

RESEARCH REPORT

The Leaf Essential Oil of *Juniperus recurva* Buch.-Ham. ex D. Don from India and Nepal Compared with *J. recurva* var. *squamata* (D. Don) Parl.

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Abstract

The composition of the leaf oils of *Juniperus recurva* from India (Sikkim) and Nepal were analyzed and compared to the composition of *J. recurva* var. *squamata* from western India. The major components of *J. recurva* oil were α -pinene (0.5-6.9%), sabinene (0.4-13.4%), δ -3-carene (13.6-23.7%), limonene (0.2-18.4%), terpinen-4-ol (0.2-3.7%), γ -cadinene (0.4-3.9%), δ -cadiene (0.8-10.2%), elemol (3.9-5.1%), cubenol (0-3.7%), epi- α -cadinol (0.3-5.5%), epi- α -muurolol (0.5-5.5%), α -cadinol (0.8-13.1%) and 4-epi-abietal (trace-3.75%).

Key Word Index

Juniperus recurva, Cupressaceae, essential oil composition.

Introduction

Juniperus recurva Buch.-Ham. ex D. Don is a small tree or spreading shrub distributed from Afghanistan eastward through the Himalayas to southwest China. There have apparently been no reports on the leaf oil composition of *J. recurva*, however, the wood oil has been examined (1) and found to contain the typical components of cedarwood oil (α - and β -cedrene, thujopsene, cuparene, cedrol, widdrol, etc.).

At least additional two varieties of *J. recurva* have been named: *J. recurva* var. *coxii* (A. B. Jacks) Melv. (found in N. Burma to Yunnan, China to 3000 m) and *J. recurva* var. *squamata* (D. Don) Parl. (a prostrate or decumbent shrub or tree to 12 m, Himalayas, 2100-4500 m). However, Gulati et al. (2) listed *J. squamata* D. Don as one of the species of the Himalayas but then used *J. recurva* var. *squamata* as the correct name in their paper on the leaf oils. Obviously the taxonomic status of *J. recurva* var. *squamata* is in confusion.

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Table I. The leaf oil of *Juniperus recurva* from India and Nepal, compared to the oil of *J. recurva* var. *squamata* (= *J. squamata*) (3)

RI	Compound	<i>J. recurva</i>		<i>J. recurva</i> var. <i>squamata</i>	RI	Compound	<i>J. recurva</i>		<i>J. recurva</i> var. <i>squamata</i>
		India	Nepal				India	Nepal	
926	tricyclene	t	t	-	1257	linalyl acetate	t	-	0.8
931	α -thujene	t	0.5	0.7	1261	methyl citronellate	0.1	0.1	0.1
939	α -pinene	0.5	6.9	8.6	1273	terpene alcohol	t	2.2	-
952	α -fenchene	t	1.0	t	1285	bornyl acetate	0.1	0.1	0.1
953	camphene	t	-	t	1285	trans-linalool oxide			
976	sabinene	0.4	13.4	12.0		acetate (pyranoid)	t	-	t
978	1-octen-3-ol	-	t	-	1322	methyl geranate	t	t	-
980	β -pinene	t	0.2	0.6	1340	terpinen-4-yl acetate	t	-	t
991	myrcene	1.1	2.4	2.8	1350	α -terpinyl acetate	t	-	1.2
1005	α -phellandrene	-	t	0.2	1351	α -cubebene	0.2	-	t
1011	δ -3-carene	13.6	23.7	0.5	1376	α -copaene	0.2	-	0.2
1018	α -terpinene	t	0.8	2.5	1383	geranyl acetate	t	-	t
1022	o-cymene	t	t	-	1390	β -cubebene	0.1	-	t
1026	p-cymene	0.1	0.2	2.2	1391	β -elemene	0.2	-	0.7
1027	sylvestrene	0.1	0.2	-	1409	α -cedrene	-	-	0.1
1031	limonene	0.2	18.4	21.5	1418	β -caryophyllene	1.3	t	0.3
1031	β -phellandrene	0.1	t	t	1450	α -cadinene	1.1	-	t
1033	1,8-cineole	t	t	-	1454	α -humulene	0.3	-	0.2
1040	(Z)- β -ocimene	-	-	t	1473	β -cadinene*	1.8	-	0.3
1050	(E)- β -ocimene	-	-	t	1477	γ -muurolene	0.7	t	0.9
1062	γ -terpinene	t	1.3	3.3	1480	germacrene D	0.2	t	0.4
1068	cis-sabinene hydrate	-	0.6	t	1491	trans-murrola-4(14), 5-diene	2.3	t	0.5
1074	cis-linalool oxide (furanoid)	t	-	-	1493	epi-cubebol	1.2	t	0.5
1086	p-mentha-2,4(8)-diene	-	0.2	-	1499	α -muurolene	1.9	0.2	2.6
1088	terpinolene	2.9	1.8	1.9	1513	γ -cadinene	3.9	0.4	3.6
1097	trans-sabinene hydrate	-	0.3	t	1521	cis-calamenene	t	-	t
1098	linalool	0.3	-	0.1	1524	δ -cadinene	10.2	0.8	10.2
1103	isopentyl-isovalerate	t	0.1	t	1533	trans-cadina-1,4-diene	0.3	-	0.1
1117	3-methyl-3-butenyl 3-methylbutyrate	0.1	0.2	-	1549	elemol	5.1	3.9	1.0
1121	cis-p-menth-2-en-1-ol	t	0.2	-	1556	germacrene B	0.1	t	0.5
1140	trans-p-menth-2-en-1-ol	-	0.2	0.1	1564	(E)-nerolidol	t	t	0.5
1159	p-mentha-1,5-dien-8-ol	t	0.5	-	1574	germacrene D-4-ol	2.3	1.0	0.7
1166	δ -terpineol	t	0.3	-	1581	caryophyllene oxide	0.2	-	t
1177	terpinen-4-ol	0.2	3.7	3.7	1596	cedrol	-	-	2.1
1180	naphthalene	t	-	-	1606	β -oplophenone	0.6	0.1	0.3
1180	m-cymen-8-ol	-	0.2	-	1612	1,10-di-epi-cubebol	0.3	-	0.1
1183	p-cymen-8-ol	t	0.1	t	1627	cubebol	3.7	-	0.3
1189	α -terpineol	t	0.3	0.3	1630	γ -eudesmol	0.2	0.1	t
1193	cis-piperitol	-	t	t	1640	epi- α -cadinol (=T-cadinol)	0.1	0.3	0.1
1204	verbenone	t	-	-	1641	epi- α -muurolol (=T-muurolol)	0.1	0.3	-
1205	trans-piperitol	-	0.1	t	1642	cubebol	t	0.1	0.2
1228	citronellol	t	-	t	1630	γ -eudesmol	0.9	1.0	0.1
1235	myrtenyl acetate	t	-	t	1640	epi- α -cadinol	5.5	0.3	1.7
1243	hexyl 3-methylbutyrate	0.6	0.1	0.1	1641	epi- α -muurolol	5.5	0.5	1.6
1244	methyl carvacrol	-	-	t	1645	α -muurolol (=torreyol)	2.1	0.1	0.4
1252	piperitone	0.3	-	-					

Table I. Continued

RI	Compound	<i>J. recurva</i>		<i>J. recurva</i>	RI	Compound	<i>J. recurva</i>		<i>J. recurva</i>
		India	Nepal	var. <i>squamata</i>			India	Nepal	var. <i>squamata</i>
1649	β -eudesmol	0.9	1.5	0.1	1789	8- α -acetoxyelemol	0.1	1.9	0.1
1652	α -eudesmol	1.0	1.0	t	2054	abietatriene	t	0.5	0.2
1653	selin-11-en-4 α -ol	1.0	-	t	2056	manool	-	-	0.4
1653	α -cadinol	13.1	0.8	3.4	2080	abietadiene	0.3	1.3	t
1666	bulnesol	t	0.8	-	2259	dehydro-4-epi-abietal	-	0.2	-
1686	epi- α -bisabolol	-	-	0.3	2278	cis-totarol	-	-	t
2054	abietatriene	t	t	t	2288	4-epi-abietal	3.7	t	t
1733	oplopanone	0.2	-	t	2303	trans-totarol	1.1	0.2	t

RI = Retention Index on DB-5(=SE54) column; *tentatively identified; compositional values less than 0.1% are denoted as traces (t); unidentified components less than 0.5% are not reported

Although there are no reports on the leaf oil of *J. recurva*, two papers have reported on the leaf oils of *J. recurva* var. *squamata*. Gulati et al. (2) reported the leaf oil contained (based on retention times) mostly camphene, terpinene, myrcene, limonene, terpineol, α -bisabolene and numerous unknown compounds. A recent complete analysis of the leaf oil of *J. recurva* var. *squamata* (3) differed in that the major components were found to be α -pinene, sabinene, and limonene with moderate amounts of α -thujene, myrcene, α -terpinene, p-cymene, γ -terpinene, linalool, terpinen-4-ol, α -muurolene, γ -cadinene, δ -cadinene, β -oplopanone, and cadinol isomers.

The purpose of this paper is to present the first report on the composition of the leaf oil of *J. recurva* from two localities and compare these oils with the oil of *J. recurva* var. *squamata* supplied by Weyerstahl (3) and analyzed on our Ion Trap MS.

Experimental

The Indian *J. recurva* specimens were collected from the eastern Sikkim, 3040-3600 m, Srivastava-19592. Voucher specimens are deposited at the Regional Research Laboratory herbarium, Jammu. The Nepal *J. recurva* specimens were collected near Sing Gompa, Langtang National Park, 3570 m (Adams 7209, 7217, 7219). Voucher specimens are deposited at SCRG, Baylor University.

The oils were isolated by steam distillation (200 g foliage, FW) using a circulatory Clevenger-type apparatus (4) for 2 h. The oil samples were concentrated (diethyl ether trap removed when collected in a Clevenger unit) with nitrogen and stored at -20°C until analyzed. Mass spectra were recorded with a Finnigan Ion Trap (ITD) mass spectrometer, model 800, directly coupled to a Varian 6500 gas chromatograph, using a J&W DB-5, 0.26 mm x 30 m, 0.25 μm coating thickness, fused silica capillary column (see reference 5 for operating details). Identifications were made by library searches of our volatile oil library, LIBR(TP) (5) using the Finnigan library search coupled with the standardized retention indices of reference compounds.

Results and Discussion

Oil yields from *J. recurva* ranged from 0.3-1.0% (2 h) [oil wt/extracted, oven dried foliage weight]. The major components of *J. recurva* oil are α -pinene (0.5-6.9%), sabinene (0.4-13.4%), δ -3-carene (13.6-23.7%), limonene (0.2-18.4%), terpinen-4-ol (0.2-3.7%), γ -cadinene (0.4-3.9%), δ -cadinene (0.8-10.2%), elemol (3.9-5.1%), cubenol (0-3.7%), epi- α -cadinol (0.3-5.5%), epi- α -muurolol (0.5-5.5%), α -cadinol (0.8-13.1%) and 4-epi-abietal (trace-3.7%) (Table I). Interestingly, the *J. recurva* sample from Sikkim, India, in many cases was more similar to *J. recurva* var. *squamata* (Table I). Although most taxonomic treatments maintain *J. recurva* var. *squamata* as a distinct species (*J. squamata* Buch.-Ham. ex D. Don), this is not very clear from the oils.

In Nepal, *J. recurva* was polymorphic for terpinen-4-ol and the unknown terpene (KI 1273). It may be possible that *J. recurva* has hybridized with adjacent *J. squamata* in Nepal. Many of the components in the oil of *J. recurva* from Nepal are quantitatively more similar to *J. recurva* var. *squamata* than to the *J. recurva* from Sikkim.

Mass spectrum for the unidentified component: [ITMS, m/z (rel. int.): KI 1273, 41(40), 53(26), 67(17), 79(100), 91(54), 105(29), 119(13), 133(7), 147(13), terpene alcohol.

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