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ESSENTIAL OIL COMPOSITION OF *Libanotis buchtormensis* FROM TAIBAI MOUNTAIN IN CHINA

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The *Libanotis* (Apiaceae family) genus consists of about 60 species widespread in Europe, Africa, Asia, and Oceania [1]. Eighteen Species (eight endemic) are found in China. Most of them grow in grassy places, riverbanks, scrublands, valleys, and sunny rocky slopes at altitudes from 400 to 4100 m [2].

In Chinese traditional medicine, some *Libanotis* species were reported in ancient literature as having various healing effects. The roots of *Libanotis buchtormensis* (Fischer) DC., a wild plant growing in northwest areas of China, are known as "*Yan Feng*" and are used as a herbal remedy for inflammation, rheumatism, pain, and the common cold [2], while the roots of *Libanotis laticalycina*, named "*Fang Feng*" and growing wildly in Hebei, Henan, and Shanxi of China, have been revealed to cure cold, fever, headache, rheumatism, quadriplegia, and stomach ache [1].

Furthermore, the biological activities of *Libanotis* genus, including anti-inflammatory, antipyretic, analgesic [3], and spasmolytic effects [4], have been reported. Investigating the composition of the essential oils from some *Libanotis* genus has become a focus for researching the biological activity of these compounds [5–8].

Although the composition of the essential oil from *Libanotis buchtormensis* depending on the period of the raw material storage [9] and the altitudes of the Altai region [10] has been revealed, so far, there are no reports on the chemical composition of the essential oils from the flowers and the fruits of *L. buchtormensis*. Here, we report on the analysis of the oils from the flowers and fruits of *L. buchtormensis* by GC and GC-MS [18].

The percentage composition of the essential oils is listed in Table 1 along with the retention indices of the identified compounds, where all constituents are arranged in order of their elution on the DB-5MS column. The classification of the identified compounds based on functional groups is summarized at the end of Table 1.

It is evident in Table 1 that there are many qualitative similarities between the two oils, although the amounts of some compounds are different. Furthermore, epiglobulol, germacrene D, β-phellandrene, and α-phellandrene are the major components of the two essential oils. These results indicate that *L. buchtormensis* is a rich source of epiglobulol and germacrene D used as a flavoring agent in the food and perfume industries.

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TABLE 1. The Essential Oil Composition of *Libanotis buchtormensis* from Taibai Mountain in China*

Compounds, references	KI[a]	Area,%		Compounds, references	KI[a]	Area,%	
		Flowers	Fruits			Flowers	Fruits
3-Methyl-1-cyclohexene	786		0.3	Cedrene [11, 14]	1409		1.7
1-Methylethyl-cyclopentane	875		0.1	δ-Elemene [13, 15]	1442	1.8	1.2
α-Pinene [11, 13, 14]	935	10.0	1.6	(*E*)-3,7-Dimethyl-2,6-octadienylbutanoic acid ester	1444		3.0
p-Mentha-1(7),3-diene	975	1.2	0.3	α-Caryophyllene [17]	1449	0.5	0.3
β-Pinene [11, 12, 16]	978	1.2	1.8	(*R*)-2,4α5,6,7,8-Hexahydro-3,5,5,9-tetramethyl-1(H)-benzocycylohene	1468		6.7
α-Phellandrene [12-15]	999	7.9	4.4	Germacrene D [11, 13, 14, 17]	1475	14.9	19.8
p-Mentha-1,4(8)-diene	1011		0.3	Humulane-1,6-dien-3-ol	1483	1.4	1.6
o-Cymene [11]	1020	0.6	0.5	Longifolene [12]	1489		1.7
β-Phellandrene [11, 14, 15]	1026	34.3	9.9	Octahydro-2,2,4,7α-tetramethyl-1,3α-ethano(1H)inden-4-ol	1490		
3,6,6-Trimethyl-2-norpinene	1029		0.1	Cedr-9-ene	1494		0.5
3-Carene	1033		Tr.	Cadina-1(10),4-diene [11, 14]	1518	0.7	1.6
ζ-Terpinene [11, 12, 14, 15]	1055		0.3	(1α,3aα,7α,8aα)-2,3,6,7,8,8α-Hexahydro-1,4,9,9-tetramethyl-1H-3α,7-methanoazulene	1523		Tr.
2-Methyl-5-(1-methylethyl)-bicyclo[3.1.0]hexan-2-ol	1064		0.1	*epi*-Globulol [16]	1528	18.5	18.9
4-Thujanol	1070	0.2		2-(3-Isopropenyl-4-methyl-4-vinylcyclohexyl)propan-2-ol	1540		0.7
1,5-Dimethyl-1-vinyl-4-hexenyl-anthranilic acid ester	1093		0.4	*n-trans*-Nerolidol [11, 13]	1552		2.9
trans-1-Methyl-4-(1-methylethyl)-2-cyclohexen-1-ol	1139		0.1	Guaia-1(5),11-diene	1591		6.1
cis-Sabinenehydrate [12, 15]	1151		0.1	Cubenol	1603		0.1
(*R*)-5-Methyl-2-(1-methylethenyl)-4-hexen-1-ol	1167		0.3	Linalyl-2-methybutanoate	1628	1.3	3.5
(*R*)-(-)-*p*-Menth-1-en-4-ol	1180		1.2	Guaia-1(10)-en-11-ol	1636		0.2
p-Menth-1-en-8-ol	1205		0.2	Geranyl tiglate	1641		0.4
endo-1,3,3-Trimethyl-2-norboeanol acetate	1244		Tr.	τ-Muurolol [12]	1654		0.4
cis-3-Hexenyl isovalerate ester	1258		0.1	α-Cadinol [11, 13, 14]	1659		0.6
p-Menth-1-en-3-one	1273		Tr.	(4αS-*cis*)-2,4α,5,6,7,8,9,9α-Octahydro-3,5,5-trimethyl-9-methylene-1*H*-benzocycloheptene	1689		0.5
5-Methyl-2-(1-methylethyl)-4-hexen-1-ol acetate	1288		0.1	Osthol	2146		0.6
(1*S*,2*R*,4*S*)-(-)-Borneol acetate	1293		0.2	Monoterpenes, %		55.2	19.2
(1*S*,2*R*)-(-)-2-Isopropenyl-1-vinyl-*p*-menth-3-ene	1340		0.1	Alcohols, %		20.1	27.4
Eugenol [11, 12]	1356		0.1	Sesquiterpenes, %		18.2	41.7
α-Cubebene [11, 13, 14, 17]	1365		0.3	Esters, %		1.3	7.7
[1*S*-(1α,2α,3α)]-1-Ethenyl-1-methyl-2,4-*bis*-(1-methylethenyl)-cyclohexane	1386		1.0	Others, %		-	1.1
α-Bourbonene [12]	1390	0.3		Sum, %		94.8	97.1
[1*S*-(1α,4α,5α)]-1,8-Dimethyl-4-(1-methylethenyl)-spiro[4,5]dec-7-ene	1397		0.2	Yield		0.25	0.76

Tr.: trace <0.1%.

[a]KI: retention indices relative to C_6-C_{24} *n*-alkanes on the HP-5MS capillary column.

*Identification method: MS, KI (Kovats index).

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