Chemistry of Natural Compounds, Vol. 46, No. 2, 2010

CHEMICAL COMPOSITION OF ESSENTIAL OILS FROM *Galeopsis bifida* AND *Phlomoides tuberosa*

D. N. Olennikov,[1*] L. V. Dudareva,[2] and L. M. Tankhaeva[2]

UDC 582.949.2:547.913

Galeopsis bifida (Lamiaceae) and *Phlomoides tuberosa* (Lamiaceae) are broadly distributed over steppe and forest-steppe regions of the Selenga River basin [1]. Lamas in Buryatiya used *G. bifida* and *P. tuberosa* to treat diseases of the eyes and lungs and as sedative and antidiarrhea agents [2]. Chemical investigations found in *G. bifida* herb flavonoids, phenylpropanoids, iridoids, triterpenes, and lipids [3–5]; in *P. tuberosa* herb, phenolic acids, flavonoids, phenylpropanoids, neolignans, alkaloids, iridoids, and triterpenes [6–14]. Compositions of essential oils from the aerial parts of both species have not been reported. Herein we communicate results from a study of essential oils (EO) from leaves of *G. bifida* and *P. tuberosa* growing in Buryatiya.

Raw material for the study (leaves of these plants) was collected in July 2008 near Atsagat (Buryatiya). EO was obtained by steam distillation in a Clevenger apparatus (steam-distillation time 2 h) and studied by GC/MS. The analysis was carried out using a 6890N GC/MS with a 5973N MS-quadrupole detector (all Agilent Techologies, EI ionization, ionization energy 70 eV, total ion peak recording, scan range 41–450 amu) and an HP-5MS capillary column (30 m × 0.25 mm × 0.50 μm; stationary phase diphenyl- and dimethylpolysiloxane 5:95). The carrier gas was He, 1 mL/min flow rate. The injected sample volume (1% solution in hexane) was 0.2 μL, stream division 20:1. The column temperature was 150–250°C (rate 2°C/min), vaporizer 250°C, ion source 230°C, detector 150°C, line connecting the GC to the MS 280°C. The mass spectra libraries NIST 05 and Wiley in addition to comparison of retention times with those of standards were used for identification.

G. bifida. EO was waxy, yellow, weak aroma; yield 0.09% of air-dried raw material mass. A total of 24 compounds (21 identified, 84.6% of the total number) was detected. The dominant components were sesquiterpenes (77.8% identified). The highest contents were found for β-caryophyllene (22.0%), spatulenol (12.1%), caryophyllene oxide (11.0%), and germacrene D (10.6%) (Table 1). The results were similar to those obtained earlier for EO of *G. pubescens* and *G. tetrahit*, the principal constituents of which were also sesquiterpenes (88.9 and 90.4%, respectively) including germacrene D, bicyclogermacrene, β-caryophyllene, and β-farnesene [15].

P. tuberosa. EO was waxy, light-yellow, weak aroma; yield 0.02% of air-dried raw material mass. EO contained 26 compounds, of which 22 were identified (92.2% of the total number). The predominant compounds were phytol (35.5%), linalool (7.7%), eugenol (7.2%), caryophyllene oxide (7.1%), oct-1-en-3-ol (5.2%), dihydroactinidiolide (4.2%), and α-terpineol and geraniol (4.1% each) (Table 1). The EO composition of *P. tuberosa* was similar to that of Chinese species of the genus *Phlomoides*: *P. megalantha* (hexadecanoic acid 46.0%; 9,12,15-octadecatrien-1-ol 22.6%; phytol 6.2%), *P. szechuanensis* (phytol 50.8%; 9,12,15-octadecatrienoic acid methyl ester 11.0%; hexahydrofarnesyl acetone 8.5%), *P. umbrosa* (hexadecanoic acid 52.1%; 9,12,15-octadecatrien-1-ol 24.8%; phytol 5.7%) [16], and *P. younghunsbandii* (hexadecanoic acid, phytol, eugenol) [17]. However, it differed from EO from *Phlomis* species such as *P. amanica*, *P. armeniaca* [18], *P. anisodonta* [19], *P. bovei* subsp. *bovei* [20], *P. bruguieri* [21], *P. cancellata* [22], *P. chimerae* [23], *P. chorassanica* [24], *P. cretica* [25], *P. crinita* subsp. *mauritanica* [26], *P. ferruginea* [27], *P. fruticosa* [28], *P. grandiflora* var. *grandiflora* [29], *P. herba-venti* [30], *P. lanata* [31], *P. lanceolata* [22], *P. leucophracta* [23], *P. linearis* [32], *P. lunariifolia*, *P. monocephala* [18], *P. nissolii* [33], *P. oliveri* [34, 28], *P. persica* [34], *P. russeliana* [29], *P. samia* [35], and *P. sieheana* [18], for which the dominant compounds were mono- and sesquiterpenes (germacrene D, β-caryophyllene, α-pinene, β-farnesene, etc.).

1) Institute of General and Experimental Biology, Siberian Branch, Russian Academy of Sciences, 670047, Ulan-Ude, Russia, fax: (3012) 43 30 34, e-mail: oldaniil@rambler.ru; 2) Siberian Institute of Plant Physiology and Biochemistry, Siberian Branch, Russian Academy of Sciences, 664033, Irkutsk, ul. Lermontova, 132, Russia, fax: (3952) 51 07 42, e-mail: laser@sifibr.irk.ru. Translated from Khimiya Prirodnykh Soedinenii, No. 2, pp. 264–265, March–April, 2010. Original article submitted August 24, 2009.

 0009-3130/10/4602-0316

TABLE 1. Composition of Essential Oils from Leaves of *Galeopsis bifida* and *Phlomoides tuberosa*

Compound	*G. bifida*	*P. tuberosa*	Compound	*G. bifida*	*P. tuberosa*
α-Pinene	0.1		α-Farnesene	1.5	
Oct-1-en-3-ol	2.7	5.2	U.i. ($C_{15}H_{24}$)*		2.1
Octan-3-ol		0.6	δ-Cadinene	2.3	
Linalool	0.4	7.7	Dihydroactinidiolide		4.2
α-Terpineol		4.1	Germacrene B	1.4	
Geraniol	0.4	4.1	Spatulenol	12.1	3.2
Carvacrol		1.7	Caryophyllene oxide	11.0	7.1
Eugenol		7.2	Isoaromadendrene epoxide		0.4
α-Copaene	0.7		*cis*-1,2-Epoxy-*Z*-α-bisabolene		1.3
β-Burbonene	1.1	0.5	Caryophylla-3,8(13)-dien-5β-ol	1.2	
U.i. ($C_{15}H_{24}O$)*		0.8	γ-Cadinene	0.7	0.7
β-Elemene	1.4		U.i. ($C_{15}H_{24}O$)*		0.8
β-Caryophyllene	22.0	0.9	α-Cadinol	1.3	1.9
α-Humulene	4.7	0.8	U.i. ($C_{15}H_{26}O$)*	5.8	
Aromadendrene	4.5	0.9	U.i. ($C_{15}H_{24}O$)*		4.1
α-Curcumene		0.6	U.i. ($C_{18}H_{30}O$)*	0.5	
Germacrene D	10.6		Phytol	3.2	35.3
β-Ionone	1.3	3.3	U.i. ($C_{15}H_{22}O$)*	9.1	
α-Selinene		0.5	Total unidentified	84.6	92.2

*U.i., unidentified.

It can be assumed that a high content of phytol and fatty acids in the EO of leaves from species of the genus *Phlomoides* is a characteristic signature.

REFERENCES

1. *Guide to Plants of Buryatiya* [in Russian], Ulan-Ude, 2001.
2. *Tibetan Medicine in Buryatiya* [in Russian], RAS, Novosibirsk, 2008.
3. Y. H. Zhang, T. Wang, Z. G. Lu, and H. Q. Wang, *Zhongguo Zhongyao Zazhi*, **27**, 206 (2002).
4. W.-D. Li and Y.-H. Zhang, *Xibei Zhiwu Xuebao*, **23**, 637 (2003).
5. S. D. Gusakova, I. I. Vinokurov, and A. U. Umarov, *Khim. Prir. Soedin.*, 288 (1981).
6. E. V. Gella and N. K. Vavilova, *Rastit. Resur.*, **8**, 107 (1971).
7. E. V. Gella, N. K. Vavilova, and V. I. Litvinenko, *Rastit. Resur.*, **8**, 554 (1971).
8. V. I. Glyzin, V. A. Peshkova, and T. A. Khokhrina, *Khim. Prir. Soedin.*, 802 (1972).
9. N. K. Vavilova and E. V. Gella, *Khim. Prir. Soedin.*, 151, 285 (1973).
10. T. A. Khokhrina, V. A. Peshkova, and V. I. Glyzin, *Khim. Prir. Soedin.*, 802 (1973).
11. T. A. Khokhrina and V. A. Peshkova, *Khim. Prir. Soedin.*, 265 (1974).
12. K. I. Alipieva, S. R. Jensen, H. Franzyk, N. V. Handjieva, and L. N. Evstatieva, *Z. Naturforsch. C: J. Biosci.*, **55**, 137 (2000).
13. T. Ersoz, S. Ivancheva, P. Akbay, O. Sticher, and I. Calis, *Z. Naturforsch. C: J. Biosci.*, **56**, 695 (2001).
14. I. Calis, H. Kirmizibekmez, T. Ersoz, A. A. Donmez, C. H. Gotfredsen, and S. R. Jensen, *Z. Naturforsch. C: J. Biosci.*, **60**, 1295 (2005).
15. G. Flamini, P. L. Cioni, and I. Morelli, *Flavour Fragrance J.*, **19**, 327 (2004).
16. Y. Zhang and Z.-Z. Wang, *J. Pharm. Biomed. Anal.*, **47**, 213 (2008).
17. C. R. Bian-ba, M. Wang, F. Wei, S. L. Ge-sang, Z. J. Zhang, and R. C. Lin, *Zhongguo Yaoxue Zazhi*, **27**, 904 (2002).
18. B. Demirci, M. Toyota, F. Demirci, M. Y. Dadandi, and K. H. C. Baser, *C. R. Chim.*, **12**, 612 (2009).

19. P. Sarkhail, G. Amin, M. H. Salehi Surmaghi, and A. Shafiee, *Flavour Fragrance J.*, **20**, 327 (2005).
20. C. Liolios, H. Laouer, N. Boulaacheb, O. Gortzi, and I. Chinou, *Molecules*, **12**, 772 (2007).
21. K. Morteza-Semnani and M. Saeedi, *Flavour Fragrance J.*, **20**, 344 (2005).
22. K. Morteza-Semnani, K. Moshiri, and M. Akbarzadeh, *J. Essent. Oil. Res.*, **18**, 672 (2006).
23. S. Celik, R. S. Gokturk, G. Flamini, P. L. Cioni, and I. Morelli, *Biochem. Syst. Ecol.*, **33**, 617 (2005).
24. P. Sarkhail, G. Amin, and A. Shafiee, *Flavour Fragrance J.*, **19**, 538 (2004).
25. A. Basta, O. Tzakou, and M. Couladis, *Flavour Fragrance J.*, **21**, 795 (2006).
26. A. I. Limem-Ben, A. Neffati, M. Ben Sgaier, W. Bhouri, J. Boubaker, I. Skandrani, I. Bouhlel, S. Kilani, R. Ben Ammar, I. Chraief, M. Hammami, M. Ghoul, L. Chekir-Ghedira, and K. Ghedira, *J. Am. Oil Chem. Soc.*, **85**, 845 (2008).
27. C. Formisano, F. Senatore, M. Bruno, and G. Bellone, *Flavour Fragrance J.*, **21**, 848 (2006).
28. S. Parisa, A. Gholamreza, and S. Abbas, *DARU*, **14**, 71 (2006).
29. F. Demirci, K. Guven, B. Demirci, M. Y. Dadandi, and K. H. C. Baser, *Food Control*, **19**, 1159 (2008).
30. K. Morteza-Semnani, M. Azadbakht, and A. Goodarzi, *Flavour Fragrance J.*, **19**, 29 (2004).
31. M. Couladis, A. Tanimanidis, O. Tzakou, I. B. Chinou, and C. Harvala, *Planta Med.*, **66**, 670 (2000).
32. B. Demirci, M. Y. Dadandi, D. H. Paper, G. Franz, and K. H. C. Baser, *Z. Naturforsch. C: J. Biosci.*, **58c**, 826 (2003).
33. N. Krimer, K. H. C. Kirimer, and M. Kurkouoglu, *J. Essent. Oil Res.*, **18**, 600 (2006).
34. M. A. Khalilzadeh, A. Rustaiyan, S. Masoudi, and M. Tajbakhsh, *J. Essent. Oil. Res.*, **17**, 624 (2005).
35. N. Aligiannis, E. Kalpoutzakis, I. Kyriakopoulou, S. Mitaku, and I. B. Chinou, *Flavour Fragrance J.*, **19**, 320 (2004).