

**Date :** April 12, 2019

**CERTIFICATE OF ANALYSIS – GC PROFILING**

**SAMPLE IDENTIFICATION**

**Internal code :** 19D02-ORA06-1-SCC  
**Customer identification :** Clary Sage  
**Type :** Essential oil  
**Source :** *Salvia sclarea*  
**Customer :** Organic Aromas Inc.

**ANALYSIS**

**Method:** PC-PA-014-17J19 - Analysis of the composition of an essential oil, or other volatile liquid, by FAST GC-FID (in French); identifications validated by GC-MS.

**Analyst :** Sylvain Mercier, M. Sc., Chimiste

**Analysis date :** April 09, 2019

Checked and approved by :

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Alexis St-Gelais, M. Sc., chimiste 2013-174

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*This report is digitally signed, it is only considered valid if the digital signature is intact.*

*PHYSICOCHEMICAL DATA*

**Physical aspect:** Faintly yellow liquid

**Refractive index:**  $1.4590 \pm 0.0003$  (20 °C)

*CONCLUSION*

No adulterant, contaminant or diluent has been detected using this method.

ANALYSIS SUMMARY

Identification	DB-5 (%)	DB-WAX (%)	Classe
Isovaleral	0.01	0.01	Aliphatic aldehyde
2-Methylbutyral	tr	tr	Aliphatic aldehyde
2-Ethylfuran	tr	tr	Furan
Isoamyl alcohol	tr	0.01*	Aliphatic alcohol
2-Methylbutanol	tr	[0.01]*	Aliphatic alcohol
Toluene	tr	tr	Simple phenolic
Hexanal	tr	0.01	Aliphatic aldehyde
(2E)-Hexenal	0.05	0.05*	Aliphatic aldehyde
(3Z)-Hexenol	0.06	0.07	Aliphatic alcohol
(2E)-Hexenol	0.11	0.14	Aliphatic alcohol
Hexanol	0.08	0.08	Aliphatic alcohol
$\alpha$ -Thujene	0.01	tr	Monoterpene
$\alpha$ -Pinene	0.08	0.08	Monoterpene
Camphene	0.03	0.02	Monoterpene
Benzaldehyde	0.01	0.02	Simple phenolic
Sabinene	0.15*	0.04	Monoterpene
$\beta$ -Pinene	[0.15]*	0.12	Monoterpene
Octen-3-ol	0.06	0.07	Aliphatic alcohol
Octan-3-one	0.02	0.59*	Aliphatic ketone
Myrcene	0.92*	0.87	Monoterpene
<i>trans</i> -Dehydroxylinalool oxide	[0.92]*	0.06	Monoterpenic ether
Octan-3-ol	0.01	0.01	Aliphatic alcohol
<i>cis</i> -Dehydroxylinalool oxide	0.06	[0.42]	Monoterpenic ether
$\alpha$ -Terpinene	0.01	0.01	Monoterpene
para-Cymene	0.04	0.05	Monoterpene
Limonene	0.30*	0.29	Monoterpene
$\beta$ -Phellandrene	[0.30]*	0.01	Monoterpene
1,8-Cineole	[0.30]*	[0.05]*	Monoterpenic ether
(Z)- $\beta$ -Ocimene	0.36	0.42*	Monoterpene
(E)- $\beta$ -Ocimene	0.57	[0.59]*	Monoterpene
$\gamma$ -Terpinene	0.02	[0.42]*	Monoterpene
<i>cis</i> -Linalool oxide (fur.)	0.02	0.02	Monoterpenic alcohol
Terpinolene	0.16*	0.14	Monoterpene
<i>trans</i> -Linalool oxide (fur.)	[0.16]*	0.03	Monoterpenic alcohol
Linalool	21.91	80.09	Monoterpenic alcohol
Hotrienol	0.03	0.03	Monoterpenic alcohol
Dehydrosabinaketone	0.01	0.01	Normonoterpenic ketone
allo-Ocimene	0.01	tr	Monoterpene
Nerol oxide	0.04	0.05	Aliphatic ether
Borneol	0.04	[5.05]*	Monoterpenic alcohol
Terpinen-4-ol	0.05	0.04	Monoterpenic alcohol
$\alpha$ -Terpineol	2.62	[5.05]*	Monoterpenic alcohol
Hodiendiol	0.04	0.04	Monoterpenic alcohol
Unknown	0.02		Unknown
Linalyl formate	0.28	0.31*	Monoterpenic ester
Nerol	0.58	0.63	Monoterpenic alcohol
Unknown	0.02		Unknown
Neral	0.03	0.03	Monoterpenic aldehyde

Geraniol	59.67*	1.56	Monoterpenic alcohol
Linalyl acetate	[59.67]*	[80.09]	Monoterpenic ester
Geranial	0.05	0.05	Monoterpenic aldehyde
Unknown	0.01		Unknown
Neryl formate	0.04	0.06	Monoterpenic ester
Bornyl acetate	0.02	0.02	Monoterpenic ester
Geranyl formate	0.10	0.11	Monoterpenic ester
$\delta$ -Elemene	0.01	0.01	Sesquiterpene
Hodiendiol derivative	0.11	0.12	Oxygenated monoterpene
$\alpha$ -Cubebene	0.07*	0.03	Sesquiterpene
$\alpha$ -Terpinyl acetate	[0.07]*	0.07	Monoterpenic ester
Unknown	0.04		Monoterpenic ester
Unknown	0.04	0.04	Oxygenated monoterpene
Neryl acetate	0.89	0.88	Monoterpenic ester
$\alpha$ -Copaene	0.36	0.35	Sesquiterpene
(Z)-8-Hydroxylinalool?	0.01	0.02	Monoterpenic alcohol
$\beta$ -Bourbonene	0.12	0.10	Sesquiterpene
Geranyl acetate	1.66	1.65	Monoterpenic ester
$\beta$ -Cubebene	0.09	0.09	Sesquiterpene
$\beta$ -Elemene	0.07	[0.31]*	Sesquiterpene
$\beta$ -Caryophyllene	1.13	1.08*	Sesquiterpene
Coumarin	0.04*	0.01	Coumarin
$\beta$ -Copaene	[0.04]*	[0.31]*	Sesquiterpene
<i>trans</i> - $\alpha$ -Bergamotene	0.02	[1.08]*	Sesquiterpene
$\alpha$ -Humulene	0.07	0.09	Sesquiterpene
9-epi- $\beta$ -Caryophyllene	0.03	0.01	Sesquiterpene
$\alpha$ -Amorphene	2.22*	0.03	Sesquiterpene
Germacrene D	[2.22]*	5.05	Sesquiterpene
$\beta$ -Selinene	0.02	0.03	Sesquiterpene
Hodiendiol derivative IV	0.23		Oxygenated monoterpene
Bicyclgermacrene	0.37	0.35*	Sesquiterpene
$\alpha$ -Muulolene	0.05	[0.35]*	Sesquiterpene
$\beta$ -Bisabolene	0.12*	0.02	Sesquiterpene
$\gamma$ -Cadinene	[0.12]*	0.17	Sesquiterpene
$\delta$ -Cadinene	0.11	[0.17]	Sesquiterpene
1,5-Epoxysalvial-4(14)-ene	0.02	0.01	Sesquiterpenic ether
Spathulenol	0.15	0.15	Sesquiterpenic alcohol
Caryophyllene oxide	0.12	0.17	Sesquiterpenic ether
Salvial-4(14)-en-1-one	0.03	0.02	Aliphatic alcohol
Guaial	0.01	0.02	Sesquiterpenic alcohol
Unknown	0.13	0.12	Unknown
Unknown	0.03		Unknown
$\beta$ -Eudesmol	0.06	0.12	Sesquiterpenic alcohol
$\alpha$ -Eudesmol	0.04	0.03	Sesquiterpenic alcohol
$\alpha$ -Cadinol	0.02	0.02	Sesquiterpenic alcohol
Unknown	0.05		Unknown
Phytone	0.03	0.02	Terpenic ketone
Sclareoloxide	0.01		Terpenic ether
Geranyl-para-cymene	0.05	0.04	Diterpene
Manoyl oxide	0.01	0.01	Diterpenic ether
13-epi-Manoyl oxide	0.01	0.01	Diterpenic ether
Manool	0.03	0.04	Diterpenic alcohol

Sclareol	0.29	0.29	Diterpenic alcohol
<b>Total identified</b>	<b>97.39%</b>	<b>97.37%</b>	

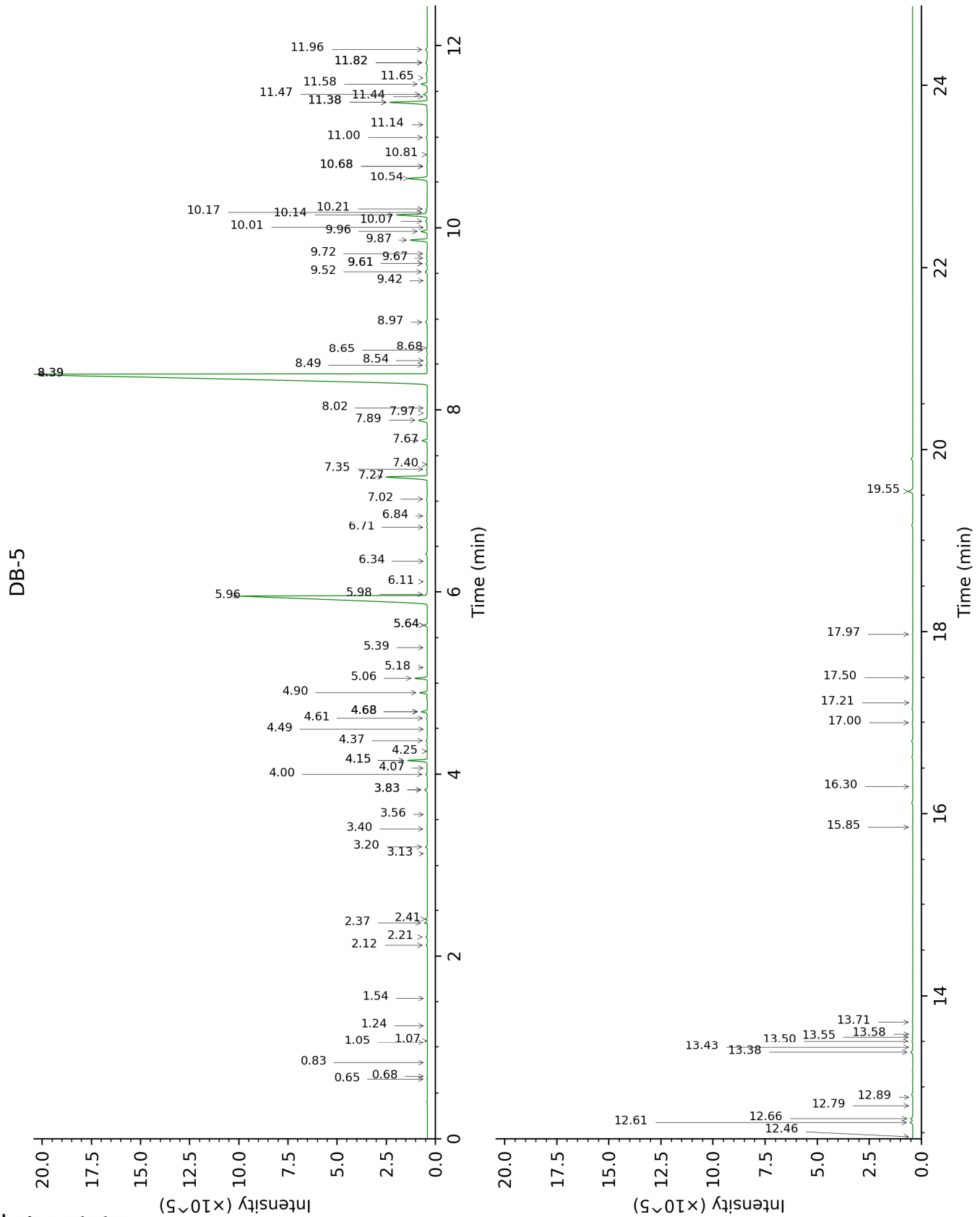
\*: Two or more compounds are coeluting on this column

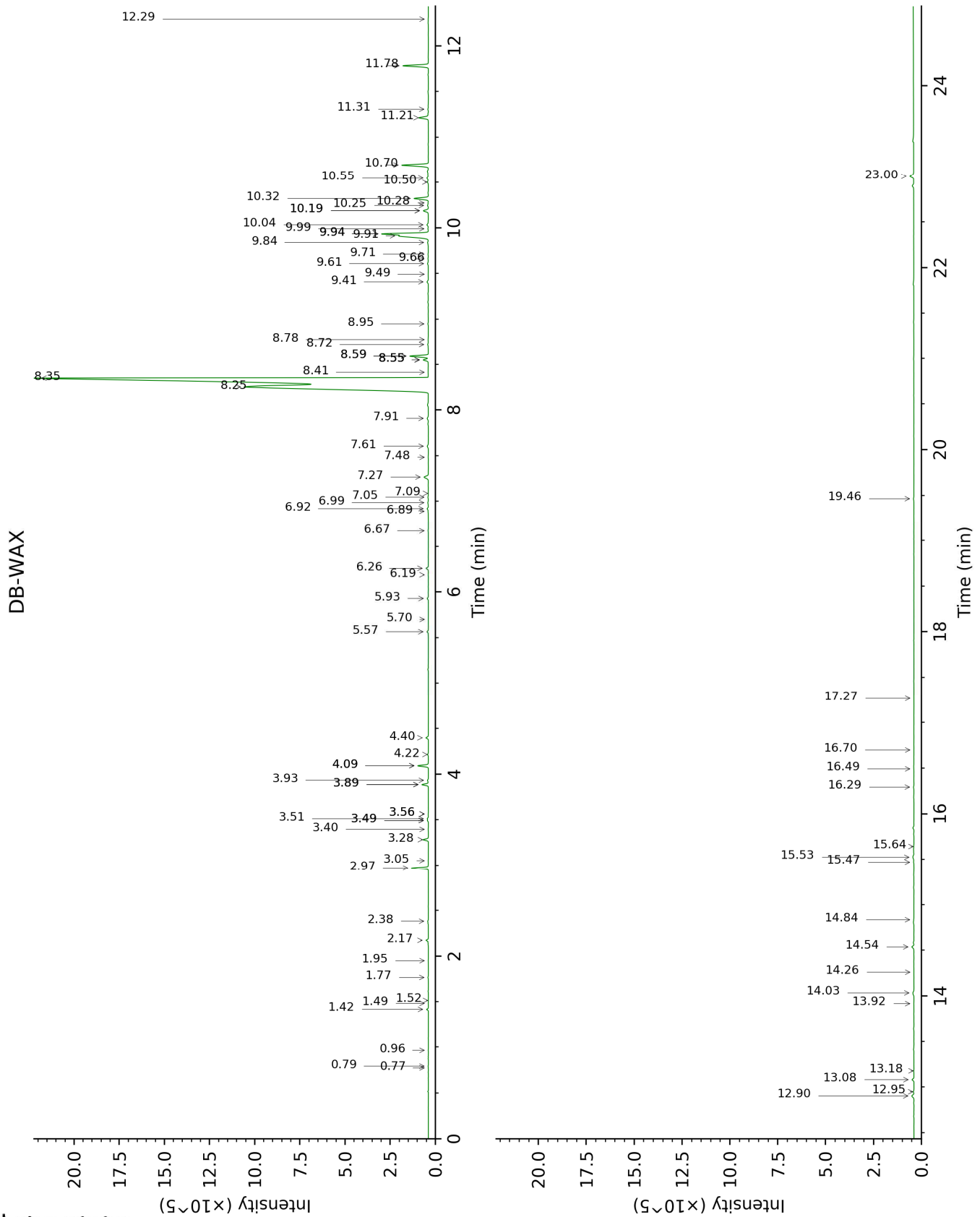
[xx]: Duplicate percentage due to coelutions, not taken account in the identified total

tr: The compound has been detected below 0.005% of total signal.

Note: no correction factor was applied

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FULL ANALYSIS DATA

Identification	Column DB-5			Column DB-WAX		
	R.T	R.I	%	R.T	R.I	%
Isovaleral	0.65	642	0.01	0.79	888	0.01
2-Methylbutyral	0.68	652	tr	0.77	880	tr
2-Ethylfuran	0.83	700	tr	0.96	918	tr
Isoamyl alcohol	1.05	732	tr	3.56*	1179	0.01
2-Methylbutanol	1.07	734	tr	3.56*	1179	[0.01]
Toluene	1.24	757	tr	1.48	998	tr
Hexanal	1.54	798	tr	1.95	1044	0.01
(2E)-Hexenal	2.12	847	0.05	3.49*	1173	0.05
(3Z)-Hexenol	2.21	854	0.06	5.93	1349	0.07
(2E)-Hexenol	2.36	867	0.11	6.26	1373	0.14
Hexanol	2.41	870	0.08	5.57	1323	0.08
α-Thujene	3.13	924	0.01	1.52	1002	tr
α-Pinene	3.20	929	0.08	1.42	991	0.08
Camphene	3.40	942	0.03	1.77	1026	0.02
Benzaldehyde	3.56	952	0.01	7.48	1463	0.02
Sabinene	3.83*	970	0.15	2.38	1086	0.04
β-Pinene	3.83*	970	[0.15]	2.18	1066	0.12
Octen-3-ol	4.00	982	0.06	6.92	1421	0.07
Octan-3-one	4.07	986	0.02	4.09*	1218	0.59
Myrcene	4.15*	992	0.92	2.97	1133	0.87
<i>trans</i> -Dehydroxylinalool oxide	4.15*	992	[0.92]	3.51	1175	0.06
Octan-3-ol	4.25	998	0.01	6.19	1368	0.01
<i>cis</i> -Dehydroxylinalool oxide	4.37	1006	0.06	3.93†	1206	[0.42]
α-Terpinene	4.49	1014	0.01	3.05	1139	0.01
para-Cymene	4.61	1021	0.04	4.22	1226	0.05
Limonene	4.68*	1026	0.30	3.28	1157	0.29
β-Phellandrene	4.68*	1026	[0.30]	3.40	1166	0.01
1,8-Cineole	4.68*	1026	[0.30]	3.49*	1173	[0.05]
(Z)-β-Ocimene	4.90	1039	0.36	3.89*†	1203	0.42
(E)-β-Ocimene	5.06	1049	0.57	4.09*	1218	[0.59]
γ-Terpinene	5.18	1057	0.02	3.89*†	1203	[0.42]
<i>cis</i> -Linalool oxide (fur.)	5.39	1070	0.02	6.67	1403	0.02
Terpinolene	5.64*	1086	0.16	4.40	1239	0.14
<i>trans</i> -Linalool oxide (fur.)	5.64*	1086	[0.16]	7.05	1430	0.03
Linalool	5.96	1106	21.91	8.25†	1521	80.09
Hotrienol	5.98	1107	0.03	8.95	1574	0.03
Dehydrosabinaketone	6.11	1116	0.01	8.78	1561	0.01
allo-Ocimene	6.34	1131	0.01	5.70	1333	tr
Nerol oxide	6.71	1155	0.04	6.99	1426	0.05
Borneol	6.84	1163	0.04	9.94*†	1653	[5.05]
Terpinen-4-ol	7.02	1175	0.05	8.72	1557	0.04
α-Terpineol	7.27	1191	2.62	9.94*†	1653	[5.05]
Hodiendiol	7.35	1196	0.04	12.95	1911	0.04

Unknown [m/z 43, 71 (80), 67 (55), 59 (51), 68 (44), 41 (43)...]	7.40	1200	0.02			
Linalyl formate	7.66	1217	0.28	8.55*	1543	0.31
Nerol	7.89	1232	0.58	11.21	1759	0.63
Unknown [m/z 43, 93 (49), 41 (22), 80 (22), 69 (17), 121 (14)...]	7.97	1238	0.02			
Neral	8.02	1241	0.03	9.66	1631	0.03
Geraniol	8.39*	1267	59.67	11.78	1808	1.56
Linalyl acetate	8.39*	1267	[59.67]	8.35†	1528	[80.09]
Geranial	8.49	1273	0.05	10.25	1678	0.05
Unknown [m/z 121, 43 (75), 95 (57), 41 (34), 93 (33), 69 (28)...]	8.54	1277	0.01			
Neryl formate	8.66	1284	0.04	9.61	1627	0.06
Bornyl acetate	8.68	1286	0.02	8.41	1533	0.02
Geranyl formate	8.97	1306	0.10	10.04	1661	0.11
δ-Elemene	9.42	1333	0.01	7.09	1434	0.01
Hodiendiol derivative	9.52	1340	0.11	13.08	1924	0.12
α-Cubebene	9.61*	1347	0.07	6.89	1419	0.03
α-Terpinyl acetate	9.61*	1347	[0.07]	9.84	1645	0.07
Unknown [m/z 43, 121 (52), 93 (48), 79 (33), 41 (30), 136 (26), 81 (25)...]	9.67	1351	0.04			
Unknown [m/z 43, 79 (46), 71 (30), 94 (25), 41 (23), 81 (21)... 197 (0)]	9.72	1354	0.04	11.31	1767	0.04
Neryl acetate	9.87	1365	0.89	10.32	1684	0.88
α-Copaene	9.96	1372	0.36	7.27	1447	0.35
(Z)-8-Hydroxylinalool?	10.01	1375	0.01	13.92	2001	0.02
β-Bourbonene	10.07	1379	0.12	7.60	1472	0.10
Geranyl acetate	10.14	1384	1.66	10.70	1715	1.65
β-Cubebene	10.17	1386	0.09	7.91	1494	0.09
β-Elemene	10.21	1389	0.07	8.55*	1543	[0.31]
β-Caryophyllene	10.54	1413	1.13	8.59*	1547	1.08
Coumarin	10.68*	1424	0.04	17.27	2340	0.01
β-Copaene	10.68*	1424	[0.04]	8.55*	1543	[0.31]
trans-α-Bergamotene	10.81	1433	0.02	8.59*	1547	[1.08]
α-Humulene	11.00	1447	0.07	9.41	1611	0.09
9-epi-β-Caryophyllene	11.14	1458	0.03	9.49	1617	0.01
α-Amorphene	11.38*	1476	2.22	9.71	1635	0.03
Germacrene D	11.38*	1476	[2.22]	9.91†	1651	5.05
β-Selinene	11.44	1480	0.02	9.99	1657	0.03
Hodiendiol derivative IV	11.47	1482	0.23			
Bicyclogermacrene	11.58	1491	0.37	10.19*	1673	0.35
α-Murolene	11.65	1496	0.05	10.19*	1673	[0.35]
β-Bisabolene	11.82*	1508	0.12	10.28	1680	0.02

γ-Cadinene	11.82*	1508	[0.12]	10.50†	1699	0.17
δ-Cadinene	11.96	1520	0.11	10.55†	1703	[0.17]
1,5-Epoxysalvial-4(14)-ene	12.46	1559	0.02	12.29	1853	0.01
Spathulenol	12.61	1571	0.15	14.54	2060	0.15
Caryophyllene oxide	12.66	1575	0.12	12.90	1907	0.17
Salvial-4(14)-en-1-one	12.80	1586	0.03	13.18	1932	0.02
Guaiol	12.89	1593	0.01	14.26	2034	0.02
Unknown [m/z 43, 93 (89), 91 (88), 79 (87), 123 (76), 81 (75)...]	13.38	1633	0.13	14.03	2012	0.12
Unknown [m/z 135, 93 (29), 79 (29), 41 (26), 107 (22), 67 (21), 69 (20)...]	13.43	1637	0.03			
β-Eudesmol	13.50	1643	0.06	15.53	2158	0.12
α-Eudesmol	13.55	1647	0.04	15.47	2152	0.03
α-Cadinol	13.58	1650	0.02	15.64	2170	0.02
Unknown [m/z 81, 41 (46), 79 (46), 93 (39), 91 (33), 107 (33)... 206 (8)]	13.71	1661	0.05			
Phytone	15.85	1846	0.03	14.84	2089	0.02
Sclareoloxide	16.30	1887	0.01			
Geranyl-para-cymene	17.00	1952	0.05	16.29	2236	0.04
Manoyl oxide	17.22	1973	0.01	16.70	2278	0.01
13-epi-Manoyl oxide	17.50	2000	0.01	16.49	2257	0.01
Manool	17.97	2047	0.03	19.46	2587	0.04
Sclareol	19.54	2207	0.29	23.00	3035	0.29
<b>Total identified</b>		<b>97.39%</b>			<b>97.37%</b>	
<b>Total reported</b>		<b>97.73%</b>			<b>97.53%</b>	

\*: Two or more compounds are coeluting on this column

[xx]: Duplicate percentage due to coelutions, not taken account in the identified total

†: Peaks apexes were resolved, but peaks overlapped and were summed for analysis

tr: The compound has been detected below 0.005% of total signal.

Note: no correction factor was applied  
R.T.: Retention time (minutes)  
R.I.: Retention index