

**Date :** December 21, 2018

**CERTIFICATE OF ANALYSIS – GC PROFILING**

**SAMPLE IDENTIFICATION**

**Internal code :** 18L17-PTH07-1-CC

**Customer identification :** Lemon Oil Steam Distilled - LI010487R

**Type :** Essential oil

**Source :** *Citrus x limon*

**Customer :** Plant Therapy

**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 :** December 19, 2018

Checked and approved by :

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

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*PHYSICOCHEMICAL DATA*

**Physical aspect:** Clear liquid

**Refractive index:**  $1.4725 \pm 0.0003$  (20 °C)

*CONCLUSION*

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

## ANALYSIS SUMMARY

Identification	DB-5 (%)	DB-WAX (%)	Classe
Toluene	tr	tr	Simple phenolic
Octane	tr	tr	Alkane
Nonane	tr	tr	Alkane
Tricyclene	0.01	0.01	Monoterpene
$\alpha$ -Thujene	0.32	0.32	Monoterpene
$\alpha$ -Pinene	1.61	1.61	Monoterpene
$\alpha$ -Fenchene	0.05*	tr	Monoterpene
Camphene	[0.05]*	0.05	Monoterpene
$\beta$ -Pinene	13.52*	12.12	Monoterpene
Sabinene	[13.52]*	1.40	Monoterpene
6-Methyl-5-hepten-2-one	tr	0.01	Aliphatic ketone
Myrcene	1.46	1.47	Monoterpene
Pseudolimonene	0.10*	0.03	Monoterpene
$\alpha$ -Phellandrene	[0.10]*	0.03	Monoterpene
Octanal	[0.10]	0.03	Aliphatic aldehyde
$\Delta^3$ -Carene	0.01	0.02	Monoterpene
$\alpha$ -Terpinene	0.25	0.26	Monoterpene
para-Cymene	65.71	0.39	Monoterpene
Limonene	[65.71]*	64.89	Monoterpene
1,8-Cineole	[65.71]*	0.29	Monoterpenic ether
(Z)- $\beta$ -Ocimene	[65.71]	tr	Monoterpene
(E)- $\beta$ -Ocimene	0.09	0.09	Monoterpene
$\gamma$ -Terpinene	9.30	9.33	Monoterpene
cis-Sabinene hydrate	0.01	0.01	Monoterpenic alcohol
Unknown	0.01	0.01	Oxygenated monoterpene
cis-Linalool oxide (fur.)	0.01	0.01	Monoterpenic alcohol
Octanol	0.01	0.01	Aliphatic alcohol
Terpinolene isomer	0.02	0.02	Monoterpene
Terpinolene	0.39	0.39	Monoterpene
trans-Sabinene hydrate	0.01	0.01	Monoterpenic alcohol
Linalool	0.10	0.11	Monoterpenic alcohol
Nonanal	0.07	0.07	Aliphatic aldehyde
trans-para-Mentha-2,8-dien-1-ol	0.01	0.01	Monoterpenic alcohol
cis-Limonene oxide	0.02	0.02	Monoterpenic ether
cis-para-Mentha-2,8-dien-1-ol	0.01	1.25*	Monoterpenic alcohol
trans-Limonene oxide	0.01	tr	Monoterpenic ether
Camphor	tr	tr	Monoterpenic ketone
Camphene hydrate	tr	tr	Monoterpenic alcohol
Epoxyterpinolene	tr	tr	Monoterpenic ether
Citronellal	0.09	0.09	Monoterpenic aldehyde
Borneol	0.01	0.17*	Monoterpenic alcohol
Terpinen-4-ol	0.02	0.02	Monoterpenic alcohol
Isogeranial	0.01	0.01	Monoterpenic aldehyde
$\alpha$ -Terpineol	0.16	[0.17]*	Monoterpenic alcohol
Decanal	0.05	0.05	Aliphatic aldehyde
trans-Carveol	0.01	0.01	Monoterpenic alcohol
2,3-Epoxyneral?	tr		Monoterpenic aldehyde
Nerol	0.04	0.04	Monoterpenic alcohol

2,3-Epoxygeranial?	0.01		Monoterpenic aldehyde
Neral	1.21	[1.25]*	Monoterpenic aldehyde
Geraniol	0.04	0.04	Monoterpenic alcohol
Perillaldehyde	tr	0.01	Monoterpenic aldehyde
Geranial	1.96	1.98*	Monoterpenic aldehyde
Limonen-10-ol	tr	tr	Monoterpenic alcohol
Undecanal	tr	0.01	Aliphatic aldehyde
$\alpha$ -Cubebene	tr	0.01	Sesquiterpene
Citronellyl acetate	0.03	[1.25]*	Monoterpenic ester
Neryl acetate	0.35	0.49*	Monoterpenic ester
$\alpha$ -Copaene	0.01	tr	Sesquiterpene
$\beta$ -Bourbonene	tr	tr	Sesquiterpene
Geranyl acetate	0.25	0.26	Monoterpenic ester
Dodecanal	tr	0.01*	Aliphatic aldehyde
$\beta$ -Caryophyllene	0.15	0.25*	Sesquiterpene
<i>trans</i> - $\alpha$ -Bergamotene	0.13	[0.25]*	Sesquiterpene
$\alpha$ -Humulene	0.02*	0.01	Sesquiterpene
Neryl propionate	[0.02]*	tr	Monoterpenic ester
$\beta$ -Santalene	0.01*	0.01	Sesquiterpene
( <i>E</i> )- $\beta$ -Farnesene	[0.01]*	0.01	Sesquiterpene
Germacrene D	0.01	0.01	Sesquiterpene
<i>trans</i> - $\beta$ -Bergamotene	0.01	0.01	Sesquiterpene
Valencene	0.01	[0.01]*	Sesquiterpene
Bicyclogermacrene	0.01	[1.98]*	Sesquiterpene
$\beta$ -Bisabolene	0.13*	[0.49]*	Sesquiterpene
$\gamma$ -Cadinene	[0.13]*	tr	Sesquiterpene
( <i>E</i> )- $\alpha$ -Bisabolene	tr	tr	Sesquiterpene
Spathulenol	0.01	0.01	Sesquiterpenic alcohol
Caryophyllene oxide	0.01*	0.01	Sesquiterpenic ether
Caryophyllene oxide isomer	[0.01]*	tr	Sesquiterpenic ether
Isospathulenol	tr	tr	Sesquiterpenic alcohol
Unknown	0.01	0.01	Oxygenated sesquiterpene
$\alpha$ -Bisabolol	0.01	tr	Sesquiterpenic alcohol
<b>Total identified</b>	<b>97.91%</b>	<b>97.80%</b>	

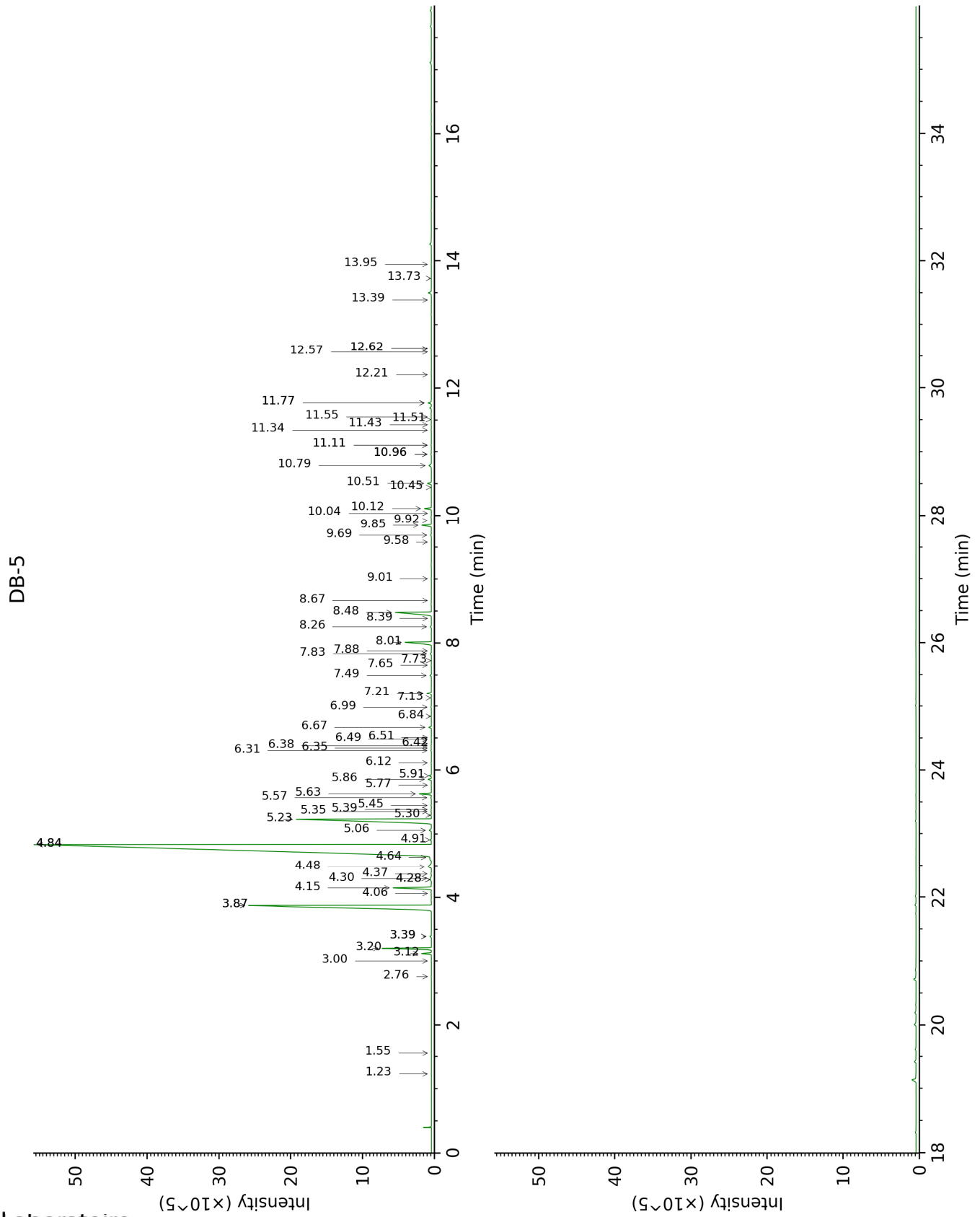
\*: Two or more compounds are coeluting on this column

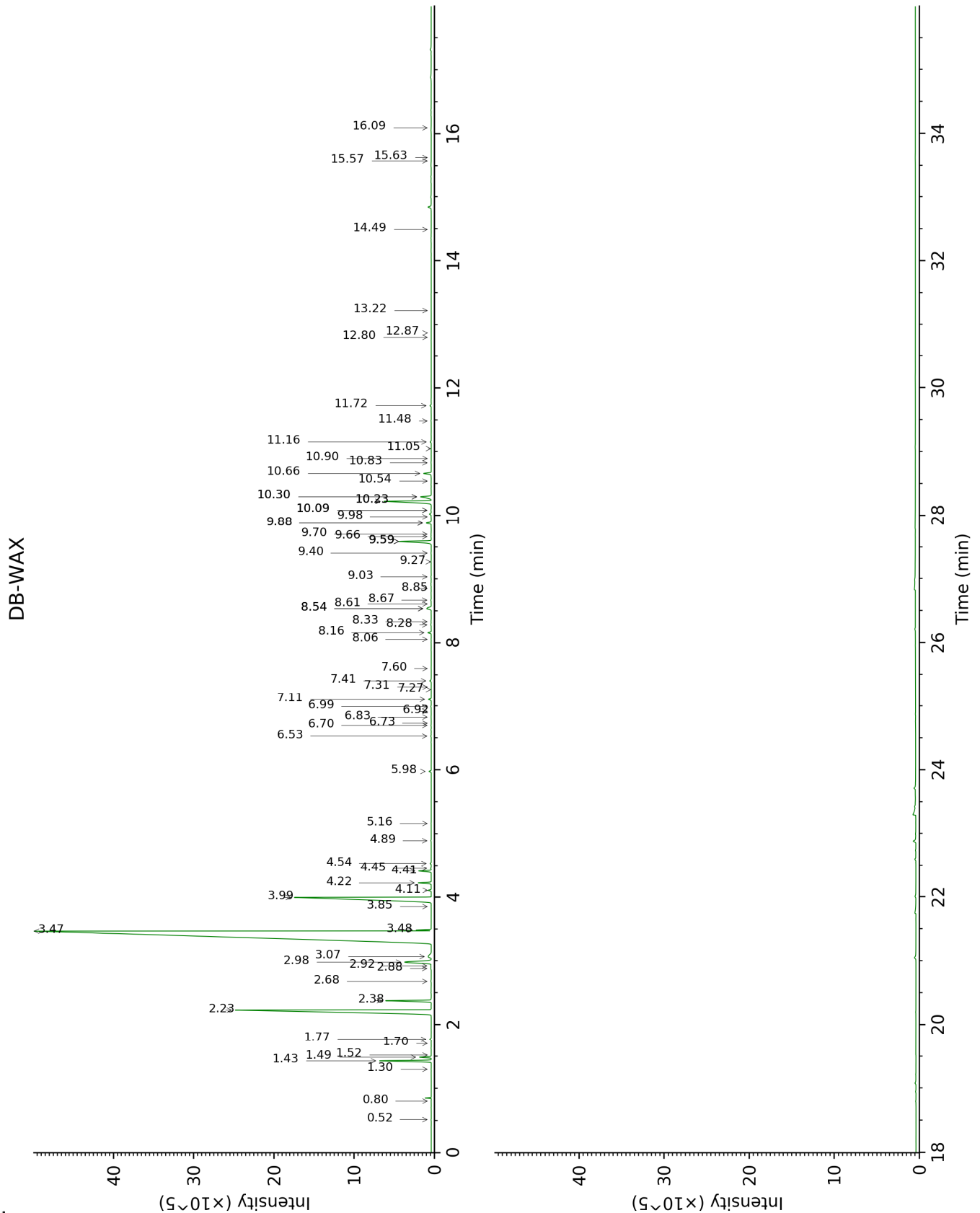
[xx]: Duplicate percentage due to coelutions, not taken account in the identified total

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	%
Toluene	1.23	756	tr	1.52	1004	tr
Octane	1.55	800	tr	0.52	786	tr
Nonane	2.76	900	tr	0.80	893	tr
Tricyclene	3.00	917	0.01	1.30	973	0.01
$\alpha$ -Thujene	3.12	924	0.32	1.49	1001	0.32
$\alpha$ -Pinene	3.20	930	1.61	1.43	993	1.61
$\alpha$ -Fenchene	3.39*	942	0.05	1.70	1021	tr
Camphene	3.39*	942	[0.05]	1.77	1027	0.05
$\beta$ -Pinene	3.87*	974	13.52	2.23	1071	12.12
Sabinene	3.87*	974	[13.52]	2.38	1085	1.40
6-Methyl-5-hepten-2-one	4.06	986	tr	5.16	1301	0.01
Myrcene	4.15	992	1.46	2.98	1134	1.47
Pseudolimonene	4.28*†	1001	0.10	2.92	1129	0.03
$\alpha$ -Phellandrene	4.28*†	1001	[0.10]	2.88	1126	0.03
Octanal	4.30†	1002	[0.10]	4.54	1253	0.03
$\Delta^3$ -Carene	4.37	1006	0.01	2.68	1110	0.02
$\alpha$ -Terpinene	4.48	1014	0.25	3.07	1141	0.26
para-Cymene	4.64†	1023	65.71	4.22	1230	0.39
Limonene	4.84*†	1036	[65.71]	3.47	1172	64.89
1,8-Cineole	4.84*†	1036	[65.71]	3.48	1173	0.29
(Z)- $\beta$ -Ocimene	4.91†	1040	[65.71]	3.85	1202	tr
(E)- $\beta$ -Ocimene	5.06	1050	0.09	4.11	1221	0.09
$\gamma$ -Terpinene	5.23	1061	9.30	3.99	1213	9.33
cis-Sabinene hydrate	5.30	1065	0.01	6.99	1427	0.01
Unknown [m/z 79, 93 (60), 43 (40), 94 (35), 137 (33), 77 (26), 91 (20), 152 (18)]	5.35	1068	0.01	4.89	1281	0.01
cis-Linalool oxide (fur.)	5.39	1070	0.01	6.70	1405	0.01
Octanol	5.45	1074	0.01	8.33	1528	0.01
Terpinolene isomer	5.57	1082	0.02	4.45	1247	0.02
Terpinolene	5.63	1086	0.39	4.41	1244	0.39
trans-Sabinene hydrate	5.77	1094	0.01	8.06	1506	0.01
Linalool	5.86	1100	0.10	8.16	1514	0.11
Nonanal	5.91	1104	0.07	5.98	1354	0.07
trans-para-Mentha-2,8-dien-1-ol	6.12	1117	0.01	9.03	1582	0.01
cis-Limonene oxide	6.31	1129	0.02	6.53	1393	0.02
cis-para-Mentha-2,8-dien-1-ol	6.35	1132	0.01	9.59*	1626	1.25



<i>trans</i> -Limonene oxide	6.38	1134	0.01	6.73	1408	tr
Camphor	6.42	1136	tr	7.31	1451	tr
Camphene hydrate	6.49	1141	tr	8.61	1549	tr
Epoxyterpinolene	6.51	1142	tr	6.83	1415	tr
Citronellal	6.67	1153	0.09	7.11	1436	0.09
Borneol	6.84	1164	0.01	9.88*	1649	0.17
Terpinen-4-ol	6.99	1173	0.02	8.67	1554	0.02
Isogeranial	7.13	1183	0.01	8.28	1524	0.01
$\alpha$ -Terpineol	7.21	1188	0.16	9.88*	1649	[0.17]
Decanal	7.49	1206	0.05	7.41	1458	0.05
<i>trans</i> -Carveol	7.65	1217	0.01	11.48	1783	0.01
2,3-Epoxyneral?	7.73	1222	tr			
Nerol	7.83	1230	0.04	11.16	1755	0.04
2,3-Epoxygeranial?	7.88	1233	0.01			
Neral	8.01	1242	1.21	9.59*	1626	[1.25]
Geraniol	8.26	1259	0.04	11.72	1803	0.04
Perillaldehyde	8.39	1268	tr	10.83	1727	0.01
Geranial	8.48	1274	1.96	10.23*	1677	1.98
Limonen-10-ol	8.67	1287	tr	13.22	1937	tr
Undecanal	9.01	1304	tr	8.85	1567	0.01
$\alpha$ -Cubebene	9.58	1345	tr	6.92	1422	0.01
Citronellyl acetate	9.69	1353	0.03	9.59*	1626	[1.25]
Neryl acetate	9.84	1364	0.35	10.30*	1683	0.49
$\alpha$ -Copaene	9.92	1369	0.01	7.27	1448	tr
$\beta$ -Bourbonene	10.04	1378	tr	7.60	1472	tr
Geranyl acetate	10.12	1383	0.25	10.66	1713	0.26
Dodecanal	10.45	1407	tr	10.08*	1666	0.01
$\beta$ -Caryophyllene	10.51	1412	0.15	8.54*	1543	0.25
<i>trans</i> - $\alpha$ -Bergamotene	10.79	1433	0.13	8.54*	1543	[0.25]
$\alpha$ -Humulene	10.96*	1446	0.02	9.40	1611	0.01
Neryl propionate	10.96*	1446	[0.02]	11.05	1746	tr
$\beta$ -Santalene	11.11*	1457	0.01	9.27	1600	0.01
( <i>E</i> )- $\beta$ -Farnesene	11.11*	1457	[0.01]	9.70	1635	0.01
Germacrene D	11.34	1474	0.01	9.98	1658	0.01
<i>trans</i> - $\beta$ -Bergamotene	11.43	1481	0.01	9.66	1632	0.01
Valencene	11.51	1487	0.01	10.08*	1666	[0.01]
Bicyclogermacrene	11.55	1490	0.01	10.23*	1677	[1.98]
$\beta$ -Bisabolene	11.77*	1506	0.13	10.30*	1683	[0.49]
$\gamma$ -Cadinene	11.77*	1506	[0.13]	10.54	1703	tr
( <i>E</i> )- $\alpha$ -Bisabolene	12.21	1542	tr	10.90	1733	tr
Spathulenol	12.57	1570	0.01	14.49	2057	0.01
Caryophyllene oxide	12.62*	1574	0.01	12.87	1905	0.01
Caryophyllene oxide isomer	12.62*	1574	[0.01]	12.80	1899	tr
Isospathulenol	13.39	1636	tr	15.63	2169	tr
Unknown [m/z 69, 95 (100), 41 (89),	13.73	1665	0.01	16.09	2216	0.01

109 (68), 67 (61)...222]						
$\alpha$ -Bisabolol	13.95	1683	0.01	15.58	2164	tr
<b>Total identified</b>	<b>97.91%</b>			<b>97.80%</b>		
<b>Total reported</b>	<b>97.93%</b>			<b>97.82%</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