Essential Oils from Two Endemic Species of Apiaceae from Iran

Narguss Yassa[a], Hossein Akhani[b,*], Majid Aqaahmadi[b], and Mojtaba Salimian[b]

[a] Tehran University of Medical Science, Faculty of Pharmacy, Department of Pharmacognosy, Tehran, Iran
[b] Tehran University, Faculty of Science, Department of Biology, PO Box 14155-6455, Tehran, Iran. Fax: 0098-21-6405141. E-mail: akhani@khayam.ut.ac.ir

* Author for correspondence and reprint requests

Z. Naturforsch. **58c,** 459–463 (2003); received January 8/February 14, 2003

The composition of essential oils of *Leutea glaucopruinosa* (Rech.f.) Akhani & Salimian comb. nov., and *Zeravschania* (Boiss. & Hausskn.) Salimian & Akhani comb. nov. were analysed by GC-MS. 49 compounds are identified in the former and 33 compounds in the latter, comprising a total of 76 compounds in both species. Both species were originally described under *Peucedanum*, which are transferred in this paper into *Leutea* and *Zeravschania*, respectively. The chemical compounds of the essential oils show that there are only seven common compounds between two species. The major compounds of *L. glaucopruinosa* are mostly monoterpene hydrocarbons and oxygenated monoterpenes, in which α-pinene (31.5%), sabinene (9.7%), β-pinene (9.2%), exo-fenchyl acetate (4.5%) are dominant. In *Z. pastinacifolia* sesquiterpene hydrocarbons and phenylpropanoids dominate with β-bisabolene (37.3%), 3,1-butyl-1,2-dimethoxy benzene (14.9%), 10,11-dimethylbicyclo[6.3.0]undec-(8)-en-9-one (12.9%), 4-*t*-butyl-1,2-dimethoxy benzene (6.8%), (*E*)-asarone (5.1%) and elemicine (4.1%) as major compounds.

Key words: Leutea, *Zeravschania*, Chemotaxonomy

Introduction

Species of the parsley family (Apiaceae) are well known with regards to their economic importance and diversity of essential oils (Hegnauer, 1971, 1973). This family is well represented in the Iranian flora at least with 112 genera, 316 species and 75 endemic species (Hedge *et al.*, 1987). *Peucedanum* s. l. is among the most critical group of Iranian *Apiaceae* which has been splitted into several genera in Flora Iranica (Pimenov, 1987). This is a first report of a series of papers related to the biochemical and biosystematical studies of *Peucedanum sensu lato* (including *Peucedanum sensu stricto*, *Leutea* and *Zeravschania*) in Iran. *Leutea glaucopruinosa* is a rock inhabiting species known from the vertical rocks in Golestan and Mazandaran Provinces in N. Iran which belongs to the Hyrcanian province of Euro-Siberian region (Fig. 1). This species was originally described under *Peucedanum* (Rechinger, 1952; Hedge *et al.*, 1987). *Zeravschania pastinacifolia* is an endemic species in Central parts of Iran and grows on more or less rocky and scree steep slopes of the Central parts of Iran (Fig. 1). It was originally described under *Peucedanum* (Boissier, 1872). It was transferred to the monotypic genus *Demavendia* (Pimenov, 1997), but our detailed studies showed that this should be transferred to *Zeravschania*.

Nomenclature and Plant Materials

The species studied in this paper are variously interpreted by different authors (Pimenov, 1987; Boissier, 1872). Based on the intensive taxonomical, anatomical and pollen morphological studies (Akhani and Salimian, in prep.), the generic concept of the members of *Peucedanum* complex in Iran is critically revised. Based on this studies the generic status of two species *Peucedanum glaucopruinosum* Rech. f., and *Demavendia pastinacifolia* (Boiss. & Hausskn.) Pimenov (Syn.: *Peucedanum pastinacifolium* Boiss. & Hausskn.) needs to be changed. In order to avoid future confusion, in this paper we follow the rules of the International Code of Botanical Nomenclature (Greuter *et al*,. 2000), and give the new generic status of the species:

Leutea glaucopruinosa (Rech. f.) Akhani & Salimian comb. nov.

Basionym: *Peucedanum glaucopruinosum* Rech. f., Anz. Math.-Nat. Kl. Österr. Akad. Wiss. **89**, 243 (1952).

Zeravschania pastinacifolia (Boiss. & Hausskn.) Salimian & Akhani comb. nov.

Basionym: *Peucedanum pastinacifolium* Boiss. & Hausskn. in Boiss., Diagn. Pl. Or. Nov. Ser. 1, **10**, 35 (1849).

Voucher specimens for phytochemical analyses are provided for both species and are deposited in the Faculty of Science, University of Tehran under No. 15015 for *L. glaucopruinosa* and No. 15226 for *Z. pastinacifolia*, respectively.

GC/MS analyses

The arial parts of examined plants were dried in shadow at room temperature and 121 g of *Leutea glaucopruinosa* and 49.3 g of *Zeravschania pastinacifolia* powdered plants were hydrodistilled with a clevenger type apparatus for 4–5 h. The yellowish oil was collected and dehydrated by anhydrous sodium sulfate. The volume of this oil was 0.71 ml/100 g dried plant material for *Zeravschania pastinacifolia* and 0.5 ml/100 g dried plant material for *Leutea glaucopruinosa*. The oil was analysed by GC/MS on a HEWLETT-PACKARD 6890 gas chromatograph coupled a mass detector (HEWLETT-PACKARD model 6973 HP). The column for oil separation use a fused silica HP-5 column, 30 m length, 250 μ i.d., and 0.32 mm film thickness. The mass spectra were obtained by electron ionization at 70 eV. The oven temperature program was 60 °C (30 min) isotherm, then to 250 °C at 5 °C/min. The injector temperature was 250 °C. The carrier gas (helium) flow rate was 1 ml/min. The sample (1 ml) was injected with a split ratio of 1/90. The compounds were identified using the Wiley 275 library, retention indices and MS fragmentation with published data (Adams, 1995).

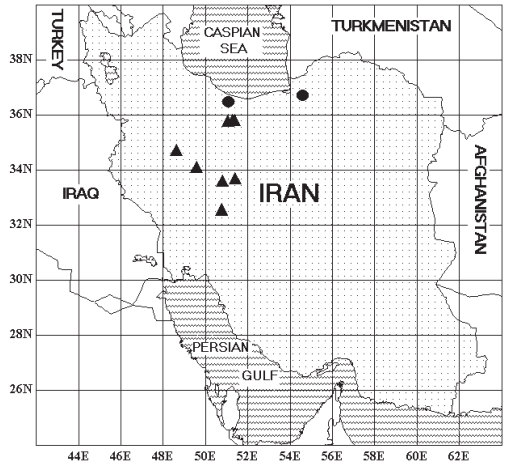

Fig. 1. Distribution maps of *Leutea gaucopruinosa* (dot) and *Zeravschania pastinacifolia* (triangle).

Results and Discussion

According to the GC mass analysis a total of 76 compounds were identified in *Leutea glaucopruinosa* and *Zeravschania pastinacifolia* together. *L. glaucopruinosa* with 49 compounds included 55.7% monoterpene hydrocarbons, 18.7% oxygenated monoterpenes, 7.1% sesquiterpene hydrocarbons and 5% oxygenated sesquiterpenes, together 88% of the total oils.

The major compounds of this species are α-pinene (31.5%), sabinene (9.7%), β-pinene (9.2%), exo-fenchyl acetate (4.5%), (–)-bornyl acetate (3.6%), limonene (2.6%), epi-ligulyloxide (2.6%), (*Z*)-verbenol (2.5%) and myrtenal (2.3%). Previously only the oils of *Leutea petiolaris* (DC.) Pimenov (under *Peucedanum petiolare* (DC.) Boiss.) was reported (Rustaiyan *et al.*, 2001). Among ten reported compounds, sabinene (57.8%), δ-3-carene (36.2%) were identified as major compounds followed by (*E*)-β-ocimene (1.8%), camphene (0.5%), β-pinene (0.6%), *p*-cymene (0.1), γ-terpinen (0.1%), myrtenol (0.2%), *trans*-carveol (0.2%) and thymol (0.1%). Seven compounds are similar between *L. glaucopruinosa* and *L. petiolaris* with various quantities. The published reports of essential oils in other members of Peucedaneae and one Apieae show that α-pinene is a major compound in *Prangos ferulacea* (12.6%) (Sefidkon *et al.*, 1998), *Peucedanum palustre* (50.3%) (Schmaus *et al.*, 1989), *P. verticillare* (6.3%) (Fraternale *et al.*, 2000), and fruits of *P. oreoselnium* (5.1–8.3%) (Motskute and Nivinskene, 1999). Sabinene was reported as a major compound in *P. verticillare* (39.6%) (Fraternale *et al.*, 2000), *P. ostruthium* (4.7% in herb and 35.2% in rhizome) (Cisowski *et al.*, 2001), and *P. lancifolium* (7.34%), (Kubeczka *et al.*, 1989). β-pinene was detected as a major compound in *P. zenkeri* (6.2% in leaves) (Menut *et al.*, 1995), and *P. oreoselnium* (1.5–15.5%) (Motskute and Nivinskene, 1999).

The oils of *Z. pastinacifolia* are composed of 33 compounds. This is apparently the first chemical report in the genus *Zeravschania*. There are large

Table I. Chemical constituents of the essential oils of *Leutea glaucopruinosa* and *Zeravschania pastinacifolia.*

Compound	RI [a]	*Leutea glaucopruinosa* (%)	*Zeravschania pastinacifolia* (%)
α-Thujene	0937	0.2	–
α-Pinene	0945	31.5	0.4
Camphene	0959	0.3	–
Verbenene	0965	0.4	–
Sabinene	0986	9.7	–
β-Pinene	0990	9.2	0.2
Myrcene	1001	0.3	0.1
α-Phellandrene	1014	–	tr
α-Terpinene	1028	0.3	tr
o-Cymene	1036	0.4	–
Limonene	1040	2.6	0.7
(*Z*)-β-ocimene	1048	tr	tr
(*E*)-β-Ocimene	1060	–	0.6
γ-Terpinene	1068	0.7	–
Terpinolene	1097	0.1	0.3
Linalool	1108	0.3	–
α-Campholene aldehyde	1132	0.6	–
(*E*)-Pinocarveol	1145	1.1	–
(*Z*)-Verbenol	1146	2.5	–
β-Phellandrene-8– 0l	1154	0.3	–
d-Pinocarvone	1166	0.8	–
Lavandulol	1170	–	0.4
α-Phellandrene-8-ol	1171	0.9	–
Terpinene-4-ol	1180	1.1	–
Myrtenal	1196	2.3	–
Verbenone	1208	0.7	–
iso-Thymol methyl ether	1215	–	0.7
exo-Fenchyl acetate	1230	4.5	–
Thymol methyl ether	1240	–	0.5
o-Hydroxy cumene	1260	–	0.2
(–)-Bornyl acetate	1284	3.6	–
Lavandulyl acetate	1294	–	0.7
α-Cubebene	1357	tr	–
α-Longipinene	1360	tr	–
Cyclosativene	1368	0.6	–
Cyclofenchene	1372	–	0.1
α-Copaene	1380	0.6	–
β-Cubebene	1390	0.7	–
4,5-Dimethoxy-2-(2-propyl)phenol	1400	–	1.4
Methyl eugenol	1409	–	0.1
(–)-Sinularene	1415	0.1	–
iso-Longifolene	1419	0.1	–
(*E*)-β-Caryophyllene	1425	0.4	–
3,1-Butyl-1,2-dimethoxy benzene	1428	–	14.9
β-Gurjunene	1434	0.5	–
γ-Elemene	1436	–	0.2
4-*t*-Butyl-1,2-dimethoxy benzene	1438	–	6.8
(*E*)-α-Bergamotene	1440	–	0.2
3*H*-Cyclopenta[a]pentalen-3-one-1,2,3a,5,6,6a,7,7a-octahydro-3a,5,5-trimethyl-(3a.α,6a.β,7a.α)	1446	1.6	–
α-Humulene	1456	0.1	–
(*Z*)-Methyl eugenol	1461	–	0.3
10,11-Dimethylbicyclo[6.3.0]undec-(8)-en-9-one	1470	–	12.9
Aristolene	1472	0.2	–
Germacrene-D	1482	0.2	–
γ-Selinene	1483	0.4	–
β-Selinene	1485	1.1	–
Valencene	1490	0.5	–

Table I. (cont.)

Compound	RI [a]	*Leutea glaucopruinosa* (%)	*Zeravschania pastinacifolia* (%)
α-Selinene	1494	0.7	–
(*E*)-Methyl eugenol	1500	–	5.6
α-Muurolene	1506	0.6	–
Germacrene-A	1509	0.1	–
β-Bisabolene	1513	–	37.3
7-Epi-α-selinene	1518	0.1	–
Myristicin	1525	–	0.1
δ-Cadinene	1530	0.1	–
Epi-ligulyloxide	1535	2.6	–
Elemicine	1560	–	4.1
Germacrene-B	1563	–	1.7
Benzene-1,2,3,4-tetramethoxy-5-(propenyl)	1570	–	0.2
Spathulenol	1581	1.3	–
(*Z*)-β-Asarone	1626	–	0.4
Dillapiol	1628	–	0.4
(*E*)-isoelemicine	1650	–	0.2
α-Eudesmol	1660	1.1	–
(*E*)-Asarone	1681	–	5.1
Monoterpene hydrocarbons		55.7	2.3
Oxygenated monoterpenes		18.7	1.1
Sesquiterpene hydrocarbons		7.1	43.8
Oxygenated sesquiterpenes		5.0	5.1
Phenylpropanoids		–	31.6
Others		1.6	12.9
Total		88.1	96.8

tr = trace < 0.1%.
[a] Retention index on the HP5 column.

differences in the oil constituents of *Z. pastinacifolia* and *L. glaucopruinosa*. Only 7 compounds including α-pinene, β-pinene, myrcene, limonene, (*Z*)-β-ocimene and α-terpinene and terpinolene present in both species, however, with very different quantities (Table I). In *Z. pastinacifolia*, sesquiterpene hydrocarbons dominates with 43.8%, with a high percentage of phenylpropanoids (31%) and lower percentage of monoterpene hydrocarbons (2.3%) and oxygenated sesquiterpenes (5.1%). The major compound is β-bisabolene with 37.3%. Other major compounds include 3,1-butyl-1,2-dimethoxy benzene (14.9%), 10,11-dimethyl-bicyclo[6.3.0]undec-(8)-en-9-one (12.9%), 4-*t*-butyl-1,2-dimethoxy benzene (6.8%), (*E*)-asarone (5.1%) and elemicine (4.1%). It is surprising that none of these compounds were distinguished in *Leutea glaucopruinosa*, which is a good reason for their taxonomic distance. By literature survey we could not find a close similarity in oils of *Z. pastinacifolia* and any other member of *Peucedanum* and related genera. The major compound β-bisabolene was reported as a trace compound in fresh (0.8%) and dried fruits (2.0%) of *P. verticillare* (Fraternale *et al.*, 2000) and fruits of *P. oreoselinum* with only 0.05–0.10% (Motskute and Nivinskene, 1999).

Acknowledgements

This research was partly supported by Research Council University of Tehran under project number 513/4/520. A three months research award by DAAD (German Academic Exchange Service) for H. A. facilitated the final preparation of this contribution.

Adams D. R. (1995), Identification of essential oil components by GC/MS spectroscopy . Allured Publ., Illinois, USA.

Boissier E. (1872), Flora Orientalis. Vol. 2. Geneve.

Cisowski W., Sawicka U., Mardarowicz M., Asztemborska M., and Łuczkiewicz M. (2001), Essential oil from herb and rhizome of *Peucedanum ostruthium* (L. Koch) ex DC. Z. Naturforsch. **56c**, 930–932.

Fraternale D., Giamperi L., Ricci D., and Manunta A. (2000), Composition of the essential oil of *Peucedanum verticillare*. Bioch. Sys. Ecol. **28**, 143–147.

Greuter W., Mcneill J., Barrie F. R., Burdet H. M., Demoulin V., Filgueiras T. S., Nicolson D. H., Silva P. C., Skog J. E., Trehane P., Turland N. J., and Hawksworth D. L. (eds) (2000), International Code of Botanical Nomenclature (Saint Louis Code). Regnum Vegetabile, 138. Koeltz Scientific Books, Königstein, Germany.

Hedge I. C., Lamond J. M., Rechinger K. H., Alava R., Chamberlain D. F., Engstrand L., Herrnstadt I., Heyn C. C., Leute G. H., Mandenova I., Peev D., Pimenov M. G., Snogerup S., and Tamamschian S. G. (1987), Umbelliferae. In: Flora Iranica (Rechinger K. H., ed.), Vol. 162. Akademische Druck- u. Verlagsanstalt Graz, Austria.

Hegnauer R. (1971), Chemical patterns and relationships of Umbelliferae. In: The Biology and Chemistry of Umbelliferae (Heywood V. H., ed.). Academic Press, New York, pp. 267–277.

Hegnauer R. (1973), Chemotaxonomie der Pflanzen. 6. Rafflesiaceae-Zygophyllaceae. Birkhäuser Verlag, Basel und Stuttgart.

Kubeczka K.-H., Schmaus G., Schultze W., and Ullmann I. (1989), The essential oil of *Peucedanum lancifolium* Lange and chemotaxonomic implications. Z. Naturforsch. **44c**, 183–188.

Menut C., Eyele Mve-Mba C., Lamaty G., Amvam Zollo P.-H., Tchoumbougnang F., and Bessiere J.-M. (1995), Aromatic plants of tropical central Africa. XVIII. Essential oils of leaf and rhizome of *Peucedanum zenkeri* Engl. from Cameroon. J. Essent. Oil Res. **7**, 77–79.

Motskute D. and Nivinskene O. (1999), Essential oil of *Peucedanum oreoselinum* fruits collected near Vilnius. Chem. Nat. Comp. **35**, 635–637.

Pimenov M. G. (1987), *Leutea* (pp. 445–450), *Demavendia* (pp. 450–451), *Cervaria* (pp. 451–454), *Johreniopsis* (pp. 454–457) and *Zeravschania* (pp. 457–462) [Umbelliferae]. In: Flora Iranica (Rechinger K. H., ed.), Vol. 162. Akademische Druck- u. Verlagsanstalt, Graz, Austria.

Rechinger K. H. (1952), Umbelliferae novae iranicae, I. Anz. math.-naturw. Kl. Österr. Akad. Wiss. **89**, 168–176.

Rustaiyan A., Komeilizadeh H., Mojab F., Khazae A., Masoudi S., and Yari M. (2001), Essential oil composition of *Peucedanum petiolare* (DC.) Boiss., from Iran. J. Essent. Oil Res. **13**, 49–50.

Schmaus G., Schultze W., and Kubeczka K. H. (1989), Volatile constituents of *Peucedanum palustre*. Planta Med. **55**, 482–487.

Sefidkon F., Khajavi M. S., and Malackpour B. (1998), Analysis of the oil of *Prangos ferulacea* (L.) Lindl. J. Essent. Oil Res. **10**, 81–82.