Rose Oil in Kashmiri India

An emerging cash crop benefiting industry and local agribusiness

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Damask rose (*Rosa damascena* Mill.) is the most important source of rose products such as rose oil, rose concrete, rose absolute and rose water. These are highly expensive base materials for the fragrance, flavor, cosmetic, pharmaceutical and food industries. Rose oil is used in compounding, to produce the characteristic rose odor with a distinctive floral tonality. The total production of rose oil is approximately 5 metric tons, with Bulgaria and Turkey being the major producers followed by Morocco, Egypt, China, Russia, Iran and India. At present, three species of rose are used for production of rose products of perfumery quality: *Rosa damascena, Rosa centifolia* L. and *Rosa gallica* L. Bulgarian rose oil distilled from *Rosa damascena* is traditionally preferred.

Queen Noor Jehan (*sometimes Jahan*), of the 16th century reign of the Mughal Empire in India, is widely credited with the discovery of rose oil. She is said to have collected droplets of rose oil from a canal flowing with rose petals. Today, approximately 2,500–3,000 hectares (ha) of Indian land are dedicated to rose cultivation, including Himachal Pradesh, Kashmir, Pushkar in Rajasthan, Hasayan, Ettah, Kanuj, Ghazipur, Lucknow in Uttar Pradesh, Bihar and some areas in Punjab. The country produces about 200 kg of rose oil and rose attars, in addition to a large quantity of rose water. The highest acreage of Damask rose lies in the Western Himalayan region of the northern plains where the land is ideal for its cultivation.

The literature on the composition of rose oils is vast. Lawrence has published an excellent review on recent studies.[1] Rose oils from various parts of India have been the subject of numerous studies, but no detailed chemical composition on rose oil from Kashmir, India has been carried out.[2-5] The purpose of this study is to compare rose oil from a pilot plant extraction in Kashmir with a quality Bulgarian rose oil and to discuss the implementation of the commercial cultivation of this crop in the highlands of Kashmir.

Experimental

Rose oils (with lab accession numbers) were obtained from Kashmir (11362, RRL, Regional Research Lab, Srinagar, Kashmir) and Bulgaria (11361, Alteya, Inc.). The oils were analyzed on an HP5971 MSD mass spectrometer, directly coupled to an HP 5890 gas chromatograph using a J&W DB-5 (0.26 mm x 30 m, 0.25 mL coating thickness, fused silica capillary column) under the following conditions: carrier gas, helium (He) at 30.5 cm/s (ca. 1 mL/min); 0.2 µL of 10% solution injected; split, 1:15; injector temperature, 220ºC; oven temperature linear programmed, 60º–246ºC at 3ºC/min; transfer line, 240ºC. Identifications were made by library searches of our volatile oil library, using the HP Chemstation library search routines, coupled with retention time data of authentic reference compounds.[6] Quantitation was performed via FID on an HP 5890 gas chromatograph, using a J&W DB-5 (0.26 mm x 30 m, 0.25 mL coating thickness, fused silica capillary column) under the following conditions: carrier gas, helium (He) at 30.5 cm/s (ca. 1 mL/min); 0.2 µL of 10% solution injected; split, 1:15; injector 220ºC; oven temperature linear programmed at 60º–246ºC at 3ºC/min; FID detector, 240ºC; H2 66 mL/min, make-up He 30 mL/min, air 300 mL/min. The FID signal (uncorrected) was analyzed using the HP Chemstation software to obtain the percentage of total oil for individual components.

Results

Both the Kashmir and Bulgarian rose oil samples were high in citronellol (37.5% and 40.6%, respectively), geraniol (30.2% and 20.5%) and nerol (8.8% and 5.8%). (For a comparison, **see T-1**.) Both oils met the ISO

At a Glance

The authors compared the composition of pilot plant-produced rose oil from Kashmir to Bulgarian rose oil. The oils were very similar in content, particularly citronellol (35.7% and 40.6%, respectively,), geraniol (30.2%, 20.5%) and nerol (8.8%, 5.8%). In general, Kashmir rose oil met or exceeded ISO rose oil standards. Thus, it could be concluded that the unique soil and climatic conditions of the Kashmir Valley are suitable for the production of rose oil of international standards. Herein the authors review, in detail, the current state of Kashmiri culture and industrial production.

Comparison of Bulgarian and Kashmir rose oils* T-1

RI	Component	Kashmir	Bulgaria	ISO Std.
0863	hexanol	0.2	0.3	
0901	heptanal	0.2	0.2	
0932	α-pinene	0.5	0.8	
0952	benzaldehyde	t	t	
0969	sabinene	t	0.1	
0974	β-pinene	0.1	0.2	
0988	myrcene	0.8	0.6	
1002	α-phellandrene	t	t	
1014	α-terpinene	0.1	t	
1020	p-cymene	t	t	
1024	limonene	0.2	t	
1025	β-phellandrene	0.1	t	
1026	1,8-cineole	0.1	t	
1032	(Z)-b-ocimene	0.2	0.1	
1044	(E)-b-ocimene	0.3	0.2	
1054	γ-terpinene	0.1	0.1	
1086	terpinolene	0.1	t	
1095	linalool	2.9	1.2	
1100	n-nonanal	t	0.1	
1106	*cis*-rose oxide	0.5	0.4	
1106	phenyl ethyl alcohol	1.1	0.7	< 3.5
1122	*trans*-rose oxide	0.2	0.2	
1141	camphor	0.1	-	
1148	citronellal	-	t	
1154	nerol oxide	0.1	t	
1158	isomenthone	0.4	-	
1174	terpinen-4-ol	1.1	0.4	
1186	α-terpineol	0.7	0.3	
1223	citronellol	35.7	40.6	25.0-46.0
1227	nerol	8.8	5.8	(cit + nerol)
1235	neral	0.4	0.8	
1249	geraniol	30.2	20.5	15.0-22.0
1264	geranial	0.6	1.4	
1271	citronellyl formate	0.2	-	
1298	geranyl formate	0.3	-	
1322	methyl geranate	t	t	
1350	citronellyl acetate	0.1	0.4	
1356	eugenol	1.6	0.6	
1359	neryl acetate	t	t	
1379	geranyl acetate	0.3	0.7	
1387	β-bourbonene	0.1	t	
1389	β-elemene	t	t	
1403	methyl eugenol	1.4	1.7	
1417	β-caryophyllene	0.3	0.7	
1437	α-guaiene	0.2	0.5	
1452	α-humulene	0.2	0.4	
1457	sesquisabinene	-	t	
1476	geranyl propionate	t	-	
1484	germacrene D	0.3	0.8	
1486	2-phenylethyl 2-methylbutyrate	-	t	
1489	β-selinene	t	-	
1500	pentadecane	0.1	0.4	
1509	α-bulnesene	0.2	0.6	
1521	*trans*-calamenene	t	-	

Comparison of Bulgarian and Kashmir rose oils* **T-1 (cont.)**

RI	Component	Kashmir	Bulgaria	ISO Std.
1522	δ-cadinene	t	t	
1584	2-phenyl ethyl tiglate	0.1	t	
1600	hexadecane	t	t	
1622	10-epi-γ-eudesmol	1.0	t	
1671	tetradecanol	t	0.2	
1700	heptadecane	0.9	1.3	1.0 - 2.5
1713	(2E,6Z)-farnesal	-	t	
1740	(2E,6E)-farnesal	-	t	
1759	benzyl benzoate	-	t	
1800	octadecane	t	0.1	
1874	1-nonadecene**	0.7	2.2	
1900	nonadecane	3.5	8.5	8.0 - 15.0
1972	1-eicosene**	t	t	
2000	eicosane	0.3	0.7	
2100	heneicosane	1.3	3.0	3.0 - 5.5
2200	docosane	t	t	
2300	tricosane	0.2	0.5	

*values are percent oil by FID
t = trace, less than 0.05%
**tentative identification
RI = arithmetic retention indices based on alkanes on a DB-5

standards for 2-phenylethyl alcohol (1.1% and 0.7%. respectively; ISO <3.5%). For citronellol and nerol, the Kashmir oil (43.5%) was within the ISO range (25–46%), but the Bulgarian oil examined (46.4%) was just above the maximum. At 30.2%, the Kashmir oil was above the ISO range for geraniol (15–22%), whereas the Bulgarian oil sample was within range (20.5%). The high boiling alkanes in Kashmir oil were a little below the ISO ranges: heptadecane (ISO, 1–2.5%; Kashmir, 0.9%; Bulgaria, 1.3%), nonadecane (ISO, 8–15%; Kashmir, 3.5%; Bulgaria, 8.5%) and heneicosane (ISO, 3–5.5%; Kashmir, 1.3%; Bulgaria, 3.0%). These variations are likely the result of environmental and processing differences. The low content of alkanes and high content of monoterpene alcohols are desired for high quality rose oil.[7] Overall, the Kashmir and Bulgarian rose oils were very similar.

Cultivation

The best quality rose oil is produced on medium-loam, well-drained soils. Rose is a temperate plant that grows best in areas with cold winters and moderate summers, which makes Kashmir Valley ideal for the cultivation of rose. The region has inadequate rainfall, so two to three flood irrigations are required during the rain-free period.

Damask rose is propagated by cuttings. Pruning is very important to get the maximum yield of flowers. During October and November, rose plants are pruned to a height of 60–75 cm, with six to eight main branches that facilitate flower picking. Normal harvest is obtained after the third year of growth. *Rosa damascena* flowers are harvested once a year, commencing in the second week of May through early June. Flowers are picked early in the morning for maximum recovery of oil. At present, 10–15 kg of rose oil is produced in Kashmir with the help of the Regional Research Laboratory's (Srinagar) technical knowledge.

Rose Products

In addition to rose oil, other value-added products are obtained from rose flowers. Rose attar is used in perfumery with sandalwood or paraffin oil. *Gul-e-Roghan* is prepared from dry rose petals for use in hair oils. *Gul-kand* is prepared by mixing fresh rose petals with sugar for use as laxative, particularly in Kashmiri *kahwa*. Rose hips are a good source of vitamin C. Rose water of different grades is prepared by distilling rose petals. In India, 60–70% of domestic damask rose is used for the preparation of rose water for use in religious ceremonies and as a coolant in soft drinks. Rose water and dry rose flowers are also used in traditional Indian medicine.

Adulteration

Because rose oil is a highly priced essential oil, it is subject to adulteration, which is performed by adding synthetic aroma chemicals and/or palmarosa oil, geranium oil, guaiac wood oil or spermaceti—the latter produces "normal" stearoptene content. One has to rely not only on olfactory tests and physical constants (specific gravity, optical rotation, refractive index, congealing point, stearoptene content, total alcohols and ester value), but also on GC/MS analysis of the oil. Chiral GC/MS is another diagnostic tool to determine adulteration.

In summary, the composition of Kashmir rose oil was found to be compatible with international standards. Cultivation of rose will play an important role in the local agribusiness and could potentially change the socioeconomic status of the farming community in particular.

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