Available online at www.sciencedirect.com
SCIENCE DIRECT®
Journal of Chromatography A, 1029 (2004) 279–282
JOURNAL OF CHROMATOGRAPHY A
www.elsevier.com/locate/chroma

Short communication

Comparative analysis by gas chromatography–mass spectrometry of the essential oils from bark and leaves of *Cedrelopsis grevei* Baill, an aromatic and medicinal plant from Madagascar

Anne Gauvin*, Harimisa Ravaomanarivo[1], Jacqueline Smadja

Laboratoire de Chimie des Substances Naturelles et des Sciences des Aliments, Faculté des Sciences et Technologies, Université de la Réunion, 15 Avenue René Cassin, B.P. 7151, 97 715 Saint Denis Messag Cedex 9, DOM, France

Received 9 October 2003; received in revised form 5 December 2003; accepted 9 December 2003

Abstract

The essential oils from bark and leaves of *Cedrelopsis grevei* Baill (Ptaeroxylaceae), an aromatic and medicinal plant from Madagascar, are widely used in folk medicine. These two commercially available oils have been examined separately by means of GC–MS. The oil constituents were identified according to their mass spectra and their relative retention indices determined on both polar and non-polar stationary phase capillary columns. A total of 55 compounds have been identified constituting 76.7% (bark) and 91.6% (leaves) of the volatile constituents. Both oils were found to have a similar composition; however the relative percentages of some compounds notably differed. The bark essential oil contained β-pinene (17.1%), *cis*-sesquisabinene hydrate (12.8%) and caryophyllene oxide (7.0%) as the main components whereas the leaf essential oil was largely dominated by *trans*-β-farnesene (35.6%); β-pinene (12.8%), *cis*-sesquisabinene hydrate (9.8%) and ar-curcumene (8.6%) were also present as major components. As far as we know, this is the first report on the *Cedrelopsis grevei* bark and leaf essential oils which therapeutic properties may be attractive for aromatherapy.

Keywords: *Cedrelopsis grevei*; Essential oils; Plant materials; Monoterpenes; Sesquiterpenes; Terpenes

1. Introduction

The genus *Cedrelopsis* Baillon belongs to the family Ptaeroxylaceae and comprises only eight species, all native to Madagascar (*C. ambanjensis* Leroy; *C. gracilis* Leroy; *C. grevei* Constantin and Poisson; *C. longibracteata* Leroy; *C. microfoliolata* Leroy; *C. procera* Leroy; *C. rakotozafyi* Cheek and Lescot; *C. trivalvis* Leroy) [1,2]. Among these eight species, *C. grevei*, small tree, known under various common names such as Katafray, Matahora, Bemafaitra, is the most locally exploited not only for its wood but for its medicinal properties [3–8] as well. The essential oils extracted from its bark and its leaves are in particular commonly used in traditional medicine as fortifying, tonic, relaxing and postnatal medications. The bark essential oil is also used to cure rheumatism and muscular pains and is known to exert antifungal and antibiotic activities. All these popular uses may be explained by the presence of biologically active volatile constituents. However, up to now, practically nothing whatsoever is known about the chemical composition of these essential oils commercially produced by traditional distilleries in Madagascar. Therefore, the aim of this study was to analyse by gas chromatography–mass spectrometry the volatile compounds of these essential oils which could provide a new and interesting raw material for use in aromatherapy. Their organoleptic and physicochemical properties were determined as well.

2. Experimental

2.1. Materials

The studied essential oil samples were furnished in august 2001 by the society Sahala located in Toliary (south-west

* Fax: +82-262-262-938183.
E-mail address: gauvin@univ-reunion.fr (A. Gauvin).
[1] Present address: Département de Chimie Minérale et Chimie Physique, Faculté des Sciences, Université d'Antananarivo, B.P. 906, Antananarivo 101, Madagascar.

0021-9673/$ – see front matter © 2004 Elsevier B.V. All rights reserved.
doi:10.1016/j.chroma.2003.12.012

of Madagascar). In this distillery, the essential oils of *C. grevei* are extracted from the bark, during 12 h, by steam distillation using stainless stills and from the leaves, during 10 h, by hydrodistillation. Depending on the season, the oil yields range from 0.4 to 0.8% for the bark and from 0.1 to 0.3% for the leaves.

2.2. Olfactoric evaluation

The two essential oils were evaluated olfactorically by J.C. Ellena (Perfurmer from Symrise, France).

2.3. Physical and chemical properties

Refractive indices, optical rotations, specific gravity, acid numbers and ester numbers were determined according to the methods recommended in the French norms AFNOR [9]. Optical rotations were measured on Polax-L Atago polarimeter. Refractive indices were obtained using Atago DR-A1 refractometer.

2.4. Gas chromatography–mass spectrometry

GC–MS analyses were carried out using a Hewlett-Packard chromatograph type 6890 series coupled to a HP 6890 mass selective detector. The MS detector was used in the electron impact ionisation (EI) mode with an ionisation voltage of 70 eV. Two capillary columns were used under the following conditions: (i) SPB-5 (60 m × 0.32 mm i.d., film thickness: 1 μm); oven temperature programme 60 °C rising at 4 °C/min to 200 °C, held for 30 min; injector temperature, 250 °C; split ratio, 1:20; carrier gas, helium; flow rate, 0.7 ml/min. (ii) Supelcowax TM 10 (60 m × 0.20 mm i.d., film thickness: 0.20 μm); oven temperature programme 60 °C rising at 4 °C/min to 200 °C, held for 40 min; injector temperature, 250 °C; split ratio, 1:20; carrier gas, helium; flow rate, 1.3 ml/min.

2.5. Qualitative and quantitative analyses

Constituents of the volatile oil were identified by comparison of their retention indices relative to C_8–C_{22} *n*-alkanes and their mass spectral fragmentation pattern with those reported in the literature [10,11] and stored in a MS Library (NBS75K). The quantification of the components was performed on the basis of their GC peak areas on the SPB-5 column.

3. Results and discussion

The organoleptic and physicochemical properties of the bark and the leaf essential oils are shown in Tables 1 and 2, respectively. The volatile compounds, their relative amount and their retention indices (Kovat's indices for polar and apolar columns) are reported in Table 3.

Table 1
Organoleptic properties of the *Cedrelopsis grevei* bark and leaf essential oils

Organoleptic properties	Bark essential oil	Leaf essential oil
Colour	Amber	Pale yellow
Odour	Odour of terpene hydrocarbons with woody, spicy, green, chypre and oriental notes	Odour of terpene hydrocarbons with woody, spicy, green, chypre and oriental notes
Aspect	Liquid movable	Liquid movable

Fifty-five components, amounting to 76.7% of the bark essential oil and 91.6% of the leaf essential oil, were identified. Both the essential oil samples were dominated by the sesquiterpene fraction: 41.0 and 74.6% for the bark and the leaves, respectively. No qualitative marked difference in the chemical composition was found between the two oil samples. However, the relative percentages of some components notably differed. Thus, the most pronounced difference is that in leaves, *trans*-β-farnesene (35.6%) was found to be the main component, while in bark, this sesquiterpene was detected only in low percentage (2.0%). The second most abundant compound in the leaf oil was β-pinene (12.8%), followed by *cis*-sesquisabinene hydrate (9.8%), ar-curcumene (8.6%), α-cedrene (3.8%), β-caryophyllene (3.5%) and β-curcumene (3.0%). In the bark essential oil, β-pinene (17.1%) was found to be the major compound together with *cis*-sesquisabinene hydrate (12.8%), caryophyllene oxide (7.0%) and δ-3-carene (4.2%).

According to our results, it appears that the relative percentages of the identified compounds depend on the plant part studied. However, it should be kept in mind that the isolation procedure was different for the bark (steam distillation) and for the leaves (hydrodistillation). This may also influence the chemical composition of the essential oil.

To conclude, the present study is intended as a contribution to the better knowledge of the chemical composition of the essential oils of the bark and the leaves of *C. grevei*. However, it is obvious that further investigations are needed to elucidate the entire chemical composition and to determine the exact contribution of each component to the biological activities of these commercially available essential oils.

Table 2
Physical and chemical properties of the *Cedrelopsis grevei* bark and leaf essential oils

Physical and chemical properties	Bark essential oil	Leaf essential oil
Refractive index n_D^{20}	1.4994	1.4906
Optical rotation (temperature (°C))	+2.00 (21.6)	+15.55 (21.5)
Specific gravity d_{20}^{20}	0.950	0.895
Acid number	1.351	0.715
Ester number	35.75	2.84

Table 3
Volatile components of the essential oils of *Cedrelopsis grevei*

Components	Retention indices on		(%)[a]	
	SPB-5	Supelcowax	Bark	Leaf
Monoterpene hydrocarbons				
α-Pinene	935	1015	1.9	1.1
Camphene	953	1051	tr	tr
Sabinene	976	1096	tr	tr
β-Pinene	984	1089	17.1	12.8
β-Myrcene	988	1134	0.7	0.6
δ-3-Carene	1016	1127	4.2	0.8
α-Terpinene	1020	1159	tr	tr
o-Cymene	1024	1248	1.0	tr
p-Cymene	1027	1245	1.3	tr
Sylvestrene	1029	1177	tr	tr
Limonene	1033	1181	1.5	0.6
β-Phellandrene	1035	1194	tr	tr
(Z)-β-Ocimene	1046	1210	0.6	0.6
(E)-β-Ocimene	1058	1226	tr	tr
Terpinolene	1092	1261	tr	tr
Total			28.3	16.5
Oxygenated monoterpene derivatives				
Linalool	1096	1506	0.5	0.5
endo-Fenchol	1120	1543	tr	tr
trans-Pinocarveol	1149	1615	2.2	tr
Borneol	1174	1663	tr	tr
Terpin-4-ol	1183	1567	1.0	tr
p-Cymen-8-ol	1186	1796	tr	tr
α-Terpineol	1194	1657	1.2	tr
Myrtenal	1202	1601	1.3	tr
Myrtenol	1203	1749	1.2	tr
Fenchyl acetate	1225	1443	tr	–
Isobornyl acetate	1292	1549	tr	–
Total			7.4	0.5
Sesquiterpene hydrocarbons				
δ-Elemene	1347	1448	tr	tr
α-Cubebene	1354	1438	tr	tr
α-Copaene	1391	1479	0.6	tr
β-Elemene	1401	1566	1.8	1.1
α-Cedrene	1409	1556	0.5	3.8
Cyperene	1421	1514	tr	-
α-*cis*-Bergamotene	1424	1530	tr	0.7
β-Caryophyllene	1441	1578	1.7	3.5
α-*trans*-Bergamotene	1444	1510	tr	0.6
cis-β-Farnesene	1456	1613	tr	1.0
trans-β-Farnesene	1464	1630	2.0	35.6
α-Humulene	1476	1651	1.2	1.7
γ-Curcumene	1488	1663	0.9	tr
ar-Curcumene	1491	1741	2.6	8.6
β-Bisabolene	1516	1698	tr	tr
β-Curcumene	1519	1711	2.1	3.0
γ-Cadinene	1531	1737	0.7	1.2
δ-Cadinene	1537	1732	1.6	0.4
trans-Calamenene	1540	1807	tr	0.5
Cadina-1,4-diene	1548	1757	tr	tr
Total			15.7	61.7
Oxygenated sesquiterpene derivatives				
Sesquicineol	1524	1715	tr	tr
β-Dihydroagarofuran	1528	1706	tr	-
cis-Sesquisabinene hydrate	1562	1949	12.8	9.8
trans-Sesquisabinene hydrate	1598	2044	2.3	1.9
Caryophyllene oxide	1605	1956	7.0	1.2

Table 3 (*Continued*)

Components	Retention indices on		(%)[a]	
	SPB-5	Supelcowax	Bark	Leaf
γ-Eudesmol	1639	2111	-	tr
β-Eudesmol	1666	2183	1.1	tr
α-Eudesmol	1668	2177	1.0	tr
α-Bisabolol	1684	2165	1.1	tr
Total			25.3	12.9
Miscellaneous compounds				
Nopinone	1145	1556	tr	tr
Total			tr	tr

tr: trace.

[a] Relative percentages obtained from peak area on SPB-5.

References

[1] J.F. Leroy, M. Lescot, Flore de Madagascar et des Comores—Famille 107 bis. Muséum National d'Histoire Naturelle, Paris, 1991, p. 87.
[2] J.F. Leroy, D. Lobreau-Callen, M. Lescot, Les Ptaeroxylaceae: Espèces Nouvelles du Genre Malgache *Cedrelopsis* et Palynologie de la Famille. Bull. Mus. Hist. Nat., Paris, 4th series, 1990, p. 43.
[3] N. Andriamanga, Les Plantes Anthelminthiques Malagasy, Département de Recherches Zootechniques et Vétérinaires, Cotonou, 1995.
[4] M.M. Iwu, Handbook of African Medicinal Plants, CRC Press, Enugu, Nigeria, 1993, p. 435.
[5] P. Boiteau, Médecine Traditionnelle de la Pharmacopée Précis de Matière Médicale Malgache, Agence de Coopération Culturelle et Technique (A.C.C.T.), Paris, 1986, p. 27.
[6] M. Randriamahefa, A. Rakotozafy (Eds.), Recherches Bibliographiques sur les Utilisations Empiriques des Plantes Médicinales Malgaches, Antananarivo, 1979.
[7] M. Debray, H. Jacquemin, R. Razafindrambao, Contribution à l'Inventaire des Plantes Médicinales de Madagascar, Travaux et documents de l'ORSTOM, Paris, vol. 8, 1971.
[8] R. Pernet, G. Meyer, Pharmacopée de Madagascar, Publication de l'Institut de Recherche Scientifique Tananarive—Tsimbazaza, Paris, 1957, p. 10.
[9] Huiles Essentielles. Recueil de Normes françaises AFNOR, Paris, fourth ed., 1992.
[10] R.P. Adams, Identification of Essential Oils by Gas Chromatography/Quadrupole Mass Spectroscopy, Allured, Carol Stream, IL, 2001.
[11] D. Joulain, W.A. König, The Atlas of Spectral Data of Sesquiterpenes Hydrocarbons, E.B.-Verlag, Hamburg, 1998.