Chemistry of Natural Compounds, Vol. 45, No. 4, 2009

ESSENTIAL OILS FROM ROOTS OF CERTAIN *Heracleum* SPECIES

K. G. Tkachenko

UDC 633.81:582.893:547.913

The component composition of essential oils from roots of *Heracleum* L. (Apiaceae) has been mentioned rarely in the literature [1–6].

The composition and dynamics of the principal components of essential oils from roots of several introduced species of *Heracleum* were found in order to determine if the data could be used to resolve issues with the species systematics of this genus.

The *Heracleum* species that were studied were: *H. antasiaticum*, *H. asperum*, *H. calcareum* var. *colchicum*, *H. chorodanum*, *H. dissectum*, *H. dulce*, *H. lehmannianum*, *H. mandenovae*, *H. moellendorffii*, *H. pastinacifolium*, *H. ponticum*, *H. pubescens*, *H. roseum*, *H. sommieri*, *H. sosnowskyi*, *H. stevenii*, *H. trachyloma*, *H. wilhelmsii*, and *H. voroschilowii*. The range of the genus and sections was taken from the literature [7]. Plants were grown at the Experimental Station of the V. L. Komarov Botanical Institute, RAS Otradnoe (Leningrad Oblast′, Priozerskii Region).

Roots of the studied species were collected from growing specimens during budding (end of May to middle of June) and at the end of vegetation (end of September to October).

Essential oils were obtained from freshly collected raw material under laboratory conditions by the standard steam-distillation method [8].

Studies of the component composition of essential oils by GC and GC/MS have been described in detail in our previous publications, where the retention indices for identified compounds and principal peaks of experimental mass spectra are also given [2, 9, 10].

Table 1 gives the maximum content of essential oil in roots of various *Heracleum* species.

The results show that the essential oil content in roots of various *Heracleum* species varied from 0.1 to 1.0%. Species of the *Pubescentia* section had the greatest accumulations.

Table 1 also lists the component composition of essential oils from roots of certain species from various sections of the genus *Heracleum*.

Table 2 shows that species from various sections of the genus have rather similar component compositions for essential oils from roots. Esters, terpenes, and sesquiterpenes dominate the essential-oil compositions. Species within a single section have similar compositions. Differences between species and sections are quantitative at both the principal level (α-pinene, β-pinene, myrcene, ocimene, octylacetate, *trans*-alloocimene) and at the level of minor components (octanol, γ-terpinene, terpinen-4-ol, etc.).

Table 3 gives data for the change of component composition of essential oils from roots of certain species at the beginning and end of vegetation.

The results show that essential oil from roots of a single species obtained at different vegetation phases differs in the ratio of components. Certain components such as α- and β-pinene, camphene, myrcene, limonene, ocimene, and octylacetate were found in all studied essential oils from *Heracleum* roots. Several components in essential oil of *Heracleum* roots were found only at the beginning of vegetation; others, only in specimens obtained in fall, e.g., α-terpinene, terpinolene, hexylbutyrate, and certain unidentified terpenes. Essential oil of each species contained common compounds and a unique set of components, the content of which varied depending on the vegetation phase.

V. L. Komarov Botanical Institute, Russian Academy of Sciences, 197376, St. Petersburg, Russia, fax: 7812 346 36 43, e-mail: kigatka@rambler.ru. Translated from Khimiya Prirodnykh Soedinenii, No. 4, pp. 487–489, July–August, 2009. Original article submitted January 12, 2009.

 0009-3130/09/4504-0578

TABLE 1. Maximum Yield of Essential Oil from Roots of *Heracleum* L. Species Grown in Leningrad Oblast′

Plant species	Yield, %
Subgenus *Heracleum,* section *Heracleum*	
H. calcareum Albov var. *colhicum* (Lipsky) Satzyperova	0.1
H. dissectum Ledeb.	0.5
H. mandenovae Satzyperova	0.3
H. moellendorffii Hance	0.4
H. ponticum (Lipsky) Schischk.	0.6
H. voroschilowii Gorovoi	0.3
Section *Pubescentia* Manden.	
H. pubescens (Hoffm.) Bieb.	0.5
H. sommieri Manden.	0.5
H. sosnowskyi Manden.	1.0
H. trachyloma Fisch. et Mey.	0.5
H. wilhelmsii Fisch. et Ave-Lall.	0.6
Section *Villosa* Manden.	
H. antasiaticum Manden.	0.2
H. stevenii Manden.	0.3
Subgenus *Wendia* (Hoffm.) Satzyperova, Section *Wendia* (Hoffm.) Satzyperova	
H. chorodanum (Hoffm.) DC.	0.1
H. pastinacifolium C. Koch	0.2
H. roseum Stev.	0.2

TABLE 2. Composition of Essential Oils from Roots of Certain *Heracleum* L. Species

Compound	1	2	3	4	5	6	7
α-Thujone	Tr.	–	Tr.	–	0.1	Tr.	0.8
Sabinene	Tr.	0.3	0.1	Tr.	Tr.	–	–
α-Pinene	2.8	4.4	4.5	6.3	2.8	2.3	12.6
β-Pinene	18.1	23.0	23.9	39.0	6.4	7.8	3.9
Camphene	0.9	1.2	Tr.	Tr.	Tr.	0.8	1.1
Myrcene	1.8	3.1	7.9	8.2	0.4	12.5	Tr.
Octanal	Tr.	Tr.	Tr.	0.2	0.3	0.8	0.9
Limonene	2.0	2.8	0.6	Tr.	2.2	4.8	Tr.
p-Cymene	0.9	Tr.	0.7	Tr.	1.1	0.9	0.3
Octanol	–	–	–	–	0.1	Tr.	0.2
α-Terpinene	1.7	2.0	2.3	5.5	Tr.	1.4	4.4
Ocimene	23.2	20.0	19.7	10.9	14.5	13.4	13.7
γ-Terpinene	–	–	6.2	7.7	3.6	Tr.	5.3
Terpinolene	0.3	0.1	4.4	2.8	Tr.	3.3	Tr.
Anethol	2.1	2.7	–	–	Tr.	Tr.	–
Hexylbutyrate	0.3	0.5	0.2	Tr.	–	Tr.	Tr.
Octylacetate	1.7	0.8	0.3	Tr.	9.9	14.7	13.1
Octylisobutyrate	–	–	Tr.	Tr.	9.8	12.2	14.7
Octylbutyrate	Tr.	Tr.	–	–	Tr.	0.2	–
trans-Alloocimene	28.0	22.5	–	–	0.9	Tr.	0.8
$C_{10}H_{16}$	3.9	3.9	Tr.	Tr.	–	1.1	0.7
cis-Alloocimene	2.9	2.7	0.8	0.6	4.9	5.3	6.6
Octyl-4-methylvalerate	–	–	Tr.	–	0.5	0.2	0.4
Terpinen-4-ol	–	–	4.2	3.0	Tr.	–	2.1
$C_{15}H_{25}OH$	4.9	4.2	–	–	0.8	–	0.3
$C_{15}H_{24}$	1.3	–	–	1.9	1.1	0.8	4.3
$C_{15}H_{24}$	–	1.2	0.4	–	1.0	0.9	0.8
$C_{15}H_{24}$	–	–	2.3	1.8	–	–	–
$C_{11}H_{12}O$ or $C_{12}H_{16}O_3$	3.4	4.4	–	–	Tr.	0.4	0.3

1, *H. mandenovae*; 2, *H. voroschilowii*; 3, *H. pubescens*; 4, *H. wilhelmsii*; 5, *H. chorodanum*; 6, *H. pastinacifolium*; 7, *H. roseum*. Here and henceforth components are given in the order of increasing retention time; a dash denotes the component is absent; Tr., trace quantities with content <0.1%.

TABLE 3. Composition of Essential Oils from Roots of Certain *Heracleum* L. Species During Budding (A) and at the End of Vegetation (B)

Compound	*H. lehmannianum*		*H. ponticum*		*H. stevenii*		*H. asperum*	*H. calcareum* var. *colhicum*	*H. dulce*
	A	B	A	B	A	B	B	B	B
α-Thujone	–	–	–	–	0.8	6.1	0.1	–	2.9
Sabinene	Tr.	0.7	0.3	Tr.	1.6	0.2	Tr.	–	–
α-Pinene	3.8	4.4	4.5	6.3	1.4	3.2	2.8	2.3	12.6
β-Pinene	17.6	21.0	23.1	36.0	0.4	0.1	22.4	17.8	33.9
Camphene	0.9	1.2	Tr.	Tr.	0.2	0.1	Tr.	0.8	1.1
Myrcene	1.8	3.1	7.9	8.2	6.8	8.9	0.4	12.5	Tr.
Octanal	–	–	–	–	1.5	1.5	–	0.8	Tr.
Limonene	2.0	2.8	0.6	Tr.	19.4	20.0	2.2	4.8	Tr.
p-Cymene	0.9	Tr.	0.7	Tr.	–	–	1.1	0.9	Tr.
Octanol	–	–	–	–	Tr.	Tr.	0.1	Tr.	0.2
α-Terpinene	0.7	–	6.3	8.5	–	–	Tr.	1.2	4.5
Ocimene	20.1	24.0	18.9	12.0	1.3	3.4	4.5	3.3	3.1
γ-Terpinene	–	–	6.2	7.7	–	–	3.6	Tr.	5.3
Terpinolene	0.3	–	4.4	2.8	Tr.	Tr.	Tr.	3.3	Tr.
Anethol	2.1	2.7	–	–	–	–	Tr.	Tr.	–
Hexylbutyrate	0.3	–	0.2	Tr.	0.1	0.2	–	Tr.	Tr.
Octylacetate	1.7	0.8	2.1	Tr.	33.0	35.0	Tr.	14.7	3.1
Octylisobutyrate	–	–	–	–	1.9	2.4	Tr.	2.2	4.7
Octylbutyrate	–	–	–	–	Tr.	–	Tr.	0.2	–
Octylhexanoate	–	–	–	–	10.3	12.0	–	–	Tr.
trans-Alloocimene	24.7	26.0	–	–	–	–	–	Tr.	7.8
$C_{10}H_{16}$	3.1	3.4	–	–	–	–	–	1.1	2.7
cis-Alloocimene	1.9	2.3	0.8	0.6	–	–	–	5.3	6.6
Octyl-4-methylvalerate	–	–	–	–	0.1	0.3	0.5	0.2	–
Octyloctanoate	–	–	–	–	15.8	18.0	–	–	–
Terpinen-4-ol	0.2	–	4.2	3.0	–	–	Tr.	–	2.1
$C_{15}H_{25}OH$	4.9	4.2	–	–	–	–	0.8	–	0.3
$C_{15}H_{24}$	1.3	–	1.9	–	–	–	1.1	0.8	4.3
$C_{15}H_{24}$	3.4	3.9	2.1	0.8	–	–	Tr.	4.2	–
$C_{15}H_{24}$	2.9	1.6	–	–	–	–	0.2	Tr.	–
$C_{15}H_{24}$	0.9	1.1	–	–	–	–	0.8	–	1.2
$C_{15}H_{24}$	1.2	–	3.4	–	–	–	1.0	–	–
$C_{15}H_{24}$	–	–	2.3	1.8	–	–	–	–	2.0
$C_{11}H_{12}O$ or $C_{12}H_{16}O_3$	3.1	0.4	0.4	–	–	–	Tr.	0.9	0.3
$C_{11}H_{12}O$ or $C_{12}H_{16}O_3$	1.2	–	3.9	4.1	–	–	Tr.	–	2.3

ACKNOWLEDGMENT

Autor thanks Candidate of Chemical Sciences I. A. Tsibul′skaya and Doctor of Chemical Sciences Prof. I. G. Zenkevich (St. Petersburg State Univ.) for assistance with the equipment, consultations, and valuable advice.

REFERENCES

1. K. G. Tkachenko, in: *Materials of the International Scientific Conference "Botanical Science for Stable Development of Central Asian Countries,"* Almaty, 2003, pp. 179-180.
2. K. G. Tkachenko and I. G. Zenkevich, *Rastit. Resur.*, **23**, 1, 87 (1987).
3. K. G. Tkachenko, L. M. Pokrovskii, and A. V. Tkachev, *Rastit. Resur.*, **37**, 3, 72 (2001).
4. K. G. Tkachenko, *J. Essent. Oil Res.*, **6**, 5, 535 (1994).

5. F. Mojab and B. Nickavar, *Iran. J. Pharm. Res.*, **2**, 4, 245 (2003).
6. C. Zhang, B. Zhang, and X. Yang, *Zhongyao Yanjiu Yu Xinxi*, **7**, 12, 9 (2005).
7. I. F. Satsyperova, *Cow-parsnips of the USSR Flora, New Fodder Plants* [in Russian], Nauka, Leningrad, 1984.
8. *USSR State Pharmacopoeia*, XIth Ed., No. 1, Meditsina, Moscow, 1989.
9. K. G. Tkachenko and I. G. Zenkevich, *Rastit. Resur.*, **23**, 2, 225 (1987).
10. K. G. Tkachenko and I. G. Zenkevich, *J. Essent. Oil Res.*, **5**, 4, 227 (1993).