Material review

Kashmir Lavender Oil

A comparison of new Kashmir lavender oils with commercial lavender oils

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The composition of two new Kashmir lavender oils were compared with nine commercial lavender oils using GC/MS, GC-FID and chiral GC. Linalool ranged from 27.3–42.2% and linalyl acetate from 27.2–46.6%. Eight of the 11 oils met the European Pharmacopoeia 5.0 (EP5) standard. All of the oils contained 1.1–2.9 % (+)-(S)-linalool, well below the EP 5 12.0% maximum. The oils, except for the Hungarian oil, contained from trace to 0.7% (+)-(S)-linalyl acetate, which is below the EP 5 maximum of ≤ 1.0%. The oil from Hungary contained 12.9% of (+)-(S)-linalyl acetate, exceeding the EP 5 standard. The Kashmir lavender oils ('Karlovo' and 'B-18') were found to be comparable to other commercial oils. The Kashmir grown 'Karlovo' oil appeared to be a little better than the 'B-18' oil.

Introduction

Lawrence and Tucker, in an excellent review of the production and uses of lavender oils, noted that the production of true lavender oil (*Lavandula augustifolia* Mill.) is declining in favor of the production of lavandin (*L. xintermedia* Emeric xe Loisel.—a hybrid between *L. angustifolia* and *L. latifolia* Medik.).[1] In France, true lavender oil production has declined from 130 metric tons (mt) (1930, 1960) to only 35 mt in 1990 and 40–60 mt per year from 1992–2002. The shift to lavandin is seen in the French production starting with 2 mt in 1924 and increasing to 1,290 mt in 2002.[1] There are several lavandin hybrids, of which Gosso and Provence are the most widely cultivated.[2]

"Agri-tourism" and "entertainment farming" are terms being used to describe farms in the United States that offer tourists opportunities to pick fruits and bouquets of flowers, taste honey and jellies, ride horses and shop for gifts. Several agri-tourism farms feature fields of lavender, or more commonly lavandin, as well as on-farm small unit lavender distillation. Lavandin is gaining favor due to its larger, showier flowers that are very attractive for photography and drying. A few of these lavender farms are marketing oils for aromatherapy and fragrances directly via the Web. Young Living Farms in Mona, Utah, has 2,000 acres (809 hectares) of *L. angustifolia* 'Munstead' and eight large stills for distillation, as well as another lavender farm in Idaho. Almost all of their lavender oil is sold for aromatherapy.

True lavender oil is now becoming commercially available from Kashmir.[1–7] It is possible that due to favorable climate and low labor costs, Kashmiri lavender oil may become a significant competitor with historical sources of lavender oil. With this increase in both small farm production and new commercially-available Kashmiri oil, it seems appropriate to compare several traditional sources with newer sources.

There are currently 969 references to lavender oil in CAS online. The oil has been thoroughly analyzed. Tucker, Maciarello and Howell published detailed essential oil compositions for 12 lavender cultivars grown in a common garden.[8] Lawrence has summarized the recent literature on lavender oils composition.[9]

Several cultivars of lavender were introduced to India from Bulgaria: 'Kazanluk,' 'Karlovo,' 'Hemus,' 'Aroma,' 'Svezhest' and 'Vebets.'[3] In addition, Russian cultivars 'Stepnaya,' 'Goranaya,' 'Prima' and 'Record,' as well as French cultivars 'Bareme' and 'Lambris' were introduced.[3] The origin of 'B-18' from Kashmir is not known.

The purpose of this paper is to compare samples of lavender oils from Kashmir versus lavender oils obtained on the world market.

Experimental

Lavender oils were purchased from commercial vendors: Bulgaria, China, 40/42 France, Hungary, Oregon (USA) and Russia from Liberty Natural Products (LNP), Portland, Oregon; 'Munstead' from Young Living Farms, Mona, Utah; 'High Alpine-France' from Dreaming Earth Botanicals, France ex Firmenich; 'Karlovo' and 'B-18' from Himalayan Foothills Oils, Srinagar, India.

The oils were analyzed on a HP5971 MSD mass spectrometer, directly coupled to a HP 5890 gas chromatograph, using a J&W DB-5, 0.26 mm x 30 m, 0.25 µ coating thickness, fused silica capillary column, using the following conditions: carrier gas He, 30.5 cm/sec (ca. 1 mL/min), 0.2 µL of 10% solution injected, split 1:15; injector 220ºC, oven temperature linear programmed, 60–246ºC at 3ºC/min, transfer line 240ºC. Identifications were made by library searches of our volatile oil library (10), using the HP Chemstation library search routines, coupled with retention time data of authentic reference compounds. Quantitation was by FID on an HP 5890 gas chromatograph, using a J&W DB-5, 0.26 mm x 30 m, 0.25 µ coating thickness, fused silica capillary column, using the following conditions: carrier gas He, 30.5 cm/s (ca. 1 mL/min), 0.2 µL of 10% solution injected, split 1:15; injector 220ºC, oven temperature linear programmed, 60–246ºC at 3ºC/min, FID detector 240ºC, H_2 66 mL/min, makeup He 30 mL/min, air 300 mL/min. The FID signal (uncorrected) was analyzed using the HP Chemstation software to obtain percent of total oil for individual components.

Chiral analyses were performed on a Restek Rt-DEXse 2,3-di-O-ethyl-6-O-tert-butyl dimethylsilyl β-cyclodextrin infused into 14% cyanopropylphenyl/86% dimethyl polysiloxane, 0.25 µ coating thickness, 0.25 mm x 30 m, fused silica capillary column, using the following conditions: carrier gas He, 30.5 cm/s (ca. 1 mL/min), 0.2 µL of 10% solution injected, split 1:15; injector 220ºC, oven temperature linear programmed, 70–230ºC at 2ºC/min, FID detector 240ºC, H_2 66 mL/min, makeup He 30 mL/min, air 300 mL/min. Standards (R-(-)-linalool, (+/-) racemic linalool, (+/-) racemic linalyl acetate) were obtained from Sigma-Aldrich (SAFC).

Results and Discussion

The compositions of the lavender oils are given in **T-1** along with the European Pharmacopoeia 5.0 (EP 5) standards. All of the oils were found to be high in linalool ranging from the Oregon grown (OR, LNP, 27.3%) to China (38.0%) and meet the EP 5 specifications. All of the oils were high in linalyl acetate with the lowest being China (27.2%) and the highest being 'B-18,' Kashmir (46.6%). In fact, the Kashmiri 'B-18' lavender oil actually exceeded the EP 5 specifications.

Camphor gives lavender oil the undesirable medicinal/camphoraceous odor.[1] The 40/42 France (a blended oil) and 'High Alpine-France' (possibly blended) have 0.6% and 0.7% camphor. Both of the Kashmiri oils were very low in camphor and this contributed to their excellent fragrance.

All the oils are within standards for 3-octanone except the 'High Alpine-France', which was less than the EP 5 lower limit (0.1%). Limonene was within EP 5 (< 1.0) specifications for all oils except for the Hungarian oil that contained 1.0% limonene. All of the oils met the EP 5 standard for α-terpineol (< 2.0%), except for the 'B-18' oil from Kashmir, which was just at the level (2.0%).

Comparison of the composition of commercial lavender oils

T-1

KI	Compound	Hung	Fran	Chin	OR LNP	40/42 Fran	Bulg	HA Fran	Russ	Munst. Utah	Karvo. Kash	B-18 Kash	Eu Pharm
921	tricyclene	t	t	t	t	t	t	t	t	t	t	t	
924	α-thujene	–	0.1	0.1	0.1	t	0.1	t	0.1	0.1	t	t	
932	α-pinene	0.1	0.2	0.1	0.2	0.1	0.3	t	0.3	0.2	0.1	0.1	
946	camphene	0.1	0.2	0.2	0.2	0.3	0.2	t	0.2	0.2	0.3	0.3	
969	sabinene	t	t	t	t	t	t	t	t	t	t	t	
974	1-octen-3-ol	0.1	0.1	0.6	0.4	0.4	t	t	0.2	t	0.2	0.1	
974	β-pinene	0.1	t	0.1	t	t	t	t	t	t	t	t	
979	3-octanone	0.9	0.8	0.1	0.3	1.3	0.7	**t E**	0.7	0.8	0.8	1.2	0.1–2.5
988	myrcene	0.7	1.2	0.9	0.9	0.9	1.8	0.4	0.8	0.9	1.0	0.8	
988	3-octanol	0.1	0.1	t	0.1	0.2	t	0.2	0.1	t	0.1	t	
993	butyl butanoate	0.1	0.1	t	0.1	0.2	t	0.2	0.1	t	0.1	t	
1007	hexyl acetate	0.4	0.4	0.7	1.1	0.5	0.6	0.2	0.6	0.4	0.2	0.2	
1020	p-cymene	0.1	0.3	0.1	0.2	0.2	0.2	0.3	0.2	0.3	0.1	0.2	
1024	limonene	**1.0 E**	0.2	0.4	0.2	0.2	0.4	0.4	0.2	0.3	0.6	0.5	< 1.0
1025	β-phellandrene	0.6	0.2	0.3	0.1	0.2	0.3	0.2	0.1	0.2	0.4	0.3	
1026	1,8 cineole	0.6	0.8	1.2	0.4	0.1	0.8	0.6	0.9	0.8	0.7	1.0	< 2.5
1032	(Z)-β-ocimene	3.3	4.8	7.3	11.6	1.7	6.3	0.8	6.1	4.3	1.2	0.2	
1044	(E)-β-ocimene	2.2	2.8	1.7	2.1	1.2	3.8	0.6	3.4	3.0	2.2	0.3	
1067	*cis*-linalool oxide (furanoid)	t	0.1	0.1	0.2	0.3	t	t	0.1	0.2	0.2	0.4	
1084	*trans*-linalool oxide (furanoid)	0.1	0.2	0.3	0.3	0.3	0.2	0.2	0.2	0.3	0.2	0.3	
1095	linalool	32.4	30.6	38.0	27.3	42.2	29.0	30.8	29.5	35.0	33.7	30.8	20–45
1110	1-octen-3-yl acetate	0.8	1.3	1.5	2.1	0.9	1.1	0.3	1.1	1.0	0.8	0.9	
1141	camphor	0.5	0.4	0.3	0.2	0.6	0.3	0.7	0.3	0.5	0.3	0.3	< 1.2
1145	hexyl isobutanoate	t	t	t	t	t	t	t	t	t	t	t	
1165	borneol	0.6	1.5	1.1	0.6	1.2	0.8	2.4	0.8	1.8	1.6	1.1	
1165	lavandulol	0.2	0.4	2.2	0.2	0.5	0.4	1.0	0.4	0.7	0.3	0.4	> 0.1
1174	terpinen-4-ol	3.2	3.2	1.3	1.4	0.2	4.6	2.0	4.6	3.4	0.7	0.7	0.1–6
1178	naphthalene	t	0.1	0.1	t	0.1	t	t	0.1	t	t	t	
1179	p-cymen-8-ol	0.1	0.2	0.2	t	0.1	t	t	0.2	t	0.3	0.5	
1186	α-terpineol	0.4	0.3	1.0	1.1	0.5	1.0	1.3	1.0	1.1	1.8	**2.0 E**	< 2.0
1191	hexyl butanoate	0.1	0.1	0.3	0.3	0.6	0.3	0.3	0.3	0.3	0.4	0.5	
1204	verbenone	t	t	t	t	t	t	t	t	t	t	t	
1254	linalyl acetate	41.9	36.6	27.2	37.0	37.3	32.5	41.0	34.5	30.9	42.0	**46.6 E**	25–46
1287	bornyl acetate	0.1	0.1	0.1	t	0.1	0.2	t	0.2	t	0.2	0.3	
1288	lavandulyl acetate	1.5	3.5	3.6	2.6	0.5	3.7	4.8	3.6	2.2	2.3	3.2	> 0.2
1359	neryl acetate	0.2	0.3	0.4	0.5	0.3	0.5	0.5	0.3	0.4	0.5	0.6	
1379	geranyl acetate	0.5	0.6	0.7	1.3	0.6	1.0	0.9	0.6	0.8	0.8	1.1	
1417	β-caryophyllene	4.4	5.1	4.2	3.9	3.4	4.3	3.1	4.2	4.6	4.0	1.8	
1454	(E)-β-farnesene	1.3	1.4	1.3	1.0	1.9	2.8	2.0	2.6	1.5	1.3	0.5	
1484	germacrene D	0.2	0.3	0.6	0.3	0.1	0.2	0.7	0.2	0.3	0.2	–	
1513	sesquiterpene 41,135, FW 204	t	0.2	0.1	0.2	0.1	t	0.8	t	0.3	0.1	0.1	
1582	caryophyllene oxide	0.1	0.4	0.3	0.4	0.4	0.2	0.4	0.3	0.4	0.3	1.5	
1638	epi-α-cadinol	t	0.2	0.1	0.2	t	t	0.4	0.1	0.1	t	0.1	

compounds are in boldface that separate the taxa; KI = Kovat's Index on DB-5(= SE54) column; *tentatively identified; compositional values less than 0.1% are denoted as traces (t); unidentified components less than 0.5% are not reported; Chin = Chinese oil; Kash = Kashmiri oil; Hung = Hungarian oil; Russ = Russian oil; Fran = French oil; OR = US oil ex Oregon; EuPharm = European Pharmacopoeia; compounds specified in EP 5.0 are in bold

Chiral composition of linalool and linalyl acetate in lavender oils **T-2**

Lavender oil	(-)-(R)-linalool	(+)-(S)-linalool	(-)-(R)-linalyl acetate	(+)-(S)-linalyl acetate
Hungary	31.0	1.4	29.0	**12.9 E**
France	28.6	2.0	35.6	<0.05
China	35.8	2.2	27.2	<0.05
OR, LNP	25.1	2.2	37.0	<0.05
40/42 France	40.4	1.8	37.3	<0.05
Bulgaria	27.2	1.8	32.5	<0.05
High Alpine	29.7	1.1	40.3	0.7
Russia	27.6	1.9	34.5	<0.05
Munstead, UT	32.5	2.5	30.5	0.4
Karlovo, Kashmir	31.0	2.7	42.0	<0.05
B18, Kashmir	27.9	2.9	46.6	<0.05
European Pharm.		≤ 12.0		≤ 1.0

Chiral analysis focused on linalool and linalyl because these are specified in the EP 5 standards. The EP 5 standards set limits of (-)-(S)-linalool (12% max) and (+)-(S)-linalyl acetate (1% max). The results of analyses on a β-cyclodextrin chiral capillary column are shown in **T-2**. All of the oils contained 1.1–2.9 % (+)-(S)-linalool, well below the EP 5 12.0% maximum. The oils, except Hungary, contained from trace to 0.7% (+)-(S)-linalyl acetate, which was below the EP 5 maximum of ≤ 1.0%. The Hungarian oil contained 12.9% of (+)-(S)-linalyl acetate, far exceeding the EP 5 standard (≤ 1.0%). This suggests that the sample of Hungary oil we obtained was a blended oil.

In general, although there is some variation in the lavender oils examined, with the exception of the Hungarian sample, the range in question generally

met EP 5 standards. It might be noted that ISO standards are applied differently based on the botanic germplasm of "spontaneous" vs. "clonal from various origins." Although several of the oils failed to meet some of the ISO standards, it does not seem feasible to determine the germplasm origin for oils bought in an open, world market. The European Pharmacopoeia standard seems to be more applicable for the evaluation lavender oil because of the worldwide production today.

In summary, the compositions and fragrances of the Kashmir lavender oils are comparable to the other lavender oils examined. In this study, nearly all the oils met the EP 5 standard. Is this important? Perhaps not as important as it has been in the past. Many companies blend lavender oils from several sources to make a lavender oil that meets its company specifications. Entrepreneurial companies in the United States are only selling their lavender oils in local shops, on the Internet, or for aromatherapy. As one lavender oil producer said, "We just use our nose. If it smells like lavender, we sell it." It seems that merchandizing in the United States has, in many cases, superseded quality control.

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