*Phytochemistry*, Vol. 24, No. 10, pp. 2440–2442, 1985.
Printed in Great Britain.

0031–9422/85 $3.00 + 0.00


# ESSENTIAL OILS OF THREE ASIATIC *ARTEMISIA* SPECIES

CARLO BICCHI, CARLOTTA FRATTINI and TOMMASO SACCO*

Istituto di Chimica farmaceutica e tossicologica, Facoltà di Farmacia, Corso Raffaello 31, 10125 Torino, Italy; *Istituto Botanica Speciale Veterinaria, Orto Botanico, Torino, Italy

(*Revised received* 20 *February* 1985)

**Key Word Index**—*Artemisia glabella*; *A. rupestris*; *A. persica*; Compositae; essential oil; GC/MS analysis.

**Abstract**—The steam-distilled essential oils from the aerial parts of three Asiatic *Artemisia*, *A. glabella*, *A. rupestris* and *A. persica*, were analysed by GC/MS. In all about 100 compounds were identified; davanone is one of the main components of *A. persica*.

## INTRODUCTION

For several years we have been studying wild and cultivated *Artemisia* species, Compositae, Anthemideae [1–5]. The objective of the present study was to determine the identities of the volatile components of three Asiatic *Artemisia*, *A. glabella* Kar. et Kir., *A. rupestris* L. and *A. persica* Boiss., which are native to the mountains and steppes of Central and Western Asia. *A. rupestris* is known also in Europe (e.g. in the Baltic region and Germany) [6]. Seeds of these three *Artemisiae* were brought to Italy and plants were cultivated in the Botanical Garden of Turin university.

Numerous reports on essential oils of other *Artemisia* species, especially on those used in the flavour industry and for medicinal purposes, have been published; however, very little is known about the volatile components of these

Table 1. Constituents of the essential oil of *Artemisia glabella*

| Compound | % of oil | Compound | % of oil |
|---|---|---|---|
| α-Thujene | Trace | Carvacrol | 2.2 |
| α-Pinene | 1.0 | Benzyl butyrate | 0.4 |
| Camphene | 0.2 | 1-*p*-Menthen-9-ol | 0.7 |
| β-Pinene | 0.2 | Eugenol | 0.2 |
| Myrcene | Trace | α-Copaene | 1.4 |
| α-Phellandrene | 0.3 | Methyleugenol | 4.6 |
| α-Terpinene | 0.1 | 3,7-Dimethyloctyl acetate | 0.5 |
| *p*-Cymene | 0.6 | β-Caryophyllene | 1.6 |
| 1,8-Cineole | 8.6 | β-Sesquiphellandrene | 0.3 |
| γ-Terpinene | 0.3 | β-Cubebene | 1.1 |
| Terpinolene | 0.2 | Sabinyl propionate | 4.3 |
| Camphor | 1.1 | β-Farnesene | 1.0 |
| *trans*-Pinocarveol | 0.1 | $M_r$ 204 | 1.5 |
| Pinocarvone | 0.1 | Sabinyl butyrate | 8.2 |
| Benzyl acetate | Trace | $M_r$ 204 | 2.4 |
| Terpinen-4-ol | 2.1 | Farnesol | 1.3 |
| α-Terpineol | 2.5 | 1-Dodecanol | 1.1 |
| Myrtenol | 0.2 | $M_r$ 220 | 1.4 |
| Phellandral | 0.3 | Nerolidol | 1.8 |
| *cis*-Piperitol | 0.7 | Chamazulene | 0.3 |
| Cuminic aldehyde | 1.0 | *iso*-Butyl phthalate | 0.4 |
| *p*-Isopropil-phenol | 0.5 | $M_r$ 214 | 6.1 |
| *p*-Menth-2-en-7-ol | 1.6 | Hexadecanoic acid | 0.8 |
| 1,5-*p*-Menthadien-7-ol | 4.5 | Phytol | 1.1 |
| | | | 72.0 |

Table 2. Constituents of the essential oil of *Artemisia rupestris*

| Compound | % of oil | Compound | % of oil |
|---|---|---|---|
| α-Pinene | 1.1 | Artemone | 0.3 |
| Camphene | Trace | Citronellyl i-valerate | 0.7 |
| β-Pinene | 0.4 | Linalyl 3-methyl-butyrate | 1.0 |
| Myrcene | 1.6 | Davanone | 0.7 |
| *p*-Cymene | Trace | Guaiol | 1.2 |
| Limonene | 0.1 | $M_r$ 222 | 6.2 |
| 1,8-Cineole | 0.2 | $M_r$ 220 | 2.3 |
| 2-Methyl-butyl-2-methyl-butyrate | 0.4 | Bazzanenol | 2.0 |
| Borneol | 0.1 | $M_r$ 220 | 1.2 |
| Terpinen-4-ol | 0.3 | Tetradecanoic acid | 1.7 |
| α-Terpineol | 0.2 | *iso*-Butyl phthalate | 1.5 |
| Citronellol | 0.1 | 4.6.10-Trimethyl-2-pentadecanone | 1.1 |
| Bornyl acetate | 0.3 | 1-Hexadecanol | 18.1 |
| α-Terpinyl acetate | 0.8 | Pentadecanoic acid | 1.1 |
| Citronellyl acetate | 0.9 | Hexadecanoic acid | 11.2 |
| β-Elemene | 3.9 | 1-Octadecanol | 0.9 |
| β-Sesquiphellandrene | 0.7 | Phytol | 0.8 |
| α-Guaiene | 2.5 | Linoleic acid | 2.5 |
| β-Chamigrene | 1.8 | | |
| | | | 70.2 |

Table 3. Constituents of the essential oil of *Artemisia persica*

| Compound | % of oil | Compound | % of oil |
|---|---|---|---|
| 2-Methyl-1-butanol | 0.1 | *iso*-Amyl tigliate | 1.4 |
| Camphene | 3.3 | α-Terpinyl acetate | 1.6 |
| Sabinene | 1.8 | Unknown | 2.0 |
| α-Terpinene | 0.6 | β-Elemene | 0.8 |
| *p*-Cymene | 5.4 | *trans*-β-Farnesene | 0.4 |
| 1,8-Cineole | 26.6 | β-Phenylethyl-2-methylbutyrate | 0.6 |
| *cis*-3-Hexenyl butyrate | 0.6 | β-Phenylethyl *n*-valerate | 0.4 |
| *trans*-3-Hexenyl butyrate | 0.8 | Artemone | 6.7 |
| 2-Methylbutyl-2-methylbutyrate | 0.9 | β-Phenylethyl tigliate | 1.0 |
| *n*-Amyl-3-methylbutyrate | 0.4 | Davanone | 15.0 |
| *trans*-Pinocarveol | 0.4 | Hydroxydavanone | 1.2 |
| δ-Terpineol | 0.5 | Hydroxydavanone (isomer) | 0.9 |
| Terpinen-4-ol | 0.8 | *iso*-Butyl phthalate | 0.6 |
| Myrtenal | 0.4 | Hexadecanoic acid | 0.4 |
| α-Terpineol | 0.7 | | |
| Myrtenol | 0.3 | | |
| | | | 77.4 |

three *Artemisiae* [7, 8]. In a paper on monoterpene components of the genus *Artemisia* Stangl and Greger [9] analyzed three different samples of *A. persica*; the main components were artemisia ketone for the first sample; artemisia ketone, thujyl alcohol and camphor for the second and β-thujone for the third sample. Also the presence of sesquiterpene coumarin ethers in *A. persica* has been reported [10, 11].

## RESULTS AND DISCUSSION

The steam-distilled essential oils were analyzed by GC/MS. The yield in essential oil was 0.34% of the dried plant for *A. glabella*, 0.24% for *A. rupestris* and 0.40% for *A. persica*. The identification of each component was made by comparison of the mass spectra with a collection of literature spectra or with those of authentic samples, and was also checked against the $R_f$ value.

43 components were identified in *A. glabella* oil (totalling 72.0%), 33 in *A. rupestris* (70.2%) and 29 in *A. persica* (77.4%) (Tables 1–3). The components not identified were reported as 'unknown' or only with $M_r$ (when known), if they were more abundant than 1% of the oil. *iso*-Butyl phthalate which is present in little amounts in the three oils is probably an impurity. Chamazulene is responsible for the blue colour of the *A. glabella* oil and is probably an artefact formed during distillation, as well as β-elemene.

The major constituents of the essential oil of *A. persica*

are 1,8 cineole (26.6%) and davanone (15.0%). Davanone is reported to occur in one of the chemotypes of *Tanacetum vulgare* [12], in *A. pallens* [13, 14] and in *A. rehan* [15]. The presence in the oil of *A. persica* of a compound (6.7%) with a mass spectrum similar to that of davanone, but with a shorter GC $R_t$, which is in agreement with the data published by Naegely *et al.* [16] and the co-occurrence of artemone and davanone in the oil of *A. pallens* [13, 14] and of two davanone isomers (one probably being artemone) in *A. rehan* [15], led us to believe that this compound might be artemone.

## EXPERIMENTAL

*Artemisia rupestris* and *A. glabella* seeds were imported in 1979 from the Botanical Garden of the Kazakistan-S.S.R. Sciences Academy, 470032 Karaganda, U.S.S.R.; *A. persica* in 1980, from the Botanical Garden of the Uzbekistan-S.S.R. Sciences Academy, Ul. Dshachan Abidovi 272, Taschkent, Uzbekistan-S.S.R., U.S.S.R. Plants were cultivated in the Botanical Garden of Turin university: a voucher is deposited in the 'herbarium'. From each plant we had at our disposal 25 g of leaves and buds.

A previous distillation of 1 g from each sample was performed on a micro-scale apparatus, already described elsewhere [17]. The whole sample (*ca* 24 g) was then distilled for 2 hr in a modified Marcusson apparatus [18].

Essential oil (1.0 $\mu$l) dil 1/2500 in hexane was injected, using the on column technique, into a glass capillary column, PS 255, 25 m × 0.32 mm i.d., film thickness 0.3 $\mu$m, crosslinked. Temp. were prog from 50° to 200° at 3°/min. Carrier gas was $H_2$, flow rate 3 ml/min, with FID.

*Acknowledgements*—The authors are grateful to Prof. G. M. Nano, Director of the Institute of Chimica Farmaceutica e Tossicologica, for helpful discussion and advice.

## REFERENCES

1. Nano, G. M., Bicchi, C., Frattini, C. and Gallino, M. (1976) *Planta Med.* **30**, 211.
2. Frattini, C., Nano, G. M. and Bicchi, C. (1981) *Z. Lebensm.-Unters. Forsch.* **172**, 457.
3. Bicchi, C., Nano, G. M. and Frattini, C. (1982) *Z. Lebensm.-Unters. Forsch.* **175**, 182.
4. Sacco, T., Frattini, C. and Bicchi, C. (1983) *Planta Med.* **47**, 49.
5. Sacco, T., Frattini, C. and Bicchi, C. (1983) *Planta Med.* **48**, 129.
6. Tutin, T. G., Heywood, V. H., Burges, N. A., Valentine, D. M., Welters, S. M., Webb, D. A. (1976) *Flora Europea.* The University Press, Cambridge.
7. Gildemeister, E. and Hoffmann, F. (1961) *Die Aetherischen Öle*, 4th edn., Vol. VII, p. 733. Akademie Verlag, Berlin.
8. Poljakov, P. P. (1961) *Flora S.S.S.R.*, Vol. 26, pp. 506–508. Sciences Academy Edition, Moscow.
9. Stangl, R. and Greger, H. (1980) *Plant Syst. Evol.* **136**, 125.
10. Greger, H., Hofer, O. and Nikiforov, A. (1982) *J. Nat. Prod.* **45**, 455.
11. Hofer, O. and Greger, H. (1984) *Phytochemistry* **23**, 181.
12. Hethelyi, E., Tétényi, P., Kettenes-van den Bosch, J. J., Salemink, C. A., Herma, W., Versluis, C., Kloosterman, J. and Sipma, J. (1981) *Phytochemistry* **20**, 1847.
13. Baslas, K. K. (1967) *Perfum. Essent. Oil Rec.* 437.
14. Lewis, Y. S. and Nambudiri, E. S. (1967) *Perfum. Essent. Oil Rec.* 613.
15. Abegaz, B. and Yohannes, P. G. (1982) *Phytochemistry* **21**, 1791.
16. Naegeli, P., Klimes, J. and Weber, G. (1970) *Tetrahedron Letters* **57**, 5021.
17. Bicchi, C., D'Amato, A., Nano, G. M. and Frattini, C. (1983) *J. Chromatogr.* **279**, 409.
18. Kaiser, H. and Lang, W. (1951) *Deut. Apoth.-Ztg.* **175**, 163.