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Comparative Study of the Essential Oil of *Rhodiola rosea* L. from Mongolia

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Abstract

The essential oil of the rhizomes of Mongolian *Rhodiola rosea* L. was investigated by GC and GC/MS. Thirty-six constituents were identified in the oil. The main components in the oil were geraniol (32.3%), myrtenol (15.7%), octanol (13.7%), *trans*-pinocarveol (11.6%), *trans*-myrtanol (3.2%), isopinocamphone (2.8%) and piperitone (1.2%). Comparisons are made with *Rhodiola rosea* rhizome oil from Finland and Norway and oils from other *Rhodiola* species (*R. crenulata*, Tibet; *R. fastigiata*, Tibet; *R. yunnanesis*, China).

Key Word Index

Rodiola rosea, Crassulaceae, essential oil composition, geraniol, myrtenol, octanol, *trans*-pinocarveol.

Introduction

Rhodiola rosea L. (Crassulaceae) has reportedly been used in food (1) as well as in traditional Tibetan-Mongolian folk medicine (2). The Mongolian name for *Rhodiola rosea* is *Altan (golden) gagnuur (solder)*. The plant is considered an excellent medicine to treat bone fractures (3). Rose root is a multipurpose medicinal plant with properties to increase nonspecific resistance of the body. It has traditionally been grown and used in Russia and Mongolia for the treatment of long term illnesses and weakness due to infection (4–6).

The chemical composition of rhizomes of *R. rosea* has been exhaustively studied by East European research groups (7–10). Active phenolic metabolites include saliroside and its aglycon tyrosol (11–13), cinnamic glycosides such as rosin, rosavin and rosarin (14), flavonoids (15–17), tannins (18), gallic acid and its esters (8,12), and the essential oil (5,19–21). The composition of rhizome oil from *Rhodiola rosea* from Norway and Finland have been recently reported (5,22).

Experimental

Plant material: Plant material was collected in September from 10 native plants in the Khandagait – ula Mountains near Ulaanbaatar: *S. Shatar* 7681/2002. Voucher specimens have been deposited at the Herbarium of the Faculty of Veterinary, Biotechnology of Agricultural University, Ulaanbaatar (Mongolia).

Oil isolation: The rhizomes (0.5 kg) of the freshly collected plants were finely chopped and steam distilled for 3 h (23). The organic phase was dried over anhydrous sodium sulfate.

GC/MS: The oil was analyzed on a VG analytical 70-250S sector field mass spectrometer, 70 eV, using a SPsil5, 25 m x 30 m, 0.25 µm coating thickness, fused silica capillary column, injector 222°C, detector 240°C, linear temperature 80°–270°C at 10°C/min. Identifications were made by library searches (24) combining MS and retention data of authentic compounds. Quantitation was by FID using the HP Chemstation software on a HP 5980 GC with the same type column as used for GC/MS and same temperature program.

Results and Discussion

Thirty-six constituents representing 99.5% of the Mongolian *R. rosea* oil were identified (Table I). The major components of *R. rosea* oil from Mongolia are geraniol (32.3%), myrtenol (15.7%), octanol (13.7%), *trans*-pinocarveol (11.6%) and *trans*-myrtanol (3.2%). Minor components are cumin

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alcohol (1.6%), linalool (1.6%), *trans*-linalool oxide (1.5%) and piperitone (1.2%). The oil from Mongolia was found to be similar to the Finish oil (Table I), except that geraniol was much less (12.7%) and cumin alcohol was much larger (12.1%) in the Finish oil. In contrast, the composition of the oil of *R. rosea* from Norway (5) was quite different (Table I), being high in decanol (30.4%), geraniol (12.5%), p-mentha-1,4-dien-7-ol (5.1%) and much lower octanol (2.8%), *trans*-pinocarveol (0.5%) and myrtenol (1.7%).

The oils of three other *Rhodiola* species, based on literature, are shown in Table I for comparison purposes. The main components of *R. yunnanesis* from China have been reported (26) to be octanol (28.3%), geraniol (21.9%), myrtanol (4.7%) and decanol (4.1%) (Table I), whereas the main constituents of *R. fastigiata* and *R. crenulata* from Tibet (25) were geraniol (45.3% and 53.3%, respectively) and octanol (12.3% and 13.4%, respectively).

Table I. Comparison of the percentage composition of the oils of *Rhodiola rosea* from Mongolia, Finland, and Norway and the oils of other *Rhodiola* species

RI	Compound	*R. rosea*			*R. yunnanesis*	*R. crenulata*	*R. fastigiata*
		Mongolia	Finland(22)	Norway(5)	China (26)	Tibet(25)	Tibet(25)
939	α-pinene	0.1		4.7			
961	benzaldehyde	0.9					
969	heptanol	0.3					
976	sabinene	0.1		1.5			
978	1-octen-3-ol	0.3					
980	β-pinene	0.1		1.5			
991	myrcene	0.1		2.3			
1026	p-cymene	0.2		3.0			
1031	limonene	1.1		4.9			
1031	β-phellandrene	0.2		2.3			
1033	1,8-cineole	0.6					
1062	γ-terpinene	0.2		1.8			
1065	acetophenone	0.3					
1070	octanol	13.7	13.6	2.8	28.3	13.4	12.3
1088	*trans*-linalool oxide (furanoid)	1.5		0.1			
1098	linalool	1.6	2.7	2.3	t	2.4	5.1
1139	*trans*-pinocarveol	11.6	16.1	0.5			
1153	menthone	–		0.4			
1160	pinocamphone	0.5					
1162	pinocarvone	1.1		0.1			
1173	isopino-camphone	2.8		0.1			
1177	terpinen-4-ol	0.5					
1189	α-terpineol	0.1		0.4			
1193	myrtenal*	1.9	1.0				
1194	myrtenol	15.7	36.9	1.7	4.7	3.0	
1217	*trans*-carveol	0.5		t			
1228	nerol	0.5		0.1			
1242	cuminaldehyde	0.5		0.4			
1240	neral	0.6		t			
1242	carvone	0.2		0.2			
1252	piperitone	1.2					
1254	*cis*-myrtanol		1.0				
1255	geraniol	32.3	12.7	12.5	21.9	53.3	45.3
1261	*trans*-myrtanol	3.2					
1266	(E)-cinnamaldehyde	0.8		0.2			
1270	geranial	1.9		0.1			
1272	n-decanol			30.4	4.1		
1287	cumin alcohol	1.6	12.1	2.7			
	dihydrocumin alcohol		2.1				
1295	perilla alcohol	0.7	1.7	0.5			
	cinnamyl alcohol			0.3			
1365	neryl acetate				3.5		
1471	dodecanol			3.7			
	p-mentha-1,4-dien -7-ol			5.1			
	Sum (%)	99.5	99.9	86.6	62.5	72.1	67.7

*called 6,6-dimethyl-bicylo(3.1.1)hept-2-ene-2-carboxaldehyde in (22); RI = retention index on SPB-5 column

The composition of *R. rosea* oil from Norway (5) was so different from the composition of oils from Finland and Mongolia (Table I), that we can not be sure whether these large differences are due to genetic or environmental factors or some procedural difference. Additional study will be needed to determine why there are such large differences.

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