Chemistry of Natural Compounds, Vol. 44, No. 2, 2008

EFFECT OF DISTILLATION METHODS AND HARVESTING TIMES ON THE ESSENTIAL OIL AND CINEOLE CONTENT OF *Eucalyptus dealbata*

F. Sefidkon,[1] A. Bahmanzadegan,[2] and M. H. Assareh[1]

UDC 547.913

There are over 700 different species of *Eucalyptus* in the world, of which at least 500 produce a type of essential oil. The leaves and oils of many *Eucalyptus* species are especially used for respiratory aliments such as bronchitis and croup [1-4], and the dried leaves are smoked like tobacco for asthma in some countries. Some of the *Eucalyptus* species are also used for feverish conditions (malaria, typhoid, cholera, etc.) and skin problems like burns, ulcers, and wounds [5]. Aqueous extracts are used for aching joints, bacterial dysentery, ringworms, tuberculosis, etc. and employed for similar reasons in western and eastern medicine. The *Eucalyptus* oils and their main component (1,8-cineole) are largely employed in the preparation of liniments, inhalants, cough syrups, ointments, toothpaste, and pharmaceutical flavorings. They are also used in veterinary practice and dentistry, and as fragrance components in soaps, detergents, and toiletries, but are little used in perfumes. The oils of *Eucalyptus* species have also antioxidant properties [6] and anti-inflammatory effects [7].

Due to these various uses of *Eucalyptus* species or their essential oils, and because of the importance of 1,8-cineol in these oils, we were interested in studying the essential oil content and composition of *E. dealbata* in different seasons using different methods of distillation for finding the best harvesting time and distillation method to obtain better quantity and quality of the oil (more oil yield and higher percentage of cineol).

There appears to be a seasonal variation in the concentration of cineole in the two *Eucalyptus* species. There was a general decrease in the percentage of cineole in the oils of *Eucalyptus polybractea* and *E. viridis* during the winter months [8]. Investigations showed that seasonal variation in cineole production of the *E. kochii* and *E. plenissima* was only slight, meaning that the time of harvesting was not important although in plantations it might need to be done at the optimum time for regeneration [9]. Study of seasonal variation in the composition of essential oil of *E. camaldulensis* in Pakistan showed that the major compound was 1,8-cineole (47.7-52.6%). The oil yield was minimum in April (0.97%) and maximum in October (1.25%) [10].

There are many other references on changes in the oil content and composition of *Eucalyptus* species in different countries [11-14].

In this paper, in addition to studying the seasonal changes in the essential oil and cineol content of *E. dealbata*, the effect of different distillation methods on quantity and quality of the oil was investigated. The chemical composition of the oil of *E. dealbata* in different seasons can be seen in Table 1.

The effect of different distillation methods on the oil content and composition of aromatic plants has also been reported previously. The rose-scented geranium (*Pelargonium* sp.) was processed by various distillation methods, which revealed that water distillation of the herb gave a higher oil yield (0.16-0.22%) than the water-steam distillation (0.09-0.12%) and steam distillation methods (0.06-0.18%) (Table 2). The distillation methods had also an effect on the percentage of oil components [15].

The effect of method and time of distillation on the essential oil yield and composition of *Eucalyptus globules* was also studied. With time, distillation resulted in increasing the yield and reducing the cineol content. 1,8-Cineol (74.8-82.2%), α-pinene (6.28-7.70%), and limonene (5.70-6.20%) in the steam distillation method and 1,8-cineol (85.60-92.70%), α-pinene (2.02-2.37%), and limonene (2.04-3.10%) in the hydrodistillation method were the major constituents, respectively [16].

1) Research Institute of Forests and Rangelands, P.O. Box: 13185-116, Tehran, Iran; 2) Department of Phytochemistry, Medicinal Plants and Drugs Research Institute, Shahid Beheshti University, P. O. Box: 19835-389, Evin, Tehran, Iran. Published in Khimiya Prirodnykh Soedinenii, No. 2, pp. 197-199, March-April, 2008. Original article submitted December 14, 2006.

 0009-3130/08/4402-0250

TABLE 1. Essential Oil Composition of *Eucalyptus dealbata* in Different Seasons

Compound	RI	Spring	Summer	Autumn	Winter
α-Thujene	930	0.5	-	-	-
α-Pinene	935	**11.4**	**23.5**	**16.3**	**10.1**
Camphene	951	-	0.1	Tr.	Tr.
Sabinene	973	0.4	0.8	0.4	-
β-Pinene	976	-	Tr.	Tr.	0.3
Myrcene	987	0.5	0.4	-	-
α-Phellandrene	1002	1.2	0.1	-	-
p-Cymene	1023	7.0	Tr.	Tr.	1.3
Limonene	1027	0.5	0.4	0.5	0.5
1,8-Cineol	1030	**59.4**	**54.9**	**68.9**	**70.0**
γ-Terpinene	1059	0.4	0.4	Tr.	-
Terpinolene	1085	0.8	0.2	0.2	-
endo-Fenchol	1110	-	0.1	0.1	0.1
α-Campholenal	1122	-	Tr.	-	0.1
trans-Pinocarveol	1136	2.0	1.5	3.2	5.4
Pinocarvone	1160	0.7	0.1	1.0	2.1
Borneol	1163	-	0.2	-	0.2
Terpinen-4-ol	1174	1.6	0.9	0.7	0.2
p-Cymen-8-ol	1182	-	0.2	0.8	-
Cryptone	1184	1.8	-	-	-
α-Terpineol	1187	0.9	0.7	0.3	0.4
trans-p-Mentha-1(7),8-dien-2-ol	1189	-	-	0.1	0.7
Myrtenol	1194	-	Tr.	0.2	0.2
trans-Carveol	1217	-	Tr.	-	-
cis-p-Mentha-1(7),8-dien-2-ol	1230	-	-	0.1	0.7
Geranyl acetate	1384	-	-	0.1	0.3
α-Guaiene	1435	0.9	0.3	0.2	1.6
Aromadendrene	1444	-	1.6	0.9	-
allo-Aromadendrene	1461	-	0.1	0.4	0.5
Bicycogermacrene	1490	1.0	0.1	-	-
Elemol	1556	-	0.2	0.2	-
Epiglobul	1562	-	0.4	-	-
Spathulenol	1572	3.1	0.1	1.8	0.4
Globulol	1578	2.3	2.2	0.9	2.3
Veridioflorol	1585	-	0.6	Tr.	0.6
γ-Eudesmol	1627	-	0.1	-	-
β-Eudesmol	1640	2.2	3.1	0.3	0.5
α-Eudesmol	1653	1.6	1.2	Tr.	-
Oil yield (w/w)*		1.25	1.97[a]	1.40	1.53

_____

Tr.: trace < 0.09.

RI: Retention indices in elution order from DB-5 column.

*Hydrodistillation.

[a]Water and steam distillation, 0.50; Steam distillation. 0.16.

TABLE 2. Essential Oil Composition of *Eucalyptus dealbata* Obtained by Different Methods of Distillation

Compound	RI	Hydrodistillation	Water and Steam distillation	Steam distillation
α-Thujene	930	-	1.6	-
α-Pinene	940	**23.5**	**15.3**	**15.1**
Camphene	953	0.1	Tr.	Tr.
Sabinene	975	0.8	0.8	0.8
β-Pinene	976	Tr.	0.6	Tr.
Myrcene	989	0.4	1.5	0.6
α-Phellandrene	997	0.1	-	-
p-Cymene	1023	Tr.	1.3	Tr.
Limonene	1030	0.5	0.4	0.4
1,8-Cineol	1033	**54.9**	**41.8**	**38.4**
γ-Terpinene	1066	0.4	0.5	0.8
Terpinolene	1077	0.2	0.1	0.1
endo-Fenchol	1105	0.1	0.1	0.3
α-Campholenal	1118	Tr.	-	0.1
trans-Pinocarveol	1137	1.5	0.2	0.9
Pinocarvone	1154	0.1	0.1	0.1
Borneol	1162	0.2	-	0.2
Terpinen-4-ol	1174	0.9	0.4	0.6
p-Cymen-8-ol	1181	0. 2	0.2	-
α-Terpineol	1187	0.7	0.1	0.4
Myrtenol	1190	Tr.	Tr.	Tr.
trans-Carveol	1217	Tr.	0.5	Tr.
Geranyl acetate	1384	-	0.4	0.2
Aromadendrene	1431	1.6	2.1	5.3
α-Guaiene	1435	0.3	1.0	0.2
allo-Aromadendrene	1462	0.1	1.5	2.1
Bicycogermacrene	1494	0.1	0.2	0.6
Elemol	1557	0.2	0.2	0.4
Epiglobul	1562	0.4	0.3	1.0
Spathulenol	1572	0.1	0.2	0.3
Globulol	1585	**2.2**	**11.5**	**6.0**
Veridioflorol	1591	0.6	2.7	1.4
γ-Eudesmol	1627	0.1	0.3	0.8
β-Eudesmol	1642	3.1	1.9	3.6
α-Eudesmol	1653	**1.2**	**1.1**	**12.5**
Dihydroeudesmol	1658	-	0.2	2.0

RI: Retention indices in elution order from DB-5 column.

REFERENCES

1. P. Kaspar, R. Repges, U. Dethlefsen, and W. Petro, *Atemw-Lungenkrkh.*, **20**, 605 (1994).
2. M. Wittman, W. Petro, P. Kaspar, R. Repges, and U. Dethlesten, *Atemw-Lungenkrkh.*, **24**, 67 (1998).
3. D. H. Mahlo, *Therapiewoche*, **40**, 3157 (1990).
4. U. R. Juergens, M. Stober, and H. Vetter, *Atemw-Lungenkrkh.*, **24**, 3 (1998).
5. J. E. F. Reynolds, A. B. Prasad (editors Martindle), *The Exta Pharmacopoiea*, 1982, 28th edn., London, Pharmaceutical Press, p. 1017.

6. J. Grafsmann, S. Hippeli, K. Dornisch, U. Rohnert, N. Beuscher, and E. F. Elstner, *Arzneim Forsch/Drug Res.*, **50**, 135 (2000).
7. U. R. Juergens, U. Dethlefsen, G. Steinkamp, A. Gillissen, R. Repges, and H. Vetter, *Respir. Med.*, **97**, 250 (2003).
8. D. G. Ammon, D. A. Clarke, and J. Tjandra, *Analyst,* **110**, 921 (1985).
9. M. I. H. Brooker, A. F. M. Barton, B. A. Rockel, and J. Tjandra, *Austr. J. Bot.*, **36**, 119 (1988).
10. R. Muhammad and F. M. Chaudhary, *Pak. J. Sci. Ind. Res*., **42**(5) 282 (1999).
11. J. Doran, B. Caruhapattana, S. Namsavat, and J. J. Brophy, *J. Essent. Oil Res*., **7**, 627 (1995).
12. H. Congrong, F. Murray, and T. Lyons, *Chemosphere: Global Change Sci.*, **2**, 65 (2000).
13. A. M. Abou-Dahab and E. N. Abou-Zeid, *Egypt. J. Bot.*, **16**, 345 (1974).
14. D. Tsiri, O. Kretsi, I. B. Chinou, and C. G. Spyropoulos, *Flavour Fragrance J.*, **18**, 244 (2003).
15. G. D. Kiran, V. Babu, and K. Kaul, *Flavour Fragance J.,* **19**, 196 (2004).
16. M. M. Barazandeh, *Iranian J. Med. Arom. Plants Res.*, **21**, 75 (2005).