



Research Article

PHYTOCHEMICAL PROFILING OF METHANOLIC EXTRACTS OF MEDICINAL PLANTS USING GC-MS

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ABSTRACT

Objectives: The plants have metabolites which can be used for medicinal and other uses. There is a need to analyze the plants for such phytochemicals. The present study was designed to screen the phytochemicals present in the leaves of some medicinal plants collected from the catchment areas of river Beas, India.

Methods: The plants studied were *Rumex dentatus* L., *Achyranthes aspera* L., *Alternanthera philoxeroides* (Mart.) Griseb., *Lantana camara* L., *Erigeron bonariensis* L. and *Sesbania bispinosa* (Jacq.) W.F. Wight. Phytochemical profiling was carried out by using GC-MS.

Results: A total of 62 phytochemicals were detected in the leaves of the six species analyzed: *R. dentatus* (17), *A. aspera* (26), *A. philoxeroides* (12), *L. camara* (20), *E. bonariensis* (19) and *S. bispinosa* (17). The major compounds detected were androstan-3-ol, 9-methyl-(3 beta, 5 alpha) (*R. dentatus*), 2-propenoic acid, 3-phenyl-methyl ester, cinnamic acid methyl ester (*A. aspera*), benzenepropanoic acid, 3,5-bis(1,1-dimethylethyl)-4-hydroxy-methyl ester (*A. philoxeroides*), olean-18-en-28-oic acid, 3-oxo-methyl ester methyl moronate (*L. camara*), 1-alpha-18O-1, 25-dihydroxycholecalciferol (*E. bonariensis*) and glaucic acid (*S. bispinosa*).

Conclusions: Palmitic acid and benzenepropanoic acid, 3,5-bis(1,1-dimethylethyl)-4-hydroxy-methyl ester were the common compounds detected in the six plant species studied. The compounds detected have medicinal and pesticidal activities and can be used commercially for extraction of chemicals.

Keywords: Phytochemicals; GC-MS; *Rumex dentatus*; *Achyranthes aspera*; *Alternanthera philoxeroides*; *Lantana camara*; *Erigeron bonariensis*; *Sesbania bispinosa*.

INTRODUCTION

Products obtained from plants have been used as a source of medicine. Medicinal plants are the main source of drugs for traditional medicines, food supplements, nutraceuticals, pharmaceuticals etc. (Das et al., 2010; Anwer et al., 2013). Studies on phytochemical profiling of plants has been reported in various plants i.e., *Cleistanthus collinus*, *Calotropis gigantean*, *Nervilia aragoana*, *Stylosanthes fruticosa*, *Brassica juncea* (Sandosh et al., 2013; Dhivya & Manimegalai, 2013; Thomas et al., 2013; Suman et al., 2013; Sharma et al., 2015). *A. aspera* (family amaranthaceae) possesses diuretic, hepatoprotective activities etc. It is also used for the prevention of various disorders i.e., asthma, diabetes, malarial fever etc. (Priya et al., 2012). *E. bonariensis* (family

asteraceae) has anti-inflammatory, antioxidant, antibacterial activities etc. (Sharma et al., 2014). *L. camara* belongs to the family verbenaceae and it has been used to cure sore throat, cough, skin rashes and itching etc. It also possesses antipyretic, antiplasmodic and antibiotic activities (Sharma et al., 2013). *S. bispinosa* (family fabaceae) is used for the treatment of fever, cough and urinary tract diseases etc. (Gohel and Pandya, 2015). *R. dentatus* (family polygonaceae) has diuretic, anti-tumor, anti-inflammatory and bactericidal activities (Litvinenko and Muzychkina, 2003; Demirezer, 1993). *A. philoxeroides* of amaranthaceae family is used in the prevention of dysentery, asthma etc. (Dutta, 2015).

MATERIALS AND METHODS

Collection and processing of plant materials

Plant samples were collected in the vicinity of river Beas, Punjab, India. From 1 g of oven dried leaves of each plant species, 100 ml methanolic extract was prepared and dried in rotary vacuum evaporator. To the dried extract, 4 ml of methanol was added, which was used for the analysis of phytochemicals. 2 µl of sample was injected into the system.

GC-MS analysis

Phytochemical analysis of methanolic extracts of plants was carried out using Shimadzu GC-MS QP2010 Plus. Carrier gas used was helium. Initially the column oven temperature was set at 70°C and held for 5 min., then increased to 250°C at 10°C per min. and held for 10 min., temperature was increased to 300°C at intervals of 10°C per min. and held for another 10 min. The instrument specifications are as follows: pressure: 110.8 kPa; injection mode: splitless; total flow: 38.9 ml/min; column flow: 1.71 ml/min; solvent cut time: 3.5 min; detector gain mode: relative; injection temperature: 280°C; purge flow: 3 ml/min and sample injection volume: 2 µl

Compounds were identified in the samples by comparing with the mass spectra with National Institute of Standard and Technology, and Wiley 7 library.

RESULTS

Tables 1-6 give the various phytochemicals present in the methanolic extracts of *R. dentatus*, *A. aspera*, *A. philoxeroides*, *L. camara*, *E. bonariensis* and *S. bispinosa*. The compounds detected in different species were *R. dentatus* (17), *A. aspera* (26), *A. philoxeroides* (12), *L. camara* (20), *E. bonariensis* (19) and *S. bispinosa* (17). In *R. dentatus*, androstan-3-ol, 9-methyl-(3 beta,5alpha) (30.24%) and ergosta-7,22-dien-3-ol, (3 beta,22E) (15.97%) were the major compounds. 2-Propenoic acid, 3-phenyl-, methyl ester, cinnamic acid methyl ester (17.09%) and benzenepropanoic acid, 3,5-bis(1,1-dimethylethyl)-4-hydroxy- methyl ester (12.72%) were the major compounds present in *A. aspera*. In *A. philoxeroides*, benzenepropanoic acid, 3, 5-bis (1,1-dimethylethyl) -4- hydroxyl - methyl ester (29.65%) and palmitic acid (23.95%) were the major compounds detected. Olean – 18 – en – 28 - oic acid, 3-oxo-methyl ester methyl

Table 1: Compounds present in the leaves methanolic extracts of *Rumex dentatus* using GC-MS

S. No.	Name of compound	R. time	Area (%)
1	Phenylacetaldehyde	7.900	1.21
2	8-Methyl-alpha-ionone	9.419	1.47
3	Propanoic acid, 2-methyl-3-[4-t-butyl]phenyl	14.269	1.42
4	Morpholine,4-(1-cyclopenten-1-yl)-1-morpholino-1-cyclopentene	14.909	0.28
5	Phenol, 2-methyl-5-(1-methylethyl)-carvacrol	15.004	1.02
6	Nonyl-phenol mix of isomers	15.107	0.66
7	Phenol, nonyl-nonylphenol	15.201	0.85
8	Hexestrol	15.516	0.88
9	Acetic acid, 2-(2,2,6-trimethyl-7-oxa-bicyclo[4.1.0]hept-1-yl)-propenyl ester	16.687	0.54
10	Benzenepropanoic acid, 3,5-bis(1,1-dimethylethyl)-4-hydroxy- methyl ester	17.426	6.42
11	Palmitic acid	17.972	11.50
12	(E,1'RS,2'RS,3'SR)-4-(2',3'-epoxy-2',6',6'-trimethylcyclohexyl)-3-methyl-3-buten-2-one	19.311	2.41
13	Androstan-3-ol, 9-methyl-(3 beta,5 alpha)	19.635	30.24
14	Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester	22.532	6.68
15	1-Alpha-18O-1,25-dihydroxycholecalciferol	24.002	12.17
16	Ergosta-7,22-dien-3-ol, (3 beta,22E)	34.074	15.97
17	Urs-12-en-28-oic acid, 3-hydroxy-methyl ester, (3beta)	37.414	6.28

Table 2: Compounds present in the leaves methanolic extracts of *Achyranthes aspera* using GC-MS

S. No.	Name of compound	R. time	Area (%)
1	Phenylacetaldehyde	7.878	2.57
2	8-Methyl-alpha-ionone	9.411	1.50
3	2-Propenoic acid, 3-phenyl-, methyl ester, cinnamic acid methyl ester	10.523	17.09
4	2,4,4-Trimethoxy-2,5-cyclohexadien-1-one	10.959	1.17
5	Trans-cinnamic acid	11.634	3.45
6	4,5-Dimethyl-o-phenylendiamine	11.729	4.58
7	Methyl p-methoxycinnamate	13.364	3.21
8	-methoxycinnamic acid	14.163	1.21
9	Trans-2-hydroxycinnamic acid, methyl ether, methyl ester	14.376	12.06
10	4-Methoxycinnamic acid	14.997	4.51
11	Phenol, nonyl- nonylphenol	15.100	1.27
12	Nonyl-phenol mix of isomers	15.194	1.52
13	Cis-2-methoxycinnamic acid	15.336	6.02
14	Phenol, p-tert-butyl	15.511	1.36
15	Eicosanoic acid, 11-oxo-, methyl ester methyl 11-ketoarachidate	15.630	1.39
16	1,2-Dimethoxy-4-(3-methoxy-1-propenyl)benzene	16.472	1.88
17	Patchouli alcohol	16.667	1.18
18	Benzenepropanoic acid, 3,5-bis(1,1-dimethylethyl)-4-hydroxy- methyl ester	17.424	12.72
19	Palmitic acid	17.919	6.94
20	Pentanoic acid, 3-methyl-2-[(1-methyl-1-phenylpropyl) amino]- ethyl ester ethyl(2-(2-phenyl)-2-butyl) imido-3	18.109	0.30
21	Duvatriendiol	19.076	1.16
22	Morpholine, 4-(1-cyclopenten-1-yl)-1-morpholino-1-cyclopentene	19.512	2.14
23	1-Alpha-18O-1,25-dihydroxycholecalciferol	19.774	1.83
24	Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester	22.508	3.05
25	Cholest-5-ene, 3-bromo-(3beta)	34.194	5.06
26	Methyl commate B	35.152	0.83

Table 3: Compounds present in the leaves methanolic extracts of *Alternanthera philoxeroides* using GC-MS

S. No.	Name of compound	R. time	Area (%)
1	2-Heptanone,6-methyl-6-[3-methyl-3-(1-methylethenyl)-1-cyclopropen-1-yl]-6-methyl-6-(3'-methyl-3'isopropenyl)cycloprop	14.992	4.35
2	Nonyl-phenol mix of isomers	15.096	6.19
3	Phenol, nonyl-nonylphenol	15.189	3.35
4	Phenol, 4-(1,1-dimethylethyl)-p-tert-butylphenol	15.505	3.91
5	1,2-Epoxy-1,2,5,9,9-pentamethyl-spiro(3.5)non-5-ene	15.587	2.50
6	Benzenepropanoic acid, 3,5-bis(1,1-dimethylethyl)-4-hydroxy-methyl ester	17.416	29.65
7	Palmitic acid	17.936	23.95
8	1-Alpha-18O-1,25-dihydroxycholecalciferol	18.476	1.11
9	Stearic acid	19.767	2.61
10	D-glucose,6-O-alpha-D-galactopyranosyl-bis-O-(trimethylsilyl) derive, cyclic tris(methylboronate)-melibiose-tri-met	22.506	4.34
11	Ergosta-7,22-dien-3-ol,3beta,5alpha,22E	33.979	10.51
12	Urs-12-en-28-oic acid, 3-hydroxy-methyl ester, (3beta)	37.387	7.53

Table 4: Compounds present in the leaves methanolic extracts of *Lantana camara* using GC-MS

S. No.	Name of compound	R. time	Area (%)
1	Phenol, 5-methyl-2-(1-methylethyl)-thymol	14.990	0.16
2	Nonyl-phenol mix of isomers	15.093	0.11
3	Morpholine, 4-(1-cyclopenten-1-yl)-1-morpholino-1-cyclopentene	15.188	0.17
4	2-Hydroxy-4-isopropyl-1-me	15.503	0.13
5	Benzenepropanoic acid, 3,5-bis(1,1-dimethylethyl)-4-hydroxy- methyl ester	17.414	0.87
6	Palmitic acid	17.995	2.52
7	(E,1'RS,2'RS,3'SR)-4-(2',3'-epoxy-2',6',6'-trimethylcyclohexyl)-3-methyl-3-buten-2-one	19.304	0.44
8	Cis-jasmone	19.638	4.50
9	Stearic acid	19.836	0.50
10	Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester -2-monopalmitin	22.532	0.87
11	Ergost-5-en-3-ol, 22, 23-dimethyl-(3beta)	23.995	1.41
12	1-Alpha-18O-1,25-dihydroxycholecalciferol	24.871	0.08
13	Duvatriendiol	25.634	0.23
14	4H-1-Benzopyran-4-one, 5,7-dihydroxy-6-methoxy-2-(4-methoxyphenyl)-pectolarigenin	27.228	11.11
15	Aciphyllol alcohol	28.623	0.70
16	6S-2,3,8,8-Tetramethyltricyclo[5.2.2.0(1,6)]undec-2-ene	32.614	8.53
17	Olean-18-en-28-oic acid, 3-oxo-methyl ester methyl moronate	33.875	16.84
18	Stigmast-5-en-3-ol, (3beta)-24 -ethyl-5 delta-cholesten-3 -ol	34.344	6.02
19	9,19-Cyclolanost-23-ene-3,25-diol, (3 23E)	36.309	34.77
20	Glaucyl alcohol	36.853	10.01

Table 5: Compounds present in the leaves methanolic extracts of *Erigeron bonariensis* using GC-MS

S. No.	Name of compound	R. time	Area (%)
1	8-Methyl-alpha-ionone	9.421	2.18
2	1,2-Benzenedicarboxylic acid, diethyl ester ethyl phthalate	13.424	3.18
3	Morpholine, 4-(1-cyclopenten-1-yl)-1-morpholino-1-cyclopentene	14.907	0.43
4	Phenol, 2-methyl-5-(1-methylethyl)-carvacrol	15.003	1.52
5	Nonyl-phenol mix of isomers	15.108	2.20
6	Phenol, nonyl-nonylphenol	15.208	2.16
7	Phenol, 4-(1,1-dimethylethyl)-p-tert-butylphenol	15.518	1.43
8	Benzenepropanoic acid, 3,5-bis(1,1-dimethylethyl)-4-hydroxy- methyl ester	17.433	10.94
9	Palmitic acid	18.049	18.97
10	(E,1'RS,2'RS,3'SR)-4-(2',3'-epoxy-2',6',6'-trimethylcyclohexyl)-3-methyl-3-buten-2-one	19.317	2.64
11	1-Alpha-18O-1,25-dihydroxycholecalciferol	19.599	22.63
12	Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester	22.526	2.56
13	Stigmasterol	32.871	4.38
14	Verticellol	33.142	4.45
15	Ergosta-7,22-dien-3-ol, (3beta,5alpha,22E)	34.041	5.43
16	Methyl commate B	34.242	5.16
17	Beta-sitosterol	35.122	4.21
18	Cholesta-7, 24-dien-3-ol, (3beta,5alpha)	35.334	1.78
19	Urs-12-en-28-oic acid, 3-hydroxy-methyl ester, (3beta)	37.411	3.75

Table 6: Compounds present in the leaves methanolic extracts of *Sesbania bispinosa* using GC-MS

S. No.	Name of compound	R. time	Area (%)
1	2-Propenoic acid, 3-(2-hydroxyphenyl)	7.906	8.46
2	8-Methyl-alpha-ionone	9.423	3.73
3	Morpholine, 4-(1-cyclopenten-1-yl)-1-morpholino-1-cyclopentene	10.621	0.54
4	2-Heptanone, 6-methyl-6-[3-methyl-3-(1-methylethenyl)-1-cyclopropen-1-yl]- (CAS) 6-methyl-6-(3'-methyl-3'-isopropenyl)cyc	14.994	1.56
5	Phenol, nonyl- nonylphenol	15.098	0.89
6	Nonyl-phenol mix of isomers	15.192	1.42
7	Phenol, 2-methyl-5-(1-methylethyl)-carvacrol	15.506	1.50
8	Benzenepropanoic acid, 3,5-bis(1,1-dimethylethyl)-4-hydroxy-, methyl ester	17.420	9.69
9	Palmitic acid	17.968	14.00
10	Cis-jasmone	19.538	8.62
11	Stearic acid	19.800	3.52
12	Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester-2-monopalmitin	22.525	5.65
13	1-Alpha-18O-1,25-dihydroxycholecalciferol	23.975	1.83
14	Stigmasterol	32.842	8.88
15	Verrucarol	34.150	6.18
16	Urs-12-en-28-oic acid, 3-hydroxy-, methyl ester,(3beta	37.399	6.98
17	Glaucic acid	38.029	16.53

moronate (16.84%) and 9, 19-cyclolanost-23-ene-3, 25-diol, (3 23E) (34.77%) were the major compounds found in *L. camara*. In *E. bonariensis*, 1-alpha-18O-1, 25-dihydroxycholecalciferol (22.63%) and palmitic acid (18.97%) were the major compounds. Glaucic acid (16.53%) and palmitic acid (14%) were the major compounds detected in *S. bispinosa*. Palmitic acid and benzenepropanoic acid, 3,5-bis(1,1-dimethylethyl)-4-hydroxy- methyl ester were the common compounds detected in the six plant species analyzed.

DISCUSSION

R. dentatus, *A. aspera*, *A. philoxeroides*, *L. camara*, *E. bonariensis* and *S. bispinosa* are rich sources of polyphenols and amino acids (Kumar et al., 2015; Kumar et al., 2015). Palmitic acid carries nematocidal and pesticidal activities (Cho et al., 2010). Benzenepropanoic acid, 3,5-bis(1,1-dimethylethyl)-4-hydroxy- methyl ester has antifungal, antioxidant activities etc. (Bashir et al., 2012). Stearic acid has hypocholesterolemic, lubricant and propepic activities. Ergost-5-en-3 beta-ol possesses antioxidant and hypocholesterolemic activities (Ponnamma and Manjunath, 2012). Stigmasterol possesses anti-inflammatory and anti-HIV reverse transcriptase activities. It also carries antioxidant activity (Raman et al., 2012).

Verrucarol has cytotoxic, insecticidal and dermatological activities. 2-methyl-5 (1-methylethyl) phenol is a cyclic monoterpene and imparts protective activities in various pathological states i.e., tumor growth and inflammation (Lee et al., 2015). Several studies reported the fungicidal, insecticidal and anti-microbial activities of 2-methyl-5 (1-methylethyl) phenol (Ahmad et al., 2011; Dambolena et al., 2011; Tang et al., 2011; Nostro & Papalia, 2012). Trans-cinnamic acid has anti-microbial, anti-fungal and nematocidal activities (Kim et al., 2012; Bock et al., 2014). Cis-jasmone is a volatile compound and acts as attractant for pollinators. It also acts as a signalling molecule (Matthes et al., 2010).

CONCLUSIONS

The present study reveals the presence of a total of 62 phytochemicals in the methanolic extracts of the leaves of *R. dentatus*, *A. aspera*, *A. philoxeroides*, *L. camara*, *E. bonariensis* and *S. bispinosa*. Palmitic acid and benzenepropanoic acid, 3,5-bis(1,1-dimethylethyl)-4-hydroxy- methyl ester were the common compounds found in the six plant species analyzed.

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