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Analysis of the Essential Oil from the Flower of *Polygonum bistorta* L. subsp. *carneum* (Koch)

NAGIHAN YILMAZ ISKENDER, CANAN ALBAY GÜLEÇ, MURAT YÜCEL, KADRIYE SINEK and NURETTIN YAYLI*

Department of Chemistry, Faculty of Arts and Sciences, Karadeniz Technical University, 61080 Trabzon, Turkey

*Corresponding author: Fax: +90 462 3253196; Tel: +90 462 3772486; E-mail: yayli@ktu.edu.tr

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The composition of the volatile oil obtained from the flower of *Polygonum bistorta* L. subsp. *carneum* (Koch) Coode and Cull grown in Turkey was analyzed by GC-FID and GC-MS. Total 44 compounds were identified in the essential oil of the flower from *P. bistorta* subsp. *carneum*. Hydrocarbons were shown to be the main group of constituents (54.5 %). The major components of the oils of *P. bistorta* subsp. *carneum* were tricosane (21.3 %), hexacosane (14.0 %), hexadecanoic acid (13.2 %), heneicosane (7.7 %) and lavandulol (6.1 %). Terpenoids were the minor constituents (14.0 %, 14 compounds out of 44 components) in the oil of the *P. bistorta* subsp. *carneum*.

Key Words: *Polygonum bistorta* L. subsp. *carneum*, Essential oil, GC-FID, GC-MS.

INTRODUCTION

The genus *Polygonum* L. (Polygonaceae) is represented with 38 species, nine of them is endemics, in Turkey[1-3]. Some species such as *P. alpinum* All. are consumed as food in Anatolia and the aerial parts of *P. aviculare* are used for staining folk clothes and carpet[4]. *P. bistorta* is represented with two subsp. in Turkey[1-3]. It is a perennial Euro Siberian elements and mainly distributed in alpine meadows of Europe, Siberia and N.E. Iran and Turkey[1-3]. Their root is used as Builder relieves constipation and blood in Anatolian folk medicine[4].

The chemical composition of the essential oils of some *Polygonum* L. genus included *P. alpinum* L., *P. cuspidatum*, *P. odoratum* Lourand *P. hydropiper* Opiz[5-11]. The major components of the oils of *P. alpinum* were ethyl hexadecanoate (flower: 11.7 %, leaf: 15.0 %, stem: 21.1 %), methyl linoleate (flower: 30.7 %, leaf: 11.7 %, stem: 36.7 %) and ethyl linoleate (leaf: 25.8 %, stem: 14.7 %)[5]. The main components in the oil of *P. cuspidatum* were thiophenes (38.1 %), phenanthrenes (4.8 %), fluorenes (3.8 %), biphenyls (3.5 %), anthracenes (2.9 %) and naphthalenes (2.3 %)[6]. The essential oil of *P. odoratum* reveled decanal (27.7 %), dodecanal (44.1 %) and decanol (10.9 %) were the main compounds[7]. Four diffrent studies had shown the main components of *P. hydropiper* were (Z)-3-hexenal, (Z)-3-hexenol, decanal, undecanal, dodecanal, 3-sulfanyl-hexanal, 3-sulfanyl-hexan-1-ol[8]; (E)-β-farnesene (35.7 %), (E)-caryophyllene (9.2 %), (E)-nerolidol (6.9 %) and α-humulene (5.9 %)[9]; (E)-β-farnesene (44.1 %), phytol (10.8 %), (E)-caryophyllene (9.3 %) and (E)-nerolidol (6.9 %)[10]; dodecanal (3-40 %), (E)-2-hexenal (20-35 %), decanal (4-22 %), (Z)-3-hexen-1-ol (4-31 %), hexanal (1.7-5.1 %) and β-caryophyllene (1.7-2.3 %)[11].

Previous study on the evaluation of phenolic profiles and antioxidant activities of *P. bistorta* roots has already been reported[12]. However, the chemical composition of the volatile oil from the flower of *P. bistorta* subsp. *carneum* has not yet been investigated. The crude volatiles were analyzed by GC-FID and GC-MS technique[13-22]. The identification of the substances was performed by comparison of retention indexes on HB-5 column (determined relatively to the retention times of a series of *n*-alkanes), authentic compounds and mass spectra with literature (Nist and Wiley)[13-22]. Therefore, the objective of the present study is to examine the chemical composition of the essential oil from the flower of *P. bistorta* subsp. *carneum* by GC-MS.

EXPERIMENTAL

Polygonum bistorta L. subsp. *carneum* (Koch) Coode and Cullen (Polygonaceae) was collected in July 2009 from Demirkapi village, Uzungöl, Trabzon (at heights of *ca.* 2380 m) in the northeastern part of Turkey. The plant was authenticated by Terzioglu[1-3]. Voucher specimen was deposited in the Herbarium of the Faculty of Forestry, KATO (KATO-11835), Karadeniz Technical University, Turkey.

Isolation of the essential oils: The flower was separated form the fresh plant and then grounded into small pieces. The essential oil from flower (70 g) of *P. bistorta* subsp. *carneum* was isolated by hydrodistillation in a Clevenger-type apparatus with cooling bath (-15 ºC) system (4 h) (yields: 0.12 %). The obtained oil was extracted with HPLC grade *n*-hexane (0.5 mL)

and dried over anhydrous sodium sulphate and stored at 4-6 ºC in a sealed brown vial.

Gas chromatography (GC) and gas chromatography-mass spectrometry (GC-MS) analysis: GC-FID and GC-MS analyses were done as described previously[5].

Identification of compounds: Retention indices of all the components were determined by Kovats method using *n*-alkanes (C_6-C_{32}) as standards. The identification of the GC peaks corresponding to the components of the essential oil was based on direct comparison of the retention times and mass spectral data with those for standard compounds (α-pinene, β-pinene, α-terpinene, limonene, α-terpineol, dodecane, tridecane, tetradecane, pentadecane, hexadecane, heptadecane, nonadecane, heneicosane, docosane, tricosane, tetracosane, pentacosane and hexacosane), computer matching with the Nist and Wiley library and by comparison of the fragmentation patterns of the mass spectra with those reported in the literature[12-23].

RESULTS AND DISCUSSION

Volatile components obtained by hydrodistillation from the flower of *P. bistorta* subsp. *carneum* growing in Turkey was analyzed by GC and GC/MS with HP-5 column. The compositions of the essential oil of the flower of *P. bistorta* subsp. *carneum* are listed in Table-1. The volatile oil content of *P. bistorta* subsp. *carneum* was 0.12 % (v/w) and led to identification of 44 components, representing 95.3 % of the total oil (Table-1). The main components of the oil were tricosane (21.3 %), hexacosane (14.0 %), hexadecanoic acid (13.2 %), heneicosane (7.7 %), lavandulol (6.1 %, tetracosane (5.2 %), nonanal (3.3 %) and farnesane (2.2 %). Terpenoids (14.0 %) were the third major constituents in the oil.

In the literature, volatile constituents of *P. alpinum* revealed esters (flower: 46.2 %, leaf: 59.1 %, stem: 82.5 %) and hydrocarbons (flower: 35.9 %, leaf: 12.9 %, stem: 1.0 %) were the major components[5]. The main components in the oil of *P. cuspidatum* were thiophenes and aromatic hydrocarbons[6]. The essential oil of *P. odoratum* revealed aldehydes and alcohols were the main compounds[7,11]. Four different studies had shown the main compounds of *P. hydropiper* were aldehydes[8] and terpenoids[9,10]. In present case, the essential oil from the flower of *P. bistorta* subsp. *carneum* revealed ester as major components.

In general, the distribution and accumulation of many compounds in the volatile oil of *P. bistorta* subsp. *carneum* are shown (Table-2) to be considerably different in other *Polygonum* species. It is obvious from this study that the chemical composition of *P. bistorta* subsp. *carneum* demonstrates a great degree of hydrocarbons and carboxylic acid as in the other *Polygonum* species (Table-2). The compositions of the essential oils vary greatly in parts, genetic factors, environmental conditions and geographical origins.

TABLE-1
IDENTIFIED COMPONENTS IN THE ESSENTIAL OIL FROM THE FLOWER OF *P. bistorta* subsp. *carneum*

Compounds	Area[a] (%)	Exp. RI[b]	Lit. RI
α-Pinene[c]	1.1	940	939
β-Pinene[c]	0.8	979	979
2-pentyl furan	0.1	995	998
α-Terpinene[c]	0.3	1015	1017
o-Cymene	0.2	1026	1026
Limonene[c]	0.6	1030	1029
1-Undecene	1.2	1089	1093
Nonanal	3.3	1098	1101
Lavandulol	6.1	1181	1181
α-Terpineol[c]	0.3	1192	1189
Dodecane[c]	0.2	1200	1200
Tridecane[c]	0.4	1300	1300
2E,4E-decadienal	0.8	1321	1317
Tetradecane[c]	1.0	1400	1400
E-Caryophyllene	0.5	1420	1419
Farnesane	2.2	1465	1462
ar-Curcumene	0.2	1483	1481
γ-Curcumene	0.3	1485	1483
Pentadecane[c]	0.2	1501	1500
E,E-α-Farnesene	0.5	1509	1506
Methyl dodecanoate	0.4	1523	1526
trans-Calamenene	0.2	1528	1529
Dodecanoic acid	0.4	1565	1567
Ethyl dodecanoate	0.3	1598	1595
Hexadecane[c]	0.3	1601	1600
Methyl tridecanoate	0.5	1633	1631
Heptadecane[c]	0.4	1702	1700
Methyl tetradecanoate	0.3	1725	1724
Tetradecanoic acid	2.7	1785	1782
Hexahydrofarnesyl acetone	0.7	1847	1847
Nonadecane[c]	0.8	1902	1900
Methyl hexadecanoate	1.2	1922	1922
Hexadecanoic acid	13.2	1984	1984
Methyl linoleate	1.6	2095	2096
Heneicosane[c]	7.7	2099	2100
Methyl-9-octadecenoate	0.2	2116	2116
Methyl octadecanoate	0.2	2133	2130
Ethyl linolenate	1.4	2172	2170
Linolenic acid	0.2	2181	2178
Docosane[c]	1.5	2200	2200
Tricosane[c]	21.3	2301	2300
Tetracosane[c]	5.2	2400	2400
Pentacosane[c]	0.3	2499	2500
Hexacosane[c]	14.0	2600	2600
Total isolate	95.3	–	–

a: RI calculated from retention times relative to that of *n*-alkanes (C_6-C_{32}) on the non-polar HP-5 column. b: Percentages obtained by FID peak-area normalization. c: Identified by authentic samples.

TABLE-2
CHEMICAL CLASS DISTRIBUTION IN THE ESSENTIAL OILS FROM THE FLOWER OF *P. bistorta* subsp. *carneum*

Compound class	Area (%)	Number of compounds
Terpenoids	–	–
Oxygenated monoterpenes	2.7	4
Sesquiterpene hydrocarbons	6.4	2
Terpene related compounds	3.9	6
Oxygenated sesquiterpenes	1.0	2
Aldehydes	4.1	2
Hydrocarbons	54.5	14
Esters	6.1	9
Carboxylic acids	16.5	4
Others	0.1	1

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REFERENCES

1. M.J.E. Coode and J. Cullen, *Polygonum* L. in P.H. Davis, Flora of Turkey and the East Aegean Islands. Edinburgh University Press, Vol. 2, p. 269 (1967).
2. P.H. Davis, *Polygonum* L. Flora of Turkey and the East Aegean Islands, Edinburgh University Press, Vol. 10, p. 84 (1988).
3. A. Güner, N. Özhatay, T. Ekim and K.H.C. Baser, *Polygonum* L. Flora of Turkey and the East Aegean Islands, Edinburgh University Press, Vol. 11, p. 54 (2000).
4. T. Baytop, Therapy with Medicinal Plants, Istanbul University Publications (1984).
5. O. Üçüncü, N. Yayli, A. Yasar, C. Albay, N. Yayli and S. Terzioglu, *Asian J. Chem*., **21**, 7321 (2009).
6. J. Suan, X. Chen, X. Jiang and J. Yu, *J. Chin. Mass Spec*., **7**, 242 (2006).
7. M.V. Hunter, J.J. Brophy, B.J. Ralph and F.E. Bienvenu, *J. Essent. Oil Res*., **9**, 603 (1997).
8. C. Starkenmann, L. Luca, Y. Niclass, E. Praz and D. Roguet, *J. Agric. Food Chem*., **54**, 3067 (2006).
9. T. Naotaka and M. Mitsuo, *Koryo, Terupen, Oyobi Seiyu Kagaku ni Kansuru Toronkai Koen Yoshishu*, **48**, 34 (2004).
10. M. Mitsuo and T. Naotaka, *Flav. Fragr. J*., **22**, 188 (2007).
11. J. Jiang, *Flav. Fragr. J*., **20**, 455 (2005).
12. S. Demiray, M.E. Pintado and P.M.L. Castro, *Eng. Technol*., **54**, 312 (2009).
13. R.P. Adams, Identification of Essential Oil Components by Gas Chromatography/Quadrupole Mass Spectroscopy, Allured, Carol Stream, IL, USA (2004).
14. N.Y. Iskender, N. Yayli, N. Yildirim, T.B. Cansu and S. Terzioglu, *J. Oleo Sci*., **58**, 117 (2009).
15. N. Yayli, A. Yasar, C. Güleç, A. Usta, S. Kolayli, K. Coskunçelebi and S. Karaoglu, *Phytochemistry*, **66**, 1741 (2005).
16. H.A. Priestap, C.M. Van Baren, P. Di Leo Lira, J.D. Coussio and A.L. Bandoni, *Phytochemistry*, **63**, 221 (2003).
17. H.D. Skaltsa, C. Demetzos, D. Lazari and M. Sokovic, *Phytochemistry*, **64**, 743 (2003).
18. S. Terzioglu, A. Yasar, N. Yayli, N. Yilmaz, S. Karaoglu and N. Yayli, *Asian J. Chem*., **20**, 3277 (2008).
19. O. Üçüncü, N. Yayli, A. Yasar, S. Terzioglu and N. Yayli, *Nat. Prod. Comp*., **3**, 925 (2008).
20. N. Yayli, A. Yasar, N. Yayli, M. Albay and K. Coskunçelebi, *Nat. Prod. Comp*., **3**, 941 (2008).
21. O. Üçüncü, N. Yayli, C. Volga, N. Yayli and S. Terzioglu, *Asian J. Chem*., **21**, 6569 (2009).
22. N.Y. Iskender, N. Yayli, A. Yasar, K. Coskunçelebi and N. Yayli, *Asian J. Chem*., **21**, 6290 (2009).
23. N. Yayli, A. Yasar, N. Yayli, C. Albay, Y. Asamaz, K. Coskunçelebi and S. Karaoglu, *Pharm. Biol.*, **47**, 7 (2009).