#### Leaf essential oils of Juniperus in central and southern Iran

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# ABSTRACT

Leaf essential oils from *Juniperus* from southern Iran were analyzed and compared to oils of *J. excelsa, J. polycarpos, J. p.* var. *turcomanica* and *J. seravschanica*. The juniper oils from southern Iran were mainly in two groups: high cedrol (cf. *J. excelsa, J. polycarpos* and *J. seravschanica*) and low cedrol (cf. *J. p.* var. *turcomanica*). Complete analyses of the compositions are given. Published on-line **www.phytologia.org** *Phytologia* 95(4): 288-295 (*Nov. 1, 2013*). ISSN 030319430

**KEY WORDS**: Juniperus polycarpos var. polycarpos, J. seravschanica, J. p. var. turcomanica, J. excelsa, Cupressaceae, Iran, terpenes, leaf essential oil.

The distributions of *J. excelsa* M.-Bieb., *J. polycarpos* K. Koch and *J. seravschanica* Kom. in Iran and the surrounding region are not well understood (Adams, 2011). Figure 1 summarizes our current understanding of these taxa's distributions. Adams and Hojjati (2012) investigated 10 populations of *Juniperus* in Iran using nrDNA, petN-psbM, trnD-trnT and trnS-trnG sequences (3705 bp). They found the northern populations, BL, Bj, Sh, were in a clade with *J. p.* var. *turcomanica* and L, H, and Q in a clade with *J. polycarpos* (Fig. 2). However, the southern populations displayed a mosiac pattern. One of



Figure 1. Distributions of *J. excelsa* (Greece not shown), *J. polycarpos* var. *polycarpos*, *J. p.* var. *seravschanica*, *J. p.* var. *turcomanica*. (adapted from Adams and Hojjati, 2012, symbols indicate the populations sampled for each taxon).

the samples from southern Kuhbanan population (Ku1) is loosely associated with the northern clade and a second sample (Ku2) is in a clade with Khabr (Kh1, Kh2) that is associated with *J. seravschanica*. Another perspective is shown in Figure 3, where the northern populations, L, H, Q, are clearly associated

with J. polycarpos. Other northern populations BL, Bj, Sh, are loosely linked to var. turcomanica (Fig. 3). The Fasa samples (F1, F2) differ by only one SNP from BL in northern Iran. The samples from Khabr (Kh1, Kh2) are linked to J. seravschanica by 9 SNP differences (Fig. 3) and a sample from Kuhbanan (Ku2) is linked to the Khabr samples by 6 SNPs differences (Fig. 3). Clearly the junipers from southern Iran contain elements of J. p. var. turcomanica and J. seravschanica.



Figure 2. NJ tree of Iranian junipers (adapted from Adams and Figure 3. Minimum spanning network Hojjati, 2012) 2012).



Adams and Shanjani (2011), using DNA sequence data, showed the juniper from the Elburz Mtns. to be typical J. polycarpos not J. excelsa as supposed. The composition of the leaf oils of J. polycarpos and J. seravschanica were previously reported by Adams (2001) and Adams et al. (2008). The leaf essential oils of *J. excelsa* have recently been reported (Adams et al. 2013).

The purpose of the present study is to investigate the leaf essential oils of the southern Juniperus of Iran.

## MATERIALS AND METHODS

## Plant materials (see Fig. 4):

Fasa (F1-F5), putative J. polycarpos var. turcomanica, 30 km past Fasa towards Neiriz, common on rocks. 29° 09' 51.1" N: 53° 44' 13.5" W. 1715 m. Oct. 2012. Prov. Fars. F. Hoijati #1 to #5 (lab acc. Adams 13754-13758);

Kuhbanan (Ku)(K1-K9), putative *J. seravschanica* and *J. polycarpos* var. *turcomanica*, Kuh-e Bajgen, 55 km from Kuhbanan, Dolatabad, common on rocks. 31° 27' 12.8" N; 55° 52' 28.8" W, 2333 m, Oct. 2012, Kerman Prov., *F. Hojjati* \*1 to \*9 (lab acc. *Adams* 13759-13767);

Khabr(KH)(B1-B5), putative *J. seravschanica*, Kuh-e Khabr. common on rocks. 28° 49' 06.7" N; 56° 21' 21.7" W, 2086 m, Oct. 2012, Prov. Kerman, *F. Hojjati -1 to -5* (lab acc. *Adams 12768-13772*);

Rabor (R)(R1-R5), putative *J. polycarpos* var. *turcomanica*, Gusichai village, 23 km past Rabor, between Rabor and Darbehest. 28° 49' 06.7" N; 56° 21' 21.7" W, 2086 m, Oct. 2012, Prov. Fasa, F. Hojjati .1 to .5 (lab acc. Adams 13773-13777).



Figure 4. Populations sampled in the present study.

Authentic, typical taxonomically identifiable reference taxa, were included from *J. excelsa*, n of Eskisehir, Turkey, *Adams 9433-9435*; *J. polycarpos* var. *polycarpos*, Lake Sevan, Armenia, *Adams 8761-8763*, *J. p.* var. *turcomanica*, Kopet Mtns., ca 140 km wnw of Ashgabat, Turkmenistan, 38° 25.12' N, 56 58.80' E, 1535m, *Adams 8757-8760*; *J. seravschanica*, Quetta, Pakistan, *Adams 8483-8485*, Dzhabagly, Kazakhstan. Voucher specimens are deposited at Baylor University (BAYLU).

#### **Chemical analysis**

Fresh, air dried leaves or herbarium specimens (20-100 g) were steam distilled for 2 h using a circulatory Clevenger-type apparatus (Adams, 1991). The oil samples were concentrated (ether trap removed) with nitrogen and the samples stored at -20°C until analyzed. The extracted leaves were oven dried (100°C, 48 h) for determination of oil yields.

The oils were analyzed on a HP5971 MSD mass spectrometer, scan time 1/ sec., directly coupled to a HP 5890 gas chromatograph, using a J & W DB-5, 0.26 mm x 30 m, 0.25 micron coating thickness, fused silica capillary column (see Adams, 2007 for operating details). Identifications were made by library searches of our volatile oil library (Adams, 2007), using the HP Chemstation library search routines, coupled with retention time data of authentic reference compounds. Quantitation was by FID on an HP 5890 gas chromatograph using a J & W DB-5, 0.26 mm x 30 m, 0.25 micron coating thickness, fused silica capillary column using the HP Chemstation software. Terpenoids (as per cent total oil) were coded and compared among the species by the Gower metric (1971). Principal coordinate analysis was performed by factoring the associational matrix using the formulation of Gower (1966) and Veldman (1967).

### **RESULTS AND DISCUSSION**

The volatile leaf oils of the junipers of southern Iran were of three kinds and illustrated (Table 1) by samples Kuh6 (high cedrol), Kuh9 (low cedrol) and Kbr5 (low cedrol). All the oils were high in  $\alpha$ -pinene (48.7 - 62.5%). Kuh6 (23.6% cedrol) was more like *J. excelsa*, (25.4), *J. polycarpos* (30.3) and *J. seravschanica* (13.8, 22.7) in having high amount of cedrol (Table 1). In contrast, Kuh9 (0.0 cedrol) and Kbr5 (0.1 cedrol) were like *J. p.* var. *turcomanica* (0.2% cedrol). However, several terpenes in southern junipers were in higher concentrations than found in *J. excelsa*, *J. polycarpos* or *J. seravschanica*: limonene,  $\beta$ -phellandrene, trans-verbenol,  $\alpha$ -eudesmol, and  $\beta$ -eudesmol (Table 1).

To further examine the patterns, the similarity matrix was factored and yielded eigenroots accounting for 29.3, 11.1 and 7.1% of the variation among the 24 samples plus the 5 exemplar taxa. The eigenroots appeared asymptote after the third root. The large amount of variance extracted by the first eigenroot indicates that the major trend was the separation of 2 groups (high and low cedrol oils) on the first eigenvector (Fig. 5). The second eigenroot (11%) mostly separates the exemplar taxa from the 24 southern Iran samples (Fig. 5). The third eigenroot (7%) separates a sub-group of low cedrol trees from the bulk of the low cedrol trees (Fig. 5). A close examination of individuals reveals that both high and low cedrol oils are found in each of the four populations sampled.



Figure 5. PCO of southern Iran *Juniperus* from 4 populations (see map, Figs. 1, 4), using 24 terpenes. The five exemplar oils are: Ex = J. *excelsa*, Turkey; Pc = J. *polycarpos*, Armenia; SK = J. *seravschanica*, Kazakhstan, SP = J. *seravschanica*, Pakistan; Tu = J. *p*. var. *turcomanica*, Kopet Mtns., Turkmenistan.

The low cedrol trees are loosely grouped with the *J. p.* var. *turcomanica* exemplar (Tu, Fig. 5). The sub-group of low cedrol oils (Fig. 5, fore-ground) is composed of 3 trees from Kuhbanan (filled circles, Fig. 5) and 2 trees from Fasa (stars, Fig. 5), with no samples from Khabr or Rabor. But the small sample numbers could have failed to include all populations in this sub-group.

The large amount of variation in the oils from each population is very likely due to hybridizing. The fact that many of samples displayed transgressive variation in several terpenoids, is suggestive of hybridization. Adams and Tsumura (2012) reviewed several papers on the inheritance of terpenes in conifers and found that terpenes seemed a little more likely to exceed the concentration (i.e., transgressive) of either parent (in a hybrid cross), than to be at intermediate levels. Hanover (1966) examined the monoterpene concentrations in 17  $F_1$  hybrids and their parents and found transgressive inheritance in 9/17 ( $\alpha$ -pinene), 10/17 ( $\beta$ -pinene), 1/17 ( $\delta$ -3-carene) and 6/17 (limonene) instances.

Cool et al. (1975), studying inheritance of terpenes in *Cupressus* hybrids, found 7/13 terpenes to be transgressive in the oils of hybrids. Adams and Stoehr (2013) analyzed the inheritance of terpenes in artificial hybrids of *Pseudotsuga menziesii* and var. *glauca*. They reported intermediate inheritance in 11/25 terpenes and transgressive inheritance in 14/15 terpenes. Adams and Tsumura (2012) analyzed artificial hybrids between cultivars of *Cryptomeria japonica* and reported intermediate inheritance for 7 terpenes and transgressive inheritance for 8 terpenes. Interestingly, the heartwood oils, cedrol, widdrol, cis-thujopsene, etc. were inherited as a group as a Mendelian dominate/ recessive fashion, with a second

gene(s) as a modifier. This genetic system made the detection of hybrids very difficult; as hybrids' oils with heartwood components were nearly identical to one parent in the ordination. Removing the heartwood components from the data set aided the detection of hybrids, but a few hybrids still ordinated close to one parent.

It may be that DNA sequencing will aid in the understanding of variation in *Juniperus* in southern Iran (in progress). It seems likely that considerable field work will be needed resolve this situation.

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## LITERATURE CITED

- Adams, R. P. 1991. Cedarwood oil Analysis and properties. pp. 159-173. in: Modern Methods of Plant Analysis, New Series: Oil and Waxes. H.-F. Linskens and J. F. Jackson, eds. Springler- Verlag, Berlin.
- Adams, R. P. 2001. Geographic variation in leaf essential oils and RAPDs of *J. polycarpos* K. Koch in central Asia. Biochem. Syst. Ecol. 29: 609-619.
- Adams, R. P. 2007. Identification of essential oil components by gas chromatography/ mass spectrometry. 4th ed. Allured Publ., Carol Stream, IL.
- Adams, R. P. 2011. The junipers of the world: The genus Juniperus. 3rd ed. Trafford Publ., Victoria, BC.
- Adams, R. P. and F. Hojjati. 2012. Taxonomy of *Juniperus* in Iran: Insight from DNA sequencing. Phytologia 94: 219-227.
- Adams, R. P., J. A. Morris and A. E. Schwarzbach. 2008. Taxonomic study of *Juniperus excelsa* and *J. polycarpos* using SNPs from nrDNA and cp trnC-trnD plus essential oils and RAPD data. Phytologia 90: 208-225.
- Adams, R. P. and P. S. Shanjani. 2011. Identification of the Elburz Mountains, Iran juniper as *Juniperus polycarpos* var. *polycarpos*. Phytologia 93: 316-321.
- Adams, R. P. and M. U. Stoehr. 2013. Multivariate detection of hybridization using conifer terpenes II: Analysis of terpene inheritance patterns in *Pseudotsuga menziesii* F<sub>1</sub> hybrids. Phytologia 95: 42-57.
- Adams, R. P., A. N. Tashev, K. H. C. Baser and A. K. Christou. 2013. Geographic variation in the volatile leaf oils of *Juniperus excelsa* M.-Bieb. Phytologia 95: 279-285
- Adams, R. P. and Y. Tsumura. 2012. Multivariate detection of hybridization using conifer terpenes I: Analysis of terpene inheritance patterns in *Cryptomeria japonica* F<sub>1</sub> hybrids Phytologia 94: 253-275.
- Cool, L., R. Bartschot, E. Zavarin and J. R. Griffin. 1975. Natural hybridization of *Cupressus sargentii* and *C. macnabiana* and the composition of the derived essential oils. Biochem. Syst. Ecol. 2: 113-119.
- Gower, J. C. 1966. Some distance properties of latent root and vector methods used in multivariate analysis. Biometrika 53: 326-338.
- Gower, J. C. 1971. A general coefficient of similarity and some of its properties. Biometrics 27: 857-874.
- Hanover, J. W. 1966. Genetics of terpenes: I. Gene control of monoterpene levels in *Pinus monticola* Dougl. Heredity 21: 73-84.
- Shanjani, P. S., M. Mirza, M. Calagari and R. P. Adams. 2010. Effects of drying and harvest season on the essential oil composition from foliage and berries of *Juniperus excelsa*. Industrial Crops and Products 32: 83-87.
- Veldman D. J., 1967. Fortran programming for the behavioral sciences. Holt, Rinehart and Winston Publ., NY.

Table 1. Leaf essential oils for the multi-seeded junipers of Iran and adjacent areas. Exc - *J. excelsa*, 13193 (9433-35) Eskisehir; Poly - *J. polycarpos* var. *polycarpos*, 13194 (8761-63); SeraK - *J. seravschanica* - 13196 (8224-26); Kazakhstan, SeraP - *J. seravschanica*, 13195 (8483-85), Pakistan; Turco - *J. p.* var. *turcomanica* 13197 (8758-90); Kuh6, 13764, high cedrol, Kuhbanan; Kuh9, 13767, low cedrol, Kuhbanan, Kbr5, 13772, low cedrol, Khabr. Components in boldface were used in numerical calculations of similarities.

KI	Compound	Exc	Poly	SeraK	SeraP	Kuh6	Kuh9	Kbr5	Turco
926	tricyclene	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.1
931	α-thujene	-	t	0.3	0.4	t	t	-	t
939	α-pinene	41.7	39.9	48.3	19.9	48.7	62.5	57.6	45.0
953	α-fenchene	0.3	t	0.1	0.1	0.1	0.1	0.3	0.1
953	camphene	0.2	0.2	0.3	0.2	0.3	0.4	0.5	0.2
957	thuja-2,4(10)-diene	0.1	t	t	-	t	t	0.1	t
961	verbenene	t	t	t	t	t	t	t	t
976	sabinene	0.1	0.4	0.5	0.5	-	t	-	0.3
980	β-pinene	0.7	0.5	1.2	0.9	1.4	1.1	1.0	0.8
991	mvrcene	1.2	1.3	18.3	27.4	1.9	2.4	2.4	1.9
1005	α-phellandrene	0.1	-	0.1	0.1	t	t	0.1	-
1011	δ-3-carene	5.3	t	-	0.8	1.3	0.9	3.4	t
1018	a-terpinene	0.1	t	0.1	0.1	t	t	t	t
1026	p-cymene	0.6	0.2	0.2	0.6	0.3	0.5	0.5	0.2
1031	limonene	1.2	1.0	1.8	1.4	4.3	6.3	5.2	1.0
1031	ß-phellandrene	0.9	0.4	1.3	1.3	2.8	4.2	3.5	0.8
1050	(F)-β-ocimene	t	-	t	t		-	-	-
1062	v-terninene	0.5	0.3	0.7	1.0	0.3	0.5	0.4	0.4
1068	cis-sabinene hydrate	t	t	0.1	0.2	-	-	-	t
1088	terninolene	11	0.6	0.9	0.8	0.5	10	15	0.8
1098	linalool*		0.0	0.3	0.8	3.8	2.6	0.8	t
1112	endo-fenchol	t	-	-	-	-	0.2	0.0	-
1116	3-methyl butanoate 3-	t t	-	_	_	t	0.2	0.1	0.1
1110	methyl-3-butenyl-	Ľ	_		_	Ľ	_	_	0.1
1121	cis-p-menth-2-en-1-ol	0.1	_	t	-	_	_	_	_
1125	g-campholenal	0.5	0.3	t	0.1	0.1	0.2	0.2	0.2
1139	trans-ninocarveol	0.8	0.0	_	t	0.3	0.3	0.3	0.2
1140	cis-verbenol	0.0	t	_	-	t.0	t	t	t.
1143	camphor	1.2	-	t		-	-	-	10
1143	trans-verbenol	1.2	11	-	03	0.6	13	07	-
1148	camphene hydrate	0.1	-	t	-	t t	1.0 t	t	t
1159	n-mentha-1 5-dien-8-ol	0.1	t	-	t	-	-	-	01
1165	borneol	0.1	-	0.1	-	03	0.1	03	0.1
1172		0.2	t	0.1	_	0.0 t	+ +	0.0	_
1172	terninen-4-ol	0.2	t t	03	0.4	-	+ +	0.1	t
1170	nanhthalene	0.1	0.2	0.0 t	-			_	0.6
1183	n-cymen-8-ol	0.1	0.2 t	t t	_	t		t	0.0 t
1180	a-ternineol	t	t t	01	t	0.2	0.2	t	t
1103	47-decenal	- -	- -	-	-	0.2	- 0.2	01	ι -
1204	verbenone	0.2	0.2	t	t	0.0	0.2	0.1	0.1
1217	trans_carveol	0.2	0. <u>2</u>	-	-	0.1	0.2	0.1	t
1241	isoamyl bexanoate	0.2	-	_	_	0.1	0.2	0.1	
1241	hervil 3-methyl butanoate	_	0.2	+	t	0.1	0.4	0.1	0.4
1240	niperitone	- 0 1	0.2	ι -	- L	-	-	-	U. <del>4</del>
1252	47-decen-1-cl	0.1	-	+ -	0.1	-	+	-	
1207		-	-	0.6	0.1	0.0	01	0.3	03
1200	linglool oxide acotato	0.4	0.4	0.0	0.4	0.2	0.1	0.4	0.0
1200	(pyranoid)	0.2							-
1290	trans-sabinyl acetate	-	-	-	0.2	-	-	-	-
1319	(2E,4E)-decadienal	2.4	-	0.1	0.3	-	-	-	t

1320 149,917,7164 - - - 0.3 - -   1330 5-elemene - t t t - 0.3 0.5 0.6 0.1   1332 hext n-hexanoate - 0.2 0.2 0.3 0.5 0.6 0.1   1383 β-bourbonene 0.1 - - - - 1. 0.2 0.2 0.2   1389 β-cubebene 0.1 0.1 1. - - - 1. 1. - - 0.1 1.   1409 1.7.3(4)epip3-cedrene 0.7 1.5 0.1 0.7 - - - 1. </th <th>KI</th> <th>Compound</th> <th>Exc</th> <th>Poly</th> <th>SeraK</th> <th>SeraP</th> <th>Kuh6</th> <th>Kuh9</th> <th>Kbr5</th> <th>Turco</th>	KI	Compound	Exc	Poly	SeraK	SeraP	Kuh6	Kuh9	Kbr5	Turco
1339   δ-elemene   -   t    141t <td>1320</td> <td>149,91,77,164</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>0.3</td> <td>-</td> <td>-</td>	1320	149,91,77,164	-	-	-	-	-	0.3	-	-
1376   a-copaene   -   t   t   t   -   -   0.1     1382   hebruhonene   0.1   -   0.2   0.3   0.5   0.6   0.1     1383   β-bourbonene   0.1   -   0.2   0.2   0.3   -	1339	δ-elemene	-	t	t	t	-	t	-	0.1
1382   hexpheheanoate   .   0.2    0.2   0.3   0.5   0.6   0.1     1383   β-buebene   .   .   t   t	1376	α-copaene	-	-	t	t	-	-	-	0.1
1383   β-bourbonene   0.1   .	1382	hexyl n-hexanoate	-	0.2	-	0.2	0.3	0.5	0.6	0.1
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	1383	β-bourbonene	0.1	-	-	-	-	_	-	-
1389 1389 a c-edrene0.10.11 <t< td=""><td>1389</td><td>ß-elemene</td><td>-</td><td>-</td><td>t</td><td>t</td><td>-</td><td>t</td><td>0.2</td><td>0.2</td></t<>	1389	ß-elemene	-	-	t	t	-	t	0.2	0.2
1409 1409c-cedrene0.81.00.20.62.10.11409 14761.7-di-epCedrene0.71.50.10.70.11418(E)-caryophyllene-0.80.10.20.8 </td <td>1389</td> <td>ß-cubebene</td> <td>0.1</td> <td>0.1</td> <td>t</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>t</td>	1389	ß-cubebene	0.1	0.1	t	-	-	-	-	t
1409   1.7-di-epiβ-cedrene   0.7   1.5   0.1   0.7   1.5   0.1   0.7   1.5   0.1   0.7   1.5   0.1   0.7   1.5   0.1   0.7   1.5   0.1   0.7   1.5   0.3   0.4   0.6     1418   (E)-caryophyllene   0.5   0.2   0.1   0.2   0.3   -	1409	g-cedrene	0.8	10	02	0.6	21	-	-	01
148   (E) caryophyllene   0.7   103   0.1   0.3   -   0.3   0.4   0.6     1418 $\beta$ -cedrene   0.5   0.2   0.1   0.2   0.8   -   -   1     1429   cis-thuigpsene   0.3   0.4   0.2   0.2   0.3   - </td <td>1409</td> <td>1 7-di-eni-ß-cedrene</td> <td>0.7</td> <td>1.5</td> <td>0.1</td> <td>0.7</td> <td></td> <td>_</td> <td>_</td> <td>-</td>	1409	1 7-di-eni-ß-cedrene	0.7	1.5	0.1	0.7		_	_	-
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	1418	(E)-carvonhyllene	-	0.8	0.1	0.7	_	03	0.4	0.6
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	1/18	B-cedrene	0.5	0.0	0.1	0.3	0.8	0.5	0.4	+ +
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	1420	cis thuionsono	0.3	0.2	0.1	0.2	0.0	-	-	ι
14.46   dismurola-3,5-diene   0.2   -   -   -   -   -   0.4   1     1446   dismurola-3,5-diene   0.2   1   -   -   -   -   -   -   1     1485   (E)-Farnesene   0.2   0.3   t   0.2   0.4   -	1429		0.5	0.4	0.2	0.2	0.5	- 0.1	-	+
H464   α-humulars, S-duene   0.2   -   1   -   -   -   1   0.2   0.3   t   0.2   0.4   -   0.3   1   0.3   0.1   -   1   0.3   0.2   1   1   0.3   0.2   -   -   0.2   1   1   1   1   1   1   1   1   1<	1434	γ-elemene	-	-	-	-	-	0.1	0.4	ι +
H456   CE-β-farmesene   0.2   0.3   t   0.2   0.4   -<	1440		0.2	-	ι +	-	-	-	-	ι 0.2
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	1404		0.1	-	L L	۱ ۵.۵	-	0.3	ι	0.2
1461Cis-muuroia-4(14),5-diene0.10.2-t0.10.2-t0.21477 $\gamma$ -muurolene0.10.2-t1477 $\gamma$ -muurolenettt-0.3t0.310.31480germacrene D0.60.60.10.30.10.50.21.31480germacrene D0.60.60.10.2-t0.2-1491trans-murola-4(14),5-0.2-t0.2-t0.2-1493epi-cubebol0.3-0.10.30.3-1494bicyclogermacrene-0.3-t0.30.3-1494wirdiflorene0.1t0.71502cuparene0.1t0.71502cuparene0.1t0.30.11.51503germacrene At0.30.11.51513 $\alpha$ -alaskene0.20.11.51.22.8-	1458	(E)-p-iamesene	0.2	0.3	l I	0.2	0.4	-	-	-
14tob   β-acoralicate   0.1   0.2   -   t   -   0.2   -   143   0.3   0.1   0.5   0.2   -   143   0.2   -   -   -   0.2   -   143   0.2   -   -   0.2   -   143   0.2   -   143   0.2   -   -   -   -   0.2   143   14   0.3   0.1   -   0.2   1   143   14   0.3   0.2   1   1   1   1   1   1	1461	cis-muurola-4(14),5-diene	-	0.1	t	t	0.1	-	-	0.2
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	1466	p-acoragiene	0.1	0.2	-	t	-	-	-	-
1477   γ-muurolene   -   t   t   -   0.3   t   0.3   t   0.3     1489   germacrene D   0.6   0.6   0.1   0.3   0.1   0.5   0.2   1.3     1489   frans-murola-4(14),5-   0.2   -   t   0.2   -   t   0.2   -   0.2   -   0.2   -   0.2   -   0.2   -   0.2   -   0.2   -   0.2   -   0.2   -   0.2   -   0.2   -   0.2   -   0.2   0.2   -   0.3   0.2   -   -   -   0.5   0.4   1.496   0.1   -   -   0.3   0.2   -   -   0.7   1.5   0.2   0.1   -   0.3   0.2   -   -   -   0.7   1.5   0.2   0.2   0.2   1.5   0.2   1.5   0.2   0.2   1.5   0.2   1.5   0.2   1.5	1473	trans-cadina-1(6),4-diene	0.2	-	t	-	-	-	-	-
1480   germacrene D   0.6   0.6   0.1   0.3   0.1   0.5   0.2   1.3     1489   β-selinene   -   -   -   -   t   0.2   -   -   0.2   0.2   -   -   0.2   0.2   -   -   0.5   0.2   1.4   0.2   0.1   -   -   0.3   -   -   0.3   0.2   -   -   0.7   1.6   0.3   0.3   -   1.4   1.4   -   -   -   -   0.7   1.6   0.2   0.2   1.5   0.3   0.1   -   -   -   -   -   -   -   -   -   -   -   -   1.6   1.7   1.5   1.5   1.5   1.6   1.5   0.6   0.1 <t< td=""><td>1477</td><td>γ-muurolene</td><td>-</td><td>-</td><td>t</td><td>t</td><td>-</td><td>0.3</td><td>t</td><td>0.3</td></t<>	1477	γ-muurolene	-	-	t	t	-	0.3	t	0.3
1489   β-selinene   -   -   -   -   t   0.2   -     1491   trans-murola-4(14),5-   0.2   -   t   0.2   -   -   0.2     diene   0.3   -   0.1   -   -   -   0.5     1493   bicyclogermacrene   -   0.3   -   t   -   -   0.5     1499   a-murolene   0.1   -   0.3   0.2   -   -   -   0.7     1502   cuparene   0.1   -   0.3   0.2   -   -   0.7     1502   cuparene   0.1   -   0.3   0.2   -   -   0.7     1503   germacrene A   -   -   t   0.1   -   0.3   0.1   -<	1480	germacrene D	0.6	0.6	0.1	0.3	0.1	0.5	0.2	1.3
1491   trans-murola-4(14),5- diene   0.2   -   t   0.2   -   -   -   0.2     1493   epi-cubebol   0.3   -   0.1   -   -   -   0.5     1494   bicyclogermacrene   -   0.3   -   t   -   -   0.3   0.3   -     1496   viridiflorene   0.1   -   0.3   0.2   -   -   -   0.7     1503   germacrene A   -   -   t   -   -   0.2     1513   c-alaskene   0.1   t   -   t   0.1   -   -   -   -   -   -   -   -   -   -   0.2   0.1   -   0.2   0.1   -   0.2   0.1   -   0.2   0.1   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -	1489	β-selinene	-	-	-	-	-	t	0.2	-
diene   -   -   -   -   -   -   -   -   1     1493   epi-cubebol   0.3   -   0.1   -   -   -   0.5     1494   bicyclogermacrene   -   0.3   -   t   -   1.6   1.1   1.1   1.1   -   1.1   -	1491	trans-murrola-4(14),5-	0.2	-	t	0.2	-	-	-	0.2
1493   epi-cubebol   0.3   -   0.1   -   -   -   0.5     1494   bicyclogermacrene   -   0.3   -   t   -   0.7   1499 $\alpha$ -muurolene   0.1   -   -   -   0.7   0.3   0.2   -   -   -   0.7   1.0   0.1   -   -   -   -   0.2   1.0   0.4   0.1   -   -   -   -   -   -   -   -   -   -   -   -   -   -   1.1   0.1   -   -   -   -   -   -   -   -   -   -   -   -   -   -   -		diene								
1494bicyclogermacrene-0.3-t1496viridiflorene0.30.3-1499α-muurolene0.10.30.20.71502cuparene0.1t10.71503germacrene At0.10.21509β-bisabolene0.1t-t0.1<	1493	epi-cubebol	0.3	-	0.1	-	-	-	-	0.5
1496   viridiflorene   -   -   -   -   0.3   0.3      1499   α-muurolene   0.1   -   0.3   0.2   -   -   0.7     1502   cuparene   0.1   -   -   t   -   -   0.7     1503   germacrene A   -   -   -   -   -   -   0.7     1503   germacrene A   -   -   -   -   -   0.2     1503   germacrene A   -   -   t   0.3   0.1   - <t< td=""><td>1494</td><td>bicyclogermacrene</td><td>-</td><td>0.3</td><td>-</td><td>t</td><td>-</td><td>-</td><td>-</td><td>-</td></t<>	1494	bicyclogermacrene	-	0.3	-	t	-	-	-	-
1499 1502α-muurolene0.1-0.30.20.71502 1503germacrene At1503 1509β-bisabolene0.1t-t0.10.21513 1513α-alaskene0.20.1-0.30.11513 1513α-alaskene0.20.1-0.30.11513 1513α-alaskene0.20.1-0.30.11513 1513α-bebol0.41521 1522β-sesquisphellandrene0.21532 1532E-γ-bisabolene0.20.31533 1533sesquiterpene, 161, 204, 133, 1890.40.70.90.30.40.40.40.40.40.4<	1496	viridiflorene	-	-	-	-	-	0.3	0.3	-
1502cuparene0.1t1503germacrene A0.20.21509β-bisabolene0.1t0.30.11513α-alaskene0.20.1-0.30.11513α-alaskene0.20.1-0.30.11513α-alaskene0.20.10.30.11513α-beol0.41521β-sesquisphellandrene0.50.81.10.8-1.6t2.81532E-γ-bisabolene0.20.31533sesquiterpene, 161, 2040.81533a-cadinene0.30.41533sesquiterpene, 161, 2040.30.41549elemol0.30.41549germacrene B-1.60.50.70.31.46.32.81574germacrene D-4-ol-1.51.22.9-2.0	1499	α-muurolene	0.1	-	0.3	0.2	-	-	-	0.7
1503 germacrene A - - - - - - 0.2   1509 β-bisabolene 0.1 t - t 0.1 - - - 0.2   1513 $\alpha$ -alaskene 0.2 0.1 - 0.3 0.1 - - -   1513 $\alpha$ -cadinene - 1.0 0.4 0.7 - 1.6 - -   1521 β-sesquisphellandrene - <t< td=""><td>1502</td><td>cuparene</td><td>0.1</td><td>-</td><td>-</td><td>t</td><td>-</td><td>-</td><td>-</td><td>-</td></t<>	1502	cuparene	0.1	-	-	t	-	-	-	-
1509β-bisabolene0.1t-t0.11513α-alaskene0.20.1-0.30.11513 $\mathbf{\gamma}$ -cadinene-1.00.40.7-1.61513cubebol0.41521β-sesquisphellandrene0.21524δ-cadinene0.50.81.10.8-1.6t2.81532 $\mathbf{E}$ -y-bisabolene0.20.31533sesquiterpene, 161, 204, 133, 1890.8-1538α-cadinene0.20.10.41549elemol0.30.41556germacrene B-1.60.50.70.31.46.32.81574germacrene D-4-ol-1.51.22.9-2.0-8.91587allo-cedrol1.92.30.81.21.11606β-oplopenonet1606β-oplopenonet1640epi-α-muurolo	1503	germacrene A	-	-	-	-	-	-	-	0.2
1513α-alaskene0.20.1-0.30.11513 $\gamma$ -cadinene-1.00.40.7-1.6-1.71513cubebol0.41521 $\beta$ -sesquisphellandrene0.21524 $\delta$ -cadinene0.50.81.10.8-1.6t2.81532E-γ-bisabolene0.20.31533sesquiterpene,0.10.2t0.11538 $\alpha$ -cadinene0.2t0.10.41545selina-3.7(11)-diene0.20.10.41545germacrene B-1.60.50.70.30.41.10.71556germacrene D-4-ol-1.51.22.9-2.0-8.91587allo-cedrol1.92.30.81.21.11606humulene epoxide IIt1606β-oplopenonet1630γ-cudesmol-0.30.4-0.4-0.4-0.4 <t< td=""><td>1509</td><td>β-bisabolene</td><td>0.1</td><td>t</td><td>-</td><td>t</td><td>0.1</td><td>-</td><td>-</td><td>-</td></t<>	1509	β-bisabolene	0.1	t	-	t	0.1	-	-	-
1513γ-cadinene-1.00.40.7-1.6-1.71513cubebol0.41521β-sesquisphellandrene0.21521β-sesquisphellandrene0.50.81.10.8-1.6t2.81532E-γ-bisabolene0.20.31533sesquiterpene, 161, 204, 133,189t0.11538α-cadinene0.20.10.41545selina-3,7(11)-diene0.30.41549elemol-0.40.70.90.30.41.10.71556germacrene B-1.60.50.70.31.46.32.81574germacrene D-4-ol-1.51.22.9-2.0-8.91587allo-cedrol25.430.313.822.723.6-0.10.21606humulene epoxide IIt1606β-oplopenonet1606β-oplopenonet0.30.4-0.5-1.4<	1513	α-alaskene	0.2	0.1	-	0.3	0.1	-	-	-
1513cubebol0.41521β-sesquisphellandrene0.21524 $\overline{\delta}$ -cadinene0.50.81.10.8-1.6t2.81532E-γ-bisabolene0.20.31533sesquiterpene, 161, 204, 133, 189t0.11533sesquiterpene, 161, 204, 133, 1890.20.10.41538α-cadinene0.20.10.4-1549elemol-0.40.70.90.30.41.10.71556germacrene B-1.60.50.70.31.46.32.81574germacrene D-4-ol-1.51.22.9-2.0-8.91587allo-cedrol1.92.30.81.21.11606homulene epoxide IIt1606β-oplopenonet1606β-oplopenonet1606β-oplopenonet0.20.30.4-0.5-	1513	v-cadinene	-	1.0	0.4	0.7	-	1.6	-	1.7
1521β-sesquisphellandrene0.21524δ-cadinene0.50.81.10.8-1.6t2.81532E-γ-bisabolene0.20.31533g-cauprenene0.2t0.11533sesquiterpene, 161, 204, 133, 189t0.11538α-cadinene0.20.10.40.70.90.30.4-1549elemol0.40.70.90.30.41.10.71556germacrene B-1.60.50.70.31.46.32.81574germacrene D-4-ol-1.51.22.9-2.01587allo-cedrol1.92.30.81.21.11596cedrol25.430.313.822.723.6-0.10.21606humulene epoxide IIt1606β-olpopenonet0.20.30.4-0.41606humulene epoxide IIt0.20.30.4-0.5-1.4-1640epi-α-cadinol-0.2	1513	cubebol	04	-	-	-	-	-	-	-
1521δ-cadinene0.50.81.10.80.21.6t2.81532E-γ-bisabolene0.20.31532Y-cuprenene0.2t0.11533sesquiterpene, 161, 204, 133, 1890.80.8-1538α-cadinene0.20.10.4-1545selina-3,7(11)-diene0.20.10.4-1549elemol-0.40.70.90.30.41.10.71556germacrene B-1.60.50.70.31.46.32.81574germacrene D-4-ol-1.51.22.9-2.0-8.91587allo-cedrol1.92.30.81.21.11606humulene epoxide IIt1606β-oplopenonet	1521	ß-sesquisphellandrene	-	-	_	_	0.2	_	_	_
13240-contribution0.00	1524	δ-cadinene	0.5	0.8	11	0.8		16	t	28
1032L-yousablene0.20.20.310.10.10.11532γ-cuprenene0.2t0.11533sesquiterpene, 161, 204, 133,1890.20.10.81538 $\alpha$ -cadinene0.20.10.41545selina-3,7(11)-diene0.30.4-1549elemol-0.40.70.90.30.41.10.71556germacrene B-1.60.50.70.31.46.32.81574germacrene D-4-ol-1.51.22.9-2.0-8.91587allo-cedrol1.92.30.81.21.11606humulene epoxide IIt1606β-oplopenonet1630 $\gamma$ -eudesmol0.51640epi- $\alpha$ -nuurololt0.30.40.4-0.5-1.41640epi- $\alpha$ -muurololt0.30.4-0.5-1.41642selina-3,11-dien-6- $\alpha$ -ol0.2-1645 $\alpha$ -muurolol	1532	E-v-bisabolene	0.2	0.3		-	_	-	-	-
1532γ-cuprenene0.210.11533sesquiterpene, 161, 204, 133,1890.8-1538 $\alpha$ -cadinene0.20.10.41545selina-3,7(11)-diene0.30.4-1549elemol0.30.4-1556germacrene B-1.60.50.70.31.46.32.81574germacrene D-4-ol-1.51.22.9-2.0-8.91587allo-cedrol1.92.30.81.21.11606humulene epoxide IIt1606β-oplopenonet1630 $\gamma$ -eudesmol0.51640epi-α-cadinolt0.30.40.4-0.5-1.41.41640epi-α-muurololt0.30.40.4-0.5-1.41642selina-3,11-dien-6-α-ol0.2-1645 $\alpha$ -muurololtt0.20.30.31.00.2-<	1532		0.2	0.0		+	0.1			
133.3Sesquile/perle, 101, 204, 133,1890.0-1538 $\alpha$ -cadinene0.20.10.40.71549elemol0.30.4-1549elemol-0.40.70.90.30.41.10.71556germacrene B-1.60.50.70.31.46.32.81574germacrene D-4-ol-1.51.22.9-2.0-8.91587allo-cedrol1.92.30.81.21.11596cedrol25.430.313.822.723.6-0.10.21606humulene epoxide IIt1606β-oplopenonet1606β-oplopenonet0.41606β-oplopenonet0.41606β-oplopenonet0.20.30.4-0.4	1532	γ-cuprenene 161 204	0.2	-	-	ι	0.1	-		-
153, 1890.20.10.41545selina-3,7(11)-diene0.20.10.30.4-1549elemol-0.40.70.90.30.41.10.71556germacrene B-1.60.50.70.31.46.32.81574germacrene D-4-ol-1.51.22.9-2.0-8.91587allo-cedrol1.92.30.81.21.11596cedrol25.430.313.822.723.6-0.10.21606humulene epoxide IIt1606β-oplopenonet1630 $\gamma$ -eudesmol0.51640epi-α-cadinolt0.20.30.4-0.5-1.41642selina-3,11-dien-6-α-ol0.2-1645 $\alpha$ -muurololtt0.10.1-t-0.51649 $\beta$ -eudesmol-t0.20.30.31.00.21653 $\alpha$ -adinolt0.50.91.0-0.5-3.6	1555	122 190	-	-	-	-	-	-	0.0	-
1536d-cadinene00.20.10.41545selina-3,7(11)-diene0.30.4-1549elemol-0.40.70.90.30.41.10.71556germacrene B-1.60.50.70.31.46.32.81574germacrene D-4-ol-1.51.22.9-2.0-8.91587allo-cedrol1.92.30.81.21.11596cedrol25.430.313.822.723.6-0.10.21606humulene epoxide IIt1606 $\beta$ -oplopenonet1630 $\gamma$ -eudesmol0.51640epi-a-cadinolt0.20.30.4-0.5-1.41642selina-3,11-dien-6- $\alpha$ -ol0.2-1645 $\alpha$ -muurololtt0.10.1-t-0.5-1649 $\beta$ -eudesmol0.5-1.41653 $\alpha$ -cadinoltt0.20.20.30.51.0t <td>1520</td> <td>133,109 g. oodinono</td> <td></td> <td></td> <td>0.0</td> <td>0.1</td> <td></td> <td></td> <td></td> <td>0.4</td>	1520	133,109 g. oodinono			0.0	0.1				0.4
1545selina-3, 7(1)-diene0.30.4-1549elemol-0.40.70.90.30.41.10.71556germacrene B-1.60.50.70.31.46.32.81574germacrene D-4-ol-1.51.22.9-2.0-8.91587allo-cedrol1.92.30.81.21.11596cedrol25.430.313.822.723.6-0.10.21606humulene epoxide IIt1606β-oplopenonet1606β-oplopenonet1606β-oplopenonet0.41630 $\gamma$ -eudesmol0.51640epi-α-cadinolt0.20.30.4-0.5-1.41642selina-3,11-dien-6-α-ol0.2-1645 $\alpha$ -muurololtt0.10.1-t-0.51649β-eudesmol-t0.20.30.31.00.21653 $\alpha$ -cadinolt0.50.91.0-0.5-3.6<	1000		-	-	0.2	0.1	-	-	-	0.4
1549elemon-0.40.70.90.30.41.10.71556germacrene B-1.60.50.70.31.46.32.81574germacrene D-4-ol-1.51.22.9-2.0-8.91587allo-cedrol1.92.30.81.21.11596cedrol25.430.313.822.723.6-0.10.21606humulene epoxide IIt1606β-oplopenonet0.4-0.416271-epi-cubenol0.51630 $\gamma$ -eudesmol0.50.41640epi-α-cadinolt0.20.30.4-0.5-1.41642selina-3,11-dien-6-α-ol0.2-1645 $\alpha$ -muurololtt0.10.1-t-0.51649 $\beta$ -eudesmol-t0.20.30.31.00.21653 $\alpha$ -cadinoltt0.50.91.0-0.5-3.6	1040	selina-3,7(11)-diene	-	-	-	-	-	0.3	0.4	-
1556germacrene B-1.60.50.70.31.46.32.81574germacrene D-4-ol-1.51.22.9-2.0-8.91587allo-cedrol1.92.30.81.21.11596cedrol25.430.313.822.723.6-0.10.21606humulene epoxide IIt1606β-oplopenonet0.4-0.416271-epi-cubenol0.51630 $\gamma$ -eudesmol-0.41640epi-α-cadinolt0.20.30.4-0.5-1.41642selina-3,11-dien-6-α-ol0.2-1645α-muurololtt0.10.1-t-0.51649β-eudesmol-t0.20.30.31.00.21653α-cadinolt0.50.91.0-0.5-3.6	1549		-	0.4	0.7	0.9	0.3	0.4	1.1	0.7
1574germacrene D-4-ol-1.51.22.9-2.0-8.91587allo-cedrol1.92.30.81.21.11596cedrol25.430.313.822.723.6-0.10.21606humulene epoxide IIt1606β-oplopenonet0.4-0.416271-epi-cubenol0.51630 $\gamma$ -eudesmol-0.41640epi-α-cadinolt0.20.30.4-0.5-1.41642selina-3,11-dien-6-α-ol0.2-1645α-muurololtt0.10.1-t0.5-1649β-eudesmol0.20.30.31.00.21652α-eudesmol-t0.20.30.51.0t1653α-cadinolt0.50.91.0-0.5-3.6	1556	germacrene B	-	1.6	0.5	0.7	0.3	1.4	0.3	2.8
1587allo-cedrol1.92.30.81.21.11596cedrol25.430.313.822.723.6-0.10.21606humulene epoxide IIt1606β-oplopenonet16071-epi-cubenol0.51630 $\gamma$ -eudesmol-0.41640epi-α-cadinolt0.20.30.4-0.5-1.41640epi-α-muurololt0.30.40.4-0.5-1.41642selina-3,11-dien-6-α-ol0.2-1645α-muurololtt0.10.1-t0.5-1649β-eudesmol-t0.20.10.20.30.51.0t1653α-cadinolt0.50.91.0-0.5-3.6	15/4	germacrene D-4-oi	-	1.5	1.2	2.9	-	2.0	-	8.9
1596cedrol25.430.313.822.723.6-0.10.21606humulene epoxide IIt1606β-oplopenonet16071-epi-cubenol0.50.4-0.416271-epi-cubenol0.51630γ-eudesmol-0.40.41640epi-α-cadinolt0.20.30.4-0.5-1.41640epi-α-muurololt0.30.40.4-0.5-1.41642selina-3,11-dien-6-α-ol0.2-1645α-muurololtt0.10.1-t0.5-1649β-eudesmol-t0.20.10.20.30.31.00.21652α-eudesmol-0.20.10.20.30.51.0t1653α-cadinolt0.50.91.0-0.5-3.6	1587	allo-cedrol	1.9	2.3	0.8	1.2	1.1	-	-	-
1606humulene epoxide IIt1606β-oplopenonet0.4-0.416271-epi-cubenol0.51630 $\gamma$ -eudesmol-0.41640epi-α-cadinolt0.20.30.4-0.5-1.41640epi-α-muurololt0.30.40.4-0.5-1.41642selina-3,11-dien-6-α-ol0.2-1645α-muurololtt0.10.1-t-0.51649β-eudesmol-t0.20.20.30.31.00.21652α-eudesmol-0.20.10.20.30.51.0t1653α-cadinolt0.50.91.0-0.5-3.6	1596	cedrol	25.4	30.3	13.8	22.7	23.6	-	0.1	0.2
1606β-oplopenonet0.4-0.416271-epi-cubenol0.51630 $\gamma$ -eudesmol-0.41640epi-α-cadinolt0.20.30.4-0.5-1.41640epi-α-muurololt0.30.40.4-0.5-1.41642selina-3,11-dien-6-α-ol0.2-1645α-muurololtt0.10.1-t-0.51649β-eudesmol-t0.20.20.30.31.00.21652α-eudesmol-0.20.10.20.30.51.0t1653α-cadinolt0.50.91.0-0.5-3.6	1606	numulene epoxide II	t	-	-	-	-	-	-	-
16271-epi-cubenol0.51630 $\gamma$ -eudesmol-0.40.4-1640epi-α-cadinolt0.20.30.4-0.5-1.41640epi-α-muurololt0.30.40.4-0.5-1.41642selina-3,11-dien-6-α-ol0.2-1645α-muurololtt0.10.1-t-0.51649β-eudesmol-t0.20.20.30.31.00.21652α-eudesmol-0.20.10.20.30.51.0t1653α-cadinolt0.50.91.0-0.5-3.6	1606	β-oplopenone	t	-	-	-	-	0.4	-	0.4
1630γ-eudesmol-0.40.4-1640epi-α-cadinolt0.20.30.4-0.5-1.41640epi-α-muurololt0.30.40.4-0.5-1.41642selina-3,11-dien-6-α-ol0.5-1.41645α-muurololtt0.10.1-t-0.2-1649β-eudesmol-t0.20.20.30.31.00.21652α-eudesmol-0.20.10.20.30.51.0t1653α-cadinolt0.50.91.0-0.5-3.6	1627	1-epi-cubenol	0.5	-	-	-	-	-	-	-
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	1630	γ-eudesmol	-	0.4	-	-	-	-	0.4	-
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	1640	epi-α-cadinol	t	0.2	0.3	0.4	-	0.5	-	1.4
1642selina-3,11-dien-6-α-ol0.2-1645 $\alpha$ -muurololtt0.10.1-t-0.51649β-eudesmol-t0.20.20.30.31.00.21652 $\alpha$ -eudesmol-0.20.10.20.30.51.0t1653 $\alpha$ -cadinolt0.50.91.0-0.5-3.6	1640	epi-α-muurolol	t	0.3	0.4	0.4	-	0.5	-	1.4
1645α-muurololtt0.10.1-t0.51649β-eudesmol-t0.20.20.30.31.00.21652α-eudesmol-0.20.10.20.30.51.0t1653α-cadinolt0.50.91.0-0.5-3.6	1642	selina-3,11-dien-6-α-ol	-	-	-	-	-	-	0.2	-
1649β-eudesmol-t0.20.20.30.31.00.21652α-eudesmol-0.20.10.20.30.51.0t1653α-cadinolt0.50.91.0-0.5-3.6	1645	α-muurolol	t	t	0.1	0.1	-	t	-	0.5
1652α-eudesmol-0.20.10.20.30.51.0t1653α-cadinolt0.50.91.0-0.5-3.6	1649	β-eudesmol	-	t	0.2	0.2	0.3	0.3	1.0	0.2
1653 α-cadinol t 0.5 0.9 1.0 - 0.5 - 3.6	1652	α-eudesmol	-	0.2	0.1	0.2	0.3	0.5	1.0	t
	1653	α-cadinol	t	0.5	0.9	1.0	-	0.5	-	3.6

KI	Compound	Exc	Poly	SeraK	SeraP	Kuh6	Kuh9	Kbr5	Turco
1661	sesquiterpene	1.0	-	-	-	-	-	-	t
	<u>85,</u> 57,41,238								
1663	β-atlantone	0.6	-	-	-	-	-	-	-
1666	bulnesol	-	0.3	-	0.2	-	-	-	0.2
1666	(2E,4E)-decadienol	0.6	-	-	-	-	-	-	-
1688	shyobunol	-	1.2	0.7	1.6	0.3	t	0.4	2.1
1700	eudesm-7(11)-en-4-ol	-	-	-	-	-	-	0.3	-
1789	8-α-acetoxyelemol	-	-	-	t	-	-	-	0.1
1961	sandaracopimara-	t	-	-	-	-		-	-
	8(14),15-diene								
1989	manoyl oxide	0.1	0.4	-	0.2	0.1	t	0.1	-
2054	abietatriene	0.1	t	-	t	-	-	t	t
2080	abietadiene	0.5	0.8	t	0.3	-	t	0.2	0.7
2147	abieta-8(14),13(15)-diene	-	-	-	-	-		-	t
2181	sandaracopimarinal	-	-	-	-	-		-	0.1
2288	4-epi-abietal	0.2	1.5	0.1	1.2	0.1	0.2	0.5	1.9