Acta Pharmaceutica Turcica
XXXX (4) 185-188 (1998)

ANALYSES OF THE ESSENTIAL OILS OF STEMS AND LEAVES OF *DIPLOLOPHIUM AFRICANUM* TURCZ. FROM CAMEROON

LEOPOLD JIROVETZ[1*], GERHARD BUCHBAUER[1], WILHELM FLEISCHHACKER[1], MARTIN B. NGASSOUM[2], S. YONKEU[3]

[1]Institute of Pharmaceutical Chemistry, University of Vienna, Althanstrasse 14, A-1090 Vienna, Austria
[2]Department of Applied Chemistry, University of Ngaoundere, BP 455, Ngaoundere,Cameroon
[3]Institute of Zootechnic and Veterinary Research, Wakwa Center, Ngaoundere, Cameroon

The essential oils of stems and leaves of Diplolophium africanum (Apiaceae, Umbelliferae) were analyzed by gas chromatographic-spectroscopic methods(GC/FID and GC/MS) to identify those compounds responsible for the use in local folk medicine as well as for the interesting odor of these oils. More than thirty constituents could be identified. Beta-phellandrene is the main compound of both essential oil samples. Further mono- and sesquiterpenes (e.g. alpha- and beta-pinene, beta-myrcene, para-mentha-1,3,8-triene and e.g. beta-caryophyllene) resp. hexane-derivatives are dominating in these essential oils. The effects of these constituents for the use in folk medicinal applications as well as their olfactoric properties are discussed.

Keywords: *Diplolophium africanum; Apiaceae; Essential oil compounds*

Introduction

The leaves *of Diplolophium africanum* (syn. *Cachrys abyssinica* Hochst. Ex A. Rich., Apiaceae, Umbelliferae; local name in baya language: ndoung ndoung resp. in boum language: dougma) are used in the folk medicine of Cameroon (1) as medicament against broncho-pneumonia (decoction) as well as externally as analgesic and rubefaciant for rheumatism or pain (juice). The insecticidal activity of this *Diplolophium* species is also described (2). Only two authors analyzed the compounds of *D. africanum* with the aim to find cons-tituents responsible for these insectividal effects(2) resp. for the inhibition of the growth of the rootlets of wheat (1,3). Some more papers (4-7) report on compounds of the much better known species *Diplolophium buchananii*. No informations were given until now on the volatiles, which probably have effects on humans by the above mentioned folk medicinal applications. Also no data are available on fragrance compounds of the essential oils of *Diplolophium africanum* responsible for the interesting odor of this plant material with a possible use in fine-perfumery resp. food flavouring.

Materials

Diplolophium africanum (Apiaceae) is an annual bushy herb growing in the savanah plateau of Adamaoua, Cameroon(8). The plant height ranges from 0.8 to 2.0 m. The leaves are linear and the fruits hairy(8,9). Fresh stems and leaves of *Diplolophium africanum* were collected in Ngaoundere (Cameroon) and the plant parts identified by Mr. Onana Jean Michel (Institute of Agronomic Research Yaounde) and a voucher specimen deposited at the National Herbarium of Yaounde (Cameroon)(Ref. 7044/SRFCAM). The essential oils were obtained by steam distillation of 1300 g fresh stems resp. 1920 g fresh leaves with a yield of 0.2% stem and 0.4% leaf oil.

After moistening a commercial odor strip (Dragoco Co. Austria) with some drops of each essential oil, the odor was evaluated by professional perfumers.

Medhods

Gas chromatography with Flame Ionization Detection (GC/FID)

The GC/FID analyses were carried out using a GC-14A with FID and the integrator C-R6A-Chromatopac (Shimadzu Co., Japan) resp. GC-3700 with FID (Varian Co., Germany) and the integrator C-R1B-Chromatopac (Shimadzu Co., Japan); carrier gas: hydrogen; injector-tempera-

ture: 250°C; detector-temperature: 320°C; temperature-program: 40°C/5 min. to 280°C/5 min. with a heating-rate of 6°C/min.; columns: 30 m x 0.32 mm bonded FSOT-RLS-200 fused silica (film thickness: 0.25 micron, Biorad Co., 3 m x Germany) and 30 m x 0.32 mm bonded Stabilwax (film thickness: 0.50 micron, Restek Co., USA); quantification by %-peak area calculations and compound identification partly by retention time correlations according to references(10,11).

Gas chromatography with Mass spectrometry (GC/MS)

For GC/MS measurements a GC-17A with a QP5000 (Shimadzu Co., Japan) and the data system Compaq-ProLinea (USA, class5k soft-ware); a GC-HP5890 with a HP5970-MSD (Hewlett-Packard Co., USA) and the PC-Pentium (Böhm Co., Austria, ChemStation software) resp. a GCQ (Finnigan - Spektronex Co., Germany-USA) with the Gateway-2000-PS75 data system (Siemens-Nixdorf Co., Germany, GCQ software) were used; carrier gas: helium; injector-temperature: 250°C; interface-heating: 300°C; ion source -heating: 200°C; El-mode; 70 eV; scan-range: 41-450 amu; other parameters see GC/FID part; mass spectra correlations with Wiley-, NBS-, NIST- and own library spectra.

Results and Discussion

The essential oils of *Diplolophium africanum* were olfactorically evaluated and their odor was described as spicy (direction of pepper, coriander and nutmeg), green-clear and pleasant-fresh for the essential oil of the stems and also spicy resp. green-clear for the essential oil of the leaves.

In accordance to these olfactoric results it was found that the investigated essential oil samples of *D. africanum* are of high interest for fine-perfumery (as possible pleasant, spicy top-note) as well as for food (as flavouring agent) applications. Considering this and the knowledge of the local folk medicinal use of the *Diplolophium* species, the essen-tial oils of stems and leaves were investigated by means of gas chromatographic-spectroscopic systems.

More than thirty constituents could be identified in the essential oil samples (see Table 1).

As the main compound of both analyzed essential oils beta-pheellandrene was found. Besides this component, further monoterpene hydrocarbons were identified in the essential oil of the stems, like alpha-pinene (9.5%), beta-myrcene (6.8%) and beta-pinene (3.1%) resp. in the essential oil of the leaves, like alpha-pinene(8.9%), beta-pinene (5.2%) and para-mentha-1,3,8-triene (2.7%), in higher concentrations (higher than 2%, calculated as %-peak area of GC/FID analyses).

In accordance with the published data (12-14) the analytical data can be correlated to the olfactoric data very well. The monoterpene hydrocarbons alpha-pinene, camphene and beta-pinene resp. the monotrepene alcohols linalool, borneol, alpha-terpineol and terpinen-4-ol were mentioned as main compounds in the essential oil of nutmeg therefore take part on the odor in this direction(12). Linalool (historic name "coriandrol"), borneol, pinenes, phellandrenes and gamma-terpinene are important constitutents of coriander oil (13) and they are essential for this odor note. Again monoterpene hydrocarbons as well as the sesquiterpene caryophyllene have odor notes is the direction of pepper (14) and can be correlated to the spicy-peppery odor impression.

The green odor note is the product of hexane-derivatives (especially 1-hexen-3-ol), while camphene, 1,8-cineole, fenchol and piperitone are monoterpenes with clear-fresh odor. As a result of this part of investigation it can be concluded that the essential oils of stems and leaves of *Diplolophium africanum* from Camero-on are dominated by especially monoterpenes with odor impressions responsible for the characteristic odor of this natural product. The analytical and olfactoric data

Table 1. Volatiles of the essential oils of stems [1] and leaves [2] of Diplolophium africunum from Cameroon

Compound+	[1]#	[2]
borneol	0.2	0.3
bronyl acetate	-	0.1
camphene	0.1	0.4
3-carene	0.1	-
beta-caryophyllene	1.1	1.0
beta-caryophyllene oxide	0.1	0.3
1,8-cineole	0.7	0.2
para-cymene	0.3	0.6
para-cymenene	-	0.2
elemol	-	0.1
alpha-eudesmol	-	0.1
beta-eudesmol	-	0.1
fenchol	0.1	0.2
germacrene-D	0.2	0.3
hexanol	0.3	0.6
1-hexen-3-ol	0.1	0.8
limonene	0.6	0.4
linalool	1.2	1.6
para-mentha-1,3,8-triene	0.5	2.7
beta-myrcene	6.8	0.2
cis-beta-ocimene	0.1	0.2
trans-beta-ocimene	0.2	0.5
alpha-phellandrene	0.4	0.7
beta-phellandrene	72.8	71.9
alpha-pinene	9.5	8.9
beta-pinene	3.1	5.2
piperitone	0.2	0.4
sabinene	0.1	0.4
gamma-terpinene	0.4	0.2
terpinen-4-ol	0.1	0.1
alpha-terpineol	0.1	0.2
alpha-thujene	0.1	0.3
alpha-thujone	-	0.2
verbenone	-	0.2
others	0.5	0.4

+in alphabetical order
#concentrations in %-peak area of GC/FID analysis

render these essential oils interesting for fine-perfumery and food-flavoring applications with spicy topnotes.

Although the insecticidal activity of the essential oil of leaves of *D. africanum* from Togo was certificated by biological testings (2) no information on single components responsible for these effects was given (only the non-volatile compound scoparone (3) was identified). In accordance with published data (15-17) the following compounds with insectici-

dal activity were identified in the essential oils of stems and leaves of *Diplolophium africanum*: camphene, 3-carene, 1,8-cineole, alpha-eudesmol, beta-eudesmol, limonene, beta - myrcene, terpinen - 4 - ol, cis - beta - ocimene, alpha - phellandrene, alpha-pinene and beta-pinene. The above mentioned single compounds show only weak insecticidal activity, but the combination of them may be responsible for the described use as an insecticide elsewhere(2).

For the folk medicinal application of *D. africanum* on broncho-pneumonia the expectorating effects of camphene, fenchol, pinene- and terpinene- derivatives, identified in the essential stem and leaf oils seems to play an important role (16).

The externally use of *Diplolophium africanum* as analgesic and rubefaciant for rheumatism and for pains can be correlated to spasmolytic effects of 1,8-cineole (18) and the better blood circulation by embrocation of camphene resp. pinene derivatives.

In conclusion we can report that especially monoterpenes are responsible for the pleasant odor as well as mainly for the folk medicinal use *of Diplolophium africanum* from Cameroon.

Acknowledgements

We acknowledge the olfactoric evaluation of the oils by Mr. V. Hausmann and Mr. W. Höppner (chief perfumers of Dragoco Co., Vienna, Austria), the vivid interest of their com-pany in this work as well as the financial support by the Austrian Bureau for International Affairs (stipendium for M.B. Ngassoum).

References

1. Watts, J.M., Breyer-Brandwijk, M.G.: The medicinal and the poisonous plants of Southern and Eastern Africa, 2nd Ed., 1037, Livingston, London, 1962
2. Koumaglo, K.H., Akpagana, K., Glitho, A.I., Garneau, F.-X., Gagnon, H., Jean, F.-I., Moudachirou, M., Addaeh-Mensah, I: J. Essent. Oil Res. 6, 449 (1994)
3. Van Puyvelde, L., De Kimpe, N., Ayobangira, F.-X., Costa, J., Nshimyumukiza, P., Boily, Y., Hakizamungu, E., Schamp, N.: J. Ethnopharmacol. 24, 233 (1988)
4. Lemmich, J., Havelund, S., Thastrup, O.: Phytochemistry 22, 553 (1983)
5. Lemmich, J.: Ibid. 38, 427 (1995)
6. Marston, A., Hostettmann, K., Msonthi, J.D.: J.Nat.Prod. 59, 128 (1995)
7. Zhao, W., Wang, Y.: Qingdao Daxue Xuebao, Gongcheng Jishuban 10, 1 (1995): cited in: Chem. Abstr. 124: 4941j (1996)
8. Hutchison, J., Dalziel, J.M.: Flora of West Africa, 2nd Ed., Vol. 1, Part 2, 755 Crown Agent Oversea Govts and Administr., London, UK 1958
9. Jacques-Felix, H.: Flore du Cameroun, Vol. 10, 60 Museum de Science Naturelle, Paris (1979)
10. Davies, N.W.: J. Chromatogr. 503, 1 (1990)
11. Jennings, W., Shibamoto, T.: Qualitative Analysis of Flavor and Fragrance Volatiles by Glass Capillary Gas Chromatography, Academic Press, New York 1980
12. Gildemeister, E., Hoffmann, Fr.: Macis-und MuskatnuBöl. (In): Die Ätherischen Öle (Treibs, W., Hrsg.) Band IV, 666 Akademie-Verlag, Berlin (1956)
13. Gildemeister, E., Hoffmann, Fr.: Corianderöl. (In) : Ibid. Band VI, 356 Akademie-Verlag, Berlin 1961
14. Ziegler, E.: Die Natürlichen und Künstlichen Aromen 85 Hüthig-Verlag, Heidelberg 1982
15. Rücker, G.: Dtsch.Apoth.Zgt. 113, 1291 (1973)
16. Schilcher, H.: Ibid. 124, 1433 (1984)
17. Teuscher, E., Lindequist, U.: Biogene Gifte, Akademie-Verlag, Berlin 1988
18. Gamez, M.J., Jimenez, J., Navarro, C., Zarzuelo, A.: Pharmazie 45, 69 (1990)

Accepted: 20.05.1998