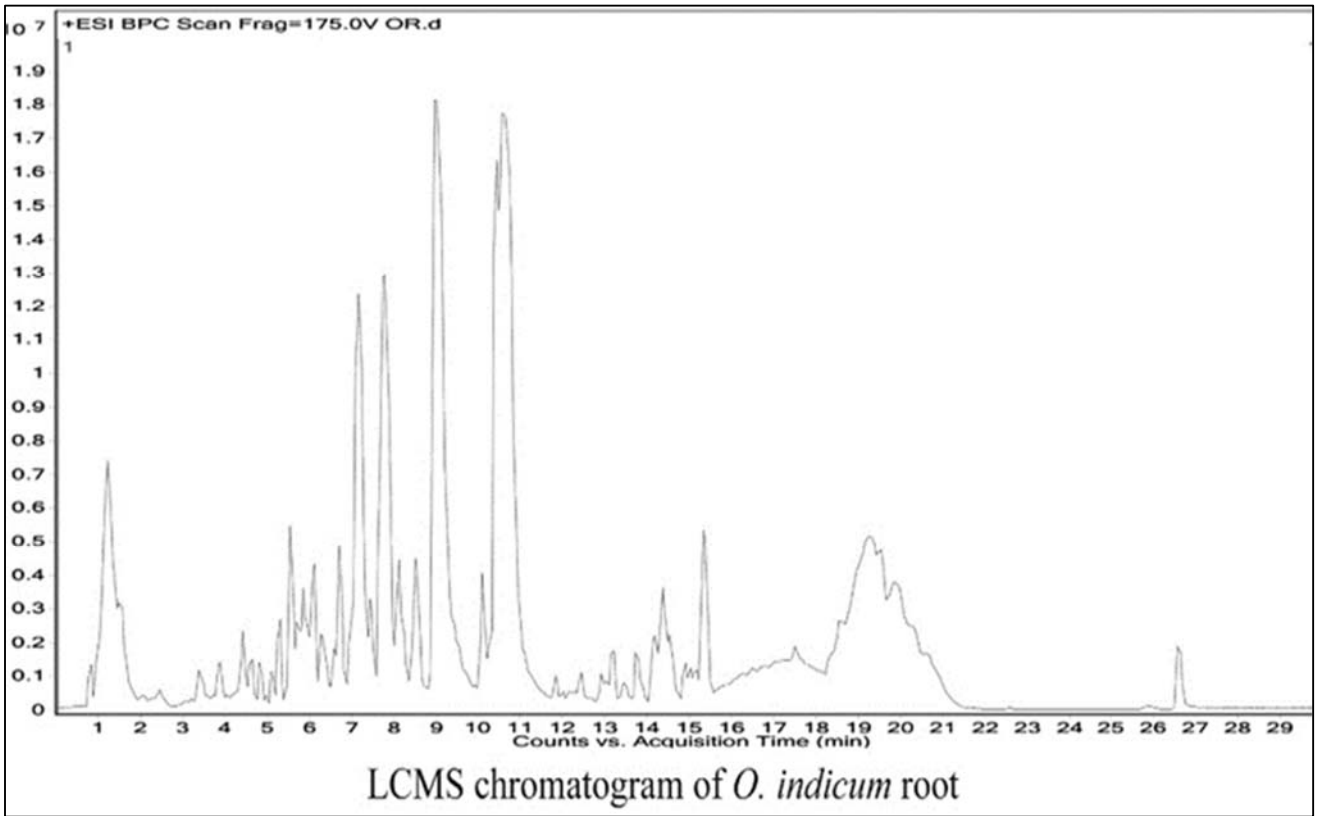
Table 1: Compounds detected from various parts of *O. indicum* through GC-MS analysis

Peak	Retention time	Name of Compound	Mol. Formula	Mass	Peak area %	m/z
Compounds in the methanolic extracts of root of *O. indicum*						
1	9.284	Methylisopropylnitrosamine	$C_4H_{10}N_2O$	102.14	1.47	56.00
2	9.536	Pyranone	C5H4O2	96.08	2.22	144.00
3	16.646	Methyl 3-Ethyl-3-Pentenoate	C8H14O2	142.2	3.61	82.05
4	18.250	1,5-Anhydro-D-talitol	C6H12O5	164.16	1.79	57.00
5	39.337	Silikonfett SE 30 (Grevels)			11.49	73.05
6	40.987	Oroxylin	$C_{16}H_{12}O_5$	284.26	55.61	69.00
7	41.543	Chrysin	$C_{15}H_{10}O_4$	254.24	8.85	254.00
8	43.332	Heptasiloxane, hexadecamethyl-	$C_{16}H_{48}O_6Si_7$		8.46	73.05
9	47.525	Cyclononasiloxane, octadecamethyl	$C_{18}H_{54}O_9Si_9$	667.4	5.44	73.05
10	47.818	Beta-sitosterol (Cupreol)	$C_{29}H_{50}O$	414.7	1.06	81.10
Compounds in the methanolic extracts of stem of *O. indicum*						
1	7.607	Methylpiperidine-(R)-MTPA amide	$C_7H_{14}N_2O$	142.2	0.81	126.05
2	11.708	4-vinylphenol	$C_8H_8O_8$	120.15	0.94	120.10
3	16.667	2- Cyclohexen-1-one, 3methyl-	$C_7H_{10}O_2$	110.15	3.79	82.00
4	17.060	1-heptanol,2,4-dimethyl-(R,R)-(+)-	$C_9H_{20}O$	144.25	1.53	55.00
5	20.241	Cyclobutanecarboxylic acid, octyl ester	$C_{13}H_{24}O_2$	212.33	1.86	55.05
6	20.703	Decanoic acid	$C_{10}H_{20}O_2$	172.26	1.35	73.00
7	29.267	Hexadecanoic acid	$C_{16}H_{32}O_2$	256.43	1.92	73.00
8	29.799	Ethyl pelargonate	$C_{11}H_{22}O_2$	186.29	0.78	88.05
9	32.049	Tetradecanal	$C_{14}H_{28}O$	832.00	2.56	71.05
10	39.344	1,2-benzenedicarboxylic acid	$C_8H_6O_4$	166.14	25.37	149.00
11	41.051	Oroxylin	$C_{16}H_{12}O_5$	284.26	51.65	69.00
12	41.611	Chrysin	$C_{15}H_{10}O_4$	254.24	6.59	254.05
13	41.738	D,l-phenylalanine amide	$C_9H_{12}N_2O$	164.2	0.83	120.10
Compounds in the methanolic extracts of leaf of *O. indicum*						
1	7.654	5-methyluracil	$C_5H_6N_2O_2$	126.113	0.45	126.00
2	8.259	4-methyloxazole	C_4H_5NO	83.09	3.78	55.00
3	9.559	2,3-Dihydro-3,5-dihydroxy-6-methyl-4H-pyran-4-one	$C_6H_8O_4$	144.12	1.00	143.95
4	10.521	Benzoic acid	$C_7H_6O_2$	122.12	1.10	84.00
5	10.738	5-Methoxypyrrolidin-2-one	$C_5H_9NO_2$	115.13	4.68	84.00
6	11.728	4-Vinylphenol	C_8H_8O	120.15	0.69	120.05
7	16.824	Seudenone	$C_7H_{10}O$	110.15	30.99	82.00

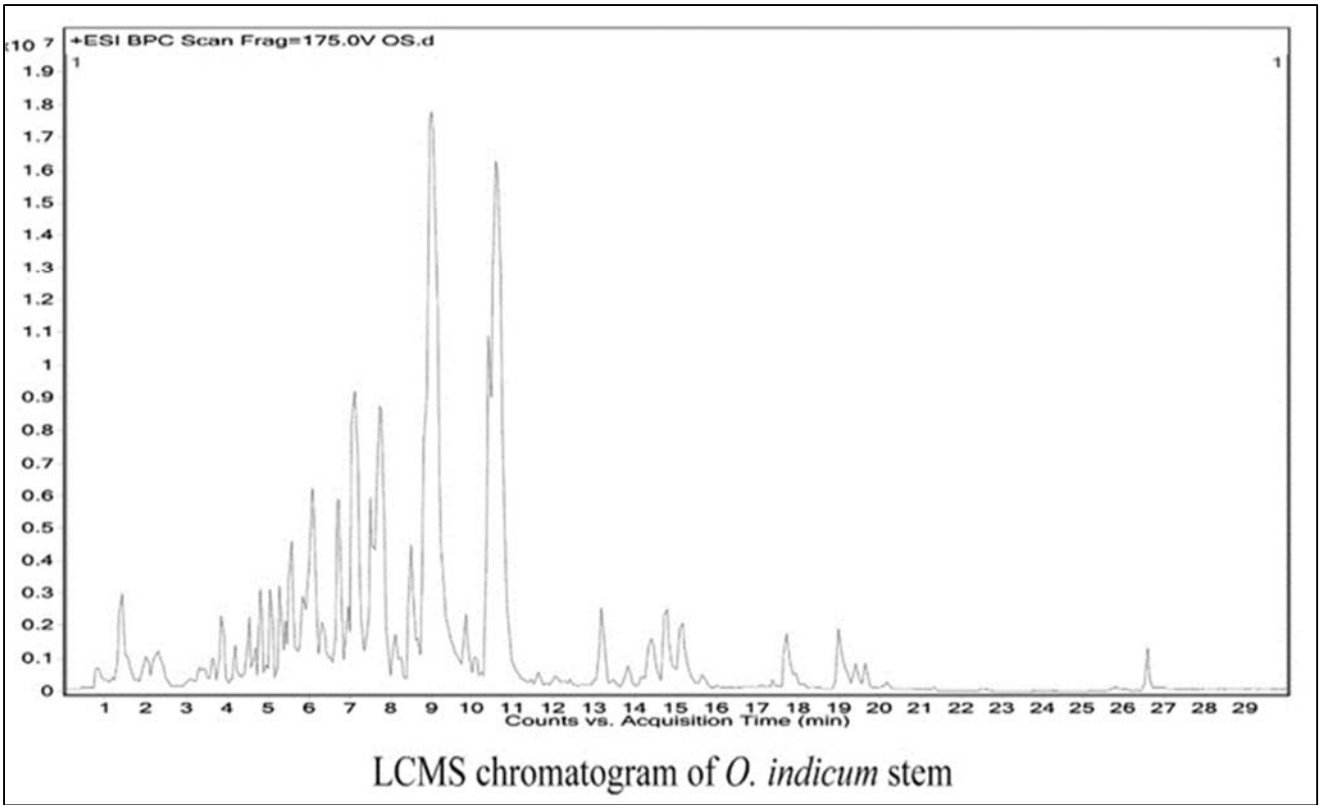
8	17.147	1,10-decane-1,1,10,10-d4-dio	$C_{10}H_{22}O_2$	174.28	5.56	55.00
9	17.469	Benzeneethanol, 4-hydroxy-	$C_8H_{10}O_2$	138.16	5.38	107.05
10	18.579	Tetrahydrofuran-2-one, 5-[1-hydroxyhexyl]-	$C_{10}H_{18}O_3$	186.25	0.80	101.05
11	19.473	Trans-1,2-d2-1,2-dihydroxy-cyclopentane	$C_5H_{10}O_2$	102.13	1.30	101.05
12	19.650	Phenol, 4-amino-	$H_2NC_6H_4OH$	109.12	3.43	84.00
13	19.700	2-(2',2',2'-d3-ethyl)pyridine	C_7H_9N	107.15	6.81	109.00
14	20.027	2-d,2-pentadecyl-1,3-dioxepane	$C_{20}H_{40}O_2$	312.5	18.35	102.05
15	20.326	Cyclobutanecarboxylic acid, decyl ester	$C_{17}H_{22}O_2$	268.4	6.84	55.00
16	21.751	1,4-Dioxin, 2,3-dihydro-	$C_4H_6O_2$	86.09	3.71	86.00
17	40.883	(-)-.Beta.-caryophyllene epoxide	$C_{15}H_{24}O$	220.35	0.37	93.00
18	40.996	Oroxylin	$C_{16}H_{12}O_5$	284.26	4.78	69.00

HRLC-MS analysis

The HRLC-MS chromatogram of various parts of *O. indicum* were depicted in figure 2. The peaks were almost similar in root, stem and leaves. The sorted list of known compounds along with their retention time, molecular formula, mass, m/z ratio and their presence or absence in various parts were summarised in Table 2. A total of 100 different compounds were detected from various parts of this tree. Among these 13 compounds *viz*- Cosmosin, Leuteolin, Propanoicacid 2-hydroxy-3-[(4-hydroxy-1-naphthalenyl)oxy]-,
Chlortetracycline, Hesperetin, Eriodictyol, S-(4-Nitrobenzyl) glutathione, Indol glycerol phosphate, Lecanoric acid, Naringenin, Kanamycin, Trandopril glucuronide and 3alpha,6beta,7alpha-trihydroxy -5beta-cholan-24-oic acid were detected in all parts. Root consisted a total of 41 compounds and stem consisted of 53 compounds. Root and stem shared 21 comounds in common including the above mentioned 13 compounds. The other common compounds of root and stem are 7-Dehydrologanin tetraacetate, Quercitrin, O-Desmethyloxotolrestat, Ginkgolide J, 1-Phosphatidyl 1D myoinositol-3-phosphate, Sennidin B and Haematoxylin 11-hydroxy palmitic acid. This reveals that majority of the bioactive compounds of root are shared by stem also. Some important bioactive compounds like Cisapride, Carisoprodol, Apin, 4-(2-hydroxyproposy)-3,5-dimethyl phenol, 7-Epiloganin tetraacetate, Naphthyl glucuronide, Hieracin, Iodovulone-I, Aesculin, Khayanthone were detected exclusively from stem. The common compounds of leaf and stem are Ketoconazole, Cefamandole naftate, Naringenin-7-O-glucoside, Oxotolrestat, Pentahydroxy flavone, Rhamnetin and 2,4-dimethyl tetradecanoic acid. Leaf consist of 50 compounds. Some important compounds like 3-indolyllactic acid, Rosmarinic acid, Salsalate, Fluvoxamine acid, Acebutol, Leukotriene E4, Oxfendazole, Evoxine, 18-Oxocortisol, Acocadene acetate, Normeperidine and Mitoxanthrone were detected only in leaf.



LCMS chromatogram of *O. indicum* root



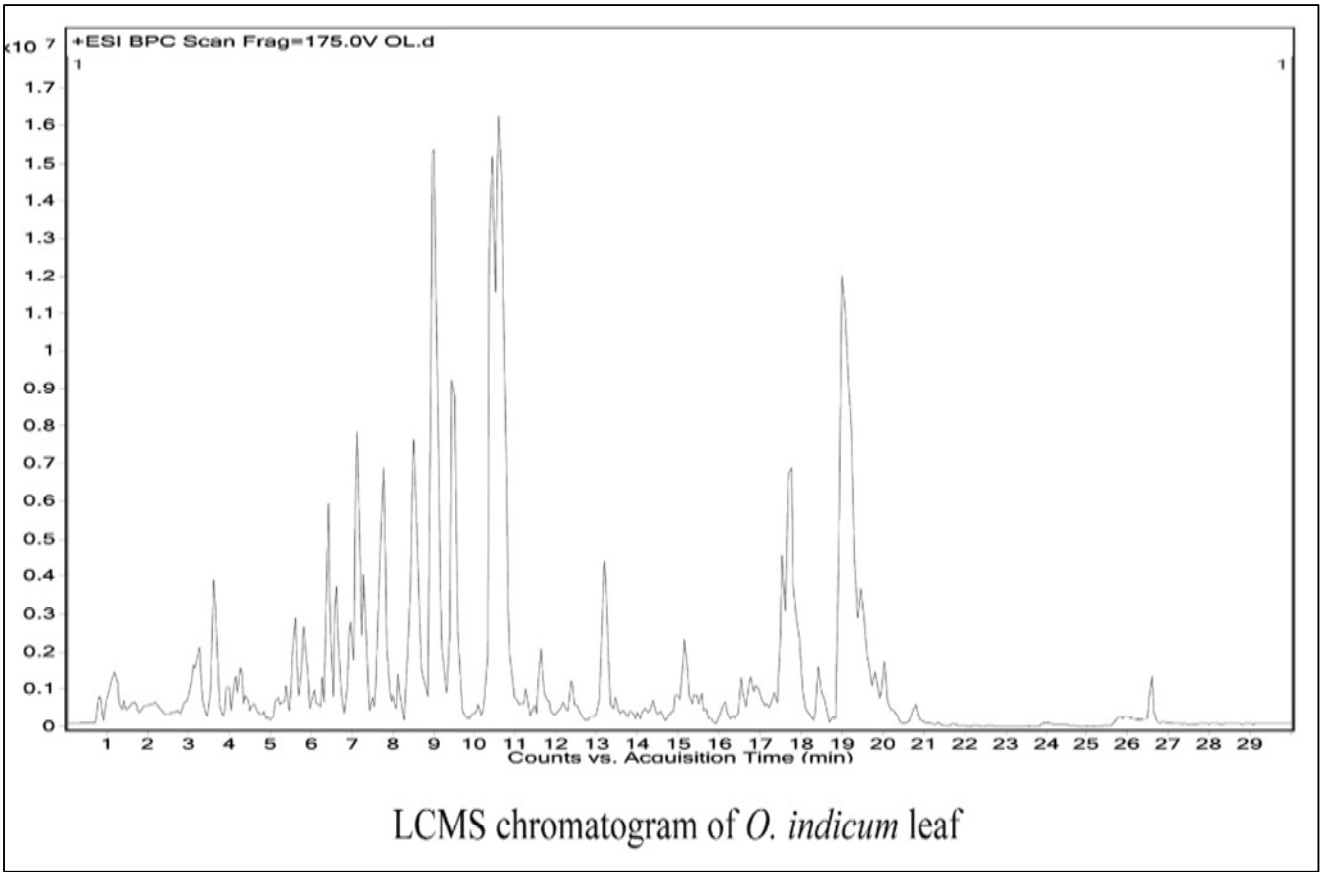


Fig 2: HR-LCMS chromatogram of methanolic extracts of various parts of *O. indicum*

Table 2: Compounds detected from the methanolic extracts of root, stem and leaf of *O. indicum* through HR-LCMS analysis

Sl. No	R.T	Name of compound	Mol.Formula	Mass	m/z	R	S	L
1	1.402	Methyl N (amethylbutyryl)glycine	$C_8H_{15}NO_3$	173.1042	156.1009	+	-	-
2	3.369	1,2-Benzenediol, 4-[[4-(4-fluorophenyl) 3piperidinyl] methoxy]-, (3Strans)-	$C_{18}H_{20}FNO_3$	317.1459	318.1532	+	-	-
3	4.482	Methsuximide	$C_{12}H_{13}NO_2$	203.0936	186.0902	+	-	+
4	5.243	7-Dehydrologanin tetraacetate	$C_{25}H_{32}O_{14}$	556.1797	579.1688	+	+	-
5	5.737	Quercitrin	$C_{21}H_{20}O_{11}$	448.0987	449.106	+	+	-
6	6.431	O-Desmethyloxotolrestat	$C_{15}H_{12}F_3NO_4$	327.0721	328.0802	+	+	-
7	7.086	Cosmosiin	$C_{21}H_{20}O_{10}$	432.104	433.1112	+	+	+
8	7.113	Luteoline	$C_{15}H_{10}O_6$	286.0471	269.0435	+	+	+
9	7.297	Propanoicacid,2-hydroxy-3-[(4-hydroxy-1 naphthalenyl)oxy]-	$C_{13}H_{12}O_5$	248.0695	271.0587	+	+	+
10	7.444	Carboxyltolmetin	$C_{15}H_{13}NO_5$	287.0773	270.0747	+	-	-
11	7.471	S-(4-Nitrobenzyl) glutathione	$C_{17}H_{22}N_4O_8S$	442.1122	447.0904	+	+	+
12	7.59	Chlortetracycline	$C_{22}H_{23}Cl\ N_2O_8$	478.11	461.1063	+	+	+
13	7.646	Hesperetin	$C_{16}H_{14}O_6$	302.0777	285.0745	+	+	+
14	7.724	Ginkgolide J	$C_{20}\ H_{24}O_{10}$	424.1377	447.127	+	+	-
15	7.793	Indoleglycerol phosphate	$C_{11}H_{14}N\ O_6P$	287.056	270.0519	+	+	+
16	7.968	3-(a-Naphthoxy)lactic acid glucuronide	$C_{19}H_{20}O_{10}$	408.1064	431.0955	+	-	+
17	8.049	Epigallocatechin	$C_{15}H_{14}O_7$	306.075	311.0536	+	-	-
18	8.232	1-Phosphatidyl 1D myoinositol-3-phosphate	$C_{11}H_{20}O_{16}P_2$	470.0238	493.0146	+	+	-
19	8.282	BICUCULLINE (+)	$C_{20}H_{17}NO_6$	367.1042	368.1113	+	-	-
20	8.388	Eriodictyol	$C_{15}H_{12}O_6$	288.0624	271.0592	+	+	+
21	8.545	N-Acetylsphingosine	$C_{20}H_{39}NO_3$	341.2939	346.2726	+	-	-
22	8.65	Lecanoric acid	$C_{16}H_{14}O_7$	318.0727	301.0692	+	+	+
23	9.086	3-Desmethyl- deshydroxy scleroin	$C_{14}H_{12}O_4$	244.0748	249.0534	+	-	-
24	9.09	Thyroacetic acid	$C_{14}H_{12}O_4$	244.0747	267.0639	+	-	-
25	10.087	Sennidin B	$C_{30}H_{18}O_{10}$	538.0885	539.0957	+	+	-
26	10.24	Pholcodine	$C_{23}H_{30}N_2O_4$	398.221	403.1994	+	-	-
27	10.304	Rhapontin	$C_{21}H_{24}O_9$	420.1399	403.1368	+	-	-
28	10.412	Naringenin	$C_{15}H_{12}O_5$	272.0693	255.0666	+	+	+
29	10.478	Haematoxylin	$C_{16}H_{14}O_6$	302.0803	285.0779	+	+	-
30	10.591	Indoprofen	$C_{17}H_{15}NO_3$	281.0997	286.0786	+	-	-
31	10.654	Genkwanin	$C_{16}H_{12}O_5$	284.0673	267.0641	+	-	-
32	12.227	Hematoporphyrin	$C_{34}H_{38}N_4O_6$	598.277	581.2734	+	-	+
33	13.025	9(S)-HpOTrE	$C_{18}H_{30}O_4$	310.2133	293.21	+	-	-
34	13.194	Kanamycin	$C_{18}H_{36}N_4O_{11}$	484.2374	507.2266	+	+	+
	14.073	5S-hydroxy-hexadecanoic acid	$C_{16}H_{32}O_3$	272.2363	295.2254	+	-	-
35	14.234	11-hydroxy palmitic acid	$C_{16}H_{32}O_3$	272.2361	277.2147	+	+	-
36	14.594	13-HOTE	$C_{18}H_{30}\ O_3$	294.2183	277.2148	+	-	-
37	15.162	Ambroxol	$C_{13}H_{18}Br_2N_2O$	375.9812	358.9781	+	-	-
38	16.509	GPA(18:0/22:0)[U]	$C_{43}H_{85}O_8P$	759.579	782.5679	+	-	-
39	19.043	Trandolapril glucuronide	$C_{30}H_{42}N_2O_{11}$	606.2826	607.29	+	+	+
40	19.712	3alpha,6beta,7alpha-trihydroxy -5beta-cholan-24-oic Acid	$C_{24}H_{40}O_5$	408.2863	391.283	+	+	+
45	0.802	Sulfabenzamide	$C_{13}H_{12}N_2O_3S$	276.0545	299.0442	-	+	-
46	1.226	3,7-Epoxycaryophyllan-6-one	$C_{15}H_{24}O_2$	236.174	241.1527	-	+	-
47	1.939	Carisoprodol	$C_{12}H_{24}N_2O_4$	260.1719	243.1686	-	+	-
48	2.327	Pantoic acid	$C_6\ H_{12}O_4$	148.0745	171.0636	-	+	-
49	3.238	Cisapride	$C_{23}H_{29}Cl\ FN_3O_4$	465.1823	466.1893	-	+	-
50	5.046	Apin	$C_{26}H_{28}O_{14}$	564.1462	565.1533	-	+	-
51	5.385	4-(2-hydroxypropoxy)-3,5-dimethyl-Phenol	$C_{11}H_{16}O_3$	196.111	219.1001	-	+	-
52	5.642	Ketoconazole	$C_{26}H_{28}C_{l2}N_4O_4$	530.1417	531.1478	-	+	+
53	5.845	Cefamandole nafate	$C_{18}H_{18}N_6O_5S_2$	462.079	463.0853	-	+	+
54	5.936	7-Epiloganin tetraacetate	$C_{25}H_{34}O_{14}$	558.1952	563.1737	-	+	-
55	5.945	Naphthyl glucuronide	$C_{16}H_{16}O_7$	320.0881	303.085	-	+	-
56	6.02	Ethanesulfonic acid, 2-[[(3a,5b,7a,12a)-3,7Dihydroxy -24-oxo-12-(sulfooxy) cholan 24yl]amino]	$C_{26}H_{45}NO_{10}S_2$	595.2486	600.227	-	+	-
57	6.381	4'-Hydroxyfenoprofen glucuronide	$C_{21}H_{22}O_{10}$	434.1192	417.1158	-	+	-
58	6.587	Hieracin	$C_{15}H_{10}O_7$	302.0419	285.0382	-	+	-
59	6.64	iodovulone I	$C_{21}H_{29}I\ O_4$	472.122	477.1007	-	+	-
60	6.742	Naringenin-7-O glucoside	$C_{21}H_{22}O_{10}$	434.1201	417.1166	-	+	+
61	6.743	Koparin 2'-methyl ether	$C_{17}H_{14}O_6$	314.0777	297.0745	-	+	-
62	6.744	Oxotolrestat	$C_{16}H_{14}F_3NO_4$	341.086	342.095	-	+	+
63	6.905	Methyl 7-Deshydroxy pyrogallin-4-carboxylate	$C_{13}H_{10}O_6$	262.0487	285.0378	-	+	-
64	6.997	Pentahydroxy flavanone	$C_{15}H_{12}O_7$	304.0569	287.0535	-	+	+
65	7.345	Veratricacidglucuronide	$C_{15}\ H_{18}\ O_{10}$	358.0909	363.0696	-	+	-
66	8.154	Aesculin	$C_{15}H_{16}O_9$	340.0804	345.0591	-	+	-
67	8.155	Chlorogenic acid	$C_{16}H_{18}O_9$	354.0957	377.085	-	+	-
68	8.723	Acetylaminodantrolene	$C_{16}H_{14}N_4O_4$	326.1008	331.0794	-	+	-

69	8.895	Rhamnetin	$C_{16}H_{12}O_7$	316.0565	299.0531	-	+	+
70	9.049	Dihydrodeoxy streptomycin	$C_{21}H_{41}N_7O_{11}$	567.2869	568.294	-	+	-
71	9.893	2,3,4-Ttrihydroxy-4-Methoxy benzophenone	$C_{14}H_{12}O_5$	260.0693	283.0582	-	+	-
72	13.677	2,4-dimethyl-tetradecanoic acid	$C_{16}H_{32}O_2$	256.2412	279.2304	-	+	+
73	14.52	GPEtn(10:0/11:0)[U]	$C_{26}H_{52}NO_8$ P	537.3404	279.2304	-	+	-
74	15.039	9,13-dihydroxy-11 octadecenoic acid	$C_{18}H_{34}O_4$	314.2441	297.2408	-	+	-
75	17.698	Khayanthone	$C_{32}H_{42}O_9$	570.2837	593.2728	-	+	-
76	19.523	23-methyl 5Z,9Z tetracosadienoic acid	$C_{25}H_{46}O_2$	378.3504	401.3397	-	+	-
77	3.231	3-Indolyllactic acid	$C_{11}H_{11}NO_3$	205.0727	188.0693	-	-	+
78	4.032	p-Hydroxy phenyllactate	$C_9H_{10}O_4$	182.057	165.0536	-	-	+
79	5.171	Metyrapone	C14 H14 N2 O	226.1095	209.1063	-	-	+
80	5.63	Fluvoxamine acid	$C_{14}H_{17}F_3N_2O_3$	318.1214	341.1118	-	-	+
81	5.855	17-phenyl-trinor PGF2 alpha	$C_{23}H_{32}O_5$	388.2215	463.0849	-	-	+
82	6.475	Salsalate	$C_{14}H_{10}O_5$	258.0518	241.0485	-	-	+
83	6.539	Mefenamic acid Metabolite (b-D-Glucopyranuronic acid, 1-[2[[3(hydroxymethyl)-2 methylphenyl]amino]	$C_{21}H_{23}NO_9$	433.1378	456.1269	-	-	+
84	6.922	Rosmarinic acid	$C_{18}H_{16}O_8$	360.0837	343.0802	-	-	+
85	7.022	Acebutolol	$C_{18}H_{24}N_2O_4$	336.2057	359.1948	-	-	+
86	7.14	Normorphine 3-glucuronide	$C_{22}H_{25}NO_9$	447.1533	470.1424	-	-	+
87	7.179	Leukotriene E4	$C_{23}H_{37}NO_5S$	439.24	440.247	-	-	+
88	7.646	5-Nitro-2-Phenylpropyl amino benzoicacid [NPPB]	$C_{16}H_{16}N_2O_4$	300.1122	305.091	-	-	+
89	7.841	Dehydrorotenone	$C_{23}H_{20}O_6$	392.1265	397.1041	-	-	+
90	7.859	4-Dedimethyl-6-dehydro anhydrotetracycline	$C_{20}H_{18}N_2O_7$	398.1104	399.1178	-	-	+
91	9.085	Oxfendazole	$C_{15}H_{13}N_3O_3S$	315.0697	298.0696	-	-	+
92	9.495	Epiafzelechin trimethyl Ether	$C_{18}H_{20}O_5$	316.1319	339.1212	-	-	+
93	9.596	Triptonide	$C_{20}H_{22}O_6$	358.1404	341.1373	-	-	+
94	11.025	Evoxine	$C_{18}H_{21}NO_6$	347.1379	370.1271	-	-	+
95	11.132	13R-hydroxy 9E,11 Zoctadecadienoic acid	$C_{18}H_{32}O_3$	296.2342	279.2308	-	-	+
96	11.185	Deoxysappanone b 7,3'- dimethyl ether acetate	$C_{20}H_{20}O_6$	356.1267	361.1054	-	-	+
97	11.619	Mitoxantrone	$C_{22}H_{28}N_4O_6$	444.2032	445.2102	-	-	+
98	11.77	18-Oxocortisol	$C_{21}H_{28}O_6$	376.1898	381.1682	-	-	+
99	12.089	Avocadene acetate	$C_{19}H_{36}O_4$	328.2621	351.2516	-	-	+
100	12.397	18-Hydroxycortisol	$C_{21}H_{30}O_6$	378.2053	383.1839	-	-	+
101	13.218	Normeperidine	$C_{14}H_{19}NO_2$	233.143	238.1217	-	-	+
102	15.371	(Z)-2-tetracos-15- enamidoethanesulfonic acid	$C_{26}H_{51}NO_4S$	473.349	496.3378	-	-	+
103	26.633	14-hydroxy-5Z-tetradecenoic acid	$C_{14}H_{26}O_3$	242.1862	247.165	-	-	+

+ Presence of the compound, - Absence of compound, R-root, S-stem, L- leaf

Substitution of underground parts with aerial parts have been studied earlier in other medicinal root species like *Aegle marmelos* [12] and *Premna latifoia* [13]. From the present phytochemical study of various part of *O. indicum*, it was clear that a good extend of similarity exist for root and stem rather than leaves. The GC-MS and HR-LCMS chromatograms of root and young stem revealed similar peaks. The principal compounds oroxylin and chrysin were present both in root and stem, almost in similar quantity. This report is the first of its kind which reveals a GCMS and LCMS profile of root stem and leaf of *O. indicum.* LC-MS based phytochemical profiling can also be used for checking the authenticity of crude drugs available in market.

Conclusion

Majority of the bioactive compounds present in the root of *O. indicum* are present in the stem too. Thus it can be concluded that young stem of *O. indicum* can be effectively substituted for its roots in Ayurvedic formulations. In leaf the principle compound Oroxylin is present in small quantity, but Chrysin is below detectable level. So leaf do not form a suitable substitute for root.

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References

1. Warrier PK, Nambiar VP and Ramankutty C. Indian Medicinal Plants -A compendium of 500 species. Orient Longman Publisher 1995;4:157-68.
2. Aparna S, Ved DK, Lalitha S, Venkatasubramanian P. Botanical identity of plant sources of Dasamula drugs through an analysis of published literature. Ancient science of life 2012;32(1):3-10
3. Jabbar S, Khan MT, Choudhuri MS, Sil BK. Bioactivity studies of the individual ingredients of the Dashamularishta. Pakistan Journal of Pharmaceutical Science 2004;17(1):9-17.
4. Zaveri M, Jain S. Gastroprotective effects of root bark of *Oroxylum indicum*, vent. Journal of Natural Remedies 2007;7(2):269-277
5. Vasanth S, Natarajan M, Sundaresan R, Bhima Rao R, Kundu AB. Ellagic acid from the root bark of *Oroxylum indicum*. Indian drugs 1991;28:507.
6. Dinda B, Mohanta BC, Arima S, Sato N, Harigaya V. Flavonoids from the stem-bark of *Oroxylum indicum*. Natural Product Sciences 2007;13(3):190-194.
7. Gunaga RP, Vidya PV, Narkhede SS. Seed abortion in *Oroxylum indicum*, A Commercial Medicinal Tree. Research and Reviews: Journal of Agriculture and Allied Sciences 2012;1:1-3
8. Ravikumar K, Ved DK, Vijaya Sankar R, Udayan PS. 100 Red listed medicinal plants of conservation concern in Southern India. Foundation for Revitalisation of Local Health Traditions, Banglore. 2000, 157-168

9. Kumar SP. Adulteration and substitution in endangered ASU medicinal plants of India: A review. International Journal of Medicinal and Aromatic Plants 2014;4(1):56-73.
10. Zschocke S, Rabe T, Taylor JL, Jager AK, Van Staden J. Plant part substitution–a way to conserve endangered medicinal plants? Journal of Ethnopharmacology 2000;71(2):281-292.
11. Phrompittayarat W, Putalun W, Tanaka H, Jetiyanon K, Wittaya-areekul S, Ingkaninan K. Comparison of various extraction method of *Bacopa monieri*. Naresuan university journal: Science and technology 2013;15(1):29-34.
12. Sulaiman CT, Balachandran I. Plant part substitution for medicinal use in *Aegle marmelos* – A phytochemical approach. Journal of Trop Med Plants 2013;14(1-2):19-22
13. Jena AK, Karan M, Vasisht K. Plant parts substitution based approach as a viable conservation strategy for medicinal plants: A case study of *Premna latifolia* Roxb. Journal of Ayurveda and Integrative Medicine 2017;8(2):68-72.