

**Date :** November 23, 2018

**CERTIFICATE OF ANALYSIS – GC PROFILING**

*SAMPLE IDENTIFICATION*

**Internal code :** 18K20-PTH11-1-CC

**Customer identification :** Bergamot Organic BF - Italy - BQ010386R

**Type :** Essential oil

**Source :** *Citrus aurantium* var. *bergamia*

**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 :** November 21, 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:**  $1.4643 \pm 0.0003$  (20 °C)

*CONCLUSION*

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

## ANALYSIS SUMMARY

Identification	DB-5 (%)	DB-WAX (%)	Classe
Toluene	tr	0.30*	Simple phenolic
Tricyclene	tr	tr	Monoterpene
$\alpha$ -Thujene	0.31	[0.30]*	Monoterpene
$\alpha$ -Pinene	1.13	1.12	Monoterpene
Camphene	0.03	0.03	Monoterpene
Sabinene	6.51*	0.99	Monoterpene
$\beta$ -Pinene	[6.51]*	5.45	Monoterpene
Myrcene	1.08	1.07	Monoterpene
$\alpha$ -Phellandrene	0.03	0.03	Monoterpene
Octanal	0.05	0.04	Aliphatic aldehyde
$\Delta^3$ -Carene	tr	tr	Monoterpene
$\alpha$ -Terpinene	0.16	0.16	Monoterpene
ortho-Cymene	tr	0.42*	Simple phenolic
para-Cymene	0.38	[0.42]*	Monoterpene
1,8-Cineole	44.19*	0.21	Monoterpenic ether
Limonene	[44.19]*	43.51	Monoterpene
(Z)- $\beta$ -Ocimene	0.02	7.45*	Monoterpene
(E)- $\beta$ -Ocimene	0.25	0.25	Monoterpene
$\gamma$ -Terpinene	7.48	[7.45]*	Monoterpene
cis-Sabinene hydrate	0.04	0.05*	Monoterpenic alcohol
cis-Linalool oxide (fur.)	tr	0.01	Monoterpenic alcohol
Octanol	0.01	24.25*	Aliphatic alcohol
Terpinolene	0.35*	0.35	Monoterpene
trans-Linalool oxide (fur.)	[0.35]*	[0.05]*	Monoterpenic alcohol
trans-Sabinene hydrate	0.01	0.01	Monoterpenic alcohol
Linalool	9.04	9.36	Monoterpenic alcohol
Nonanal	0.02	0.02	Aliphatic aldehyde
cis-Limonene oxide	0.01	0.01	Monoterpenic ether
trans-Limonene oxide	0.01	0.01	Monoterpenic ether
Camphor	0.01	0.01	Monoterpenic ketone
Epoxyterpinolene	0.01	tr	Monoterpenic ether
Citronellal	0.02	0.02	Monoterpenic aldehyde
Borneol	0.01	0.01	Monoterpenic alcohol
Terpinen-4-ol	0.04	0.04	Monoterpenic alcohol
$\alpha$ -Terpineol	0.24	0.29*	Monoterpenic alcohol
$\gamma$ -Terpineol	tr	0.01	Monoterpenic alcohol
Unknown	tr		Unknown
Decanal	0.05	0.05	Aliphatic aldehyde
Octyl acetate	0.10	0.10	Aliphatic ester
Nerol	0.06	0.07	Monoterpenic alcohol
Citronellol	0.01	0.02*	Monoterpenic alcohol
Neral	0.27	0.27	Monoterpenic aldehyde
Geraniol	24.14*	0.04	Monoterpenic alcohol
Linalyl acetate	[24.14]*	[24.25]*	Monoterpenic ester
Unknown	0.01	0.01	Unknown
Geranial	0.40	0.40	Monoterpenic aldehyde
Unknown	tr		Unknown
Bornyl acetate	0.02	0.03	Monoterpenic ester

<i>cis</i> -para-Mentha-2,8-diene-1-hydroperoxide	0.01		Monoterpenic peroxide
<i>trans</i> -para-Mentha-2,8-diene-1-hydroperoxide	0.01		Monoterpenic peroxide
para-Mentha-1,8-diene-4-hydroperoxide	0.01		Monoterpenic peroxide
Linalyl propionate	0.03	0.03	Monoterpenic ester
Hodiendiol derivative	tr	0.01	Oxygenated monoterpene
$\alpha$ -Terpinyl acetate	0.16	0.19	Monoterpenic ester
Unknown	0.09		Monoterpenic ester
Hodiendiol derivative III	0.01		Oxygenated monoterpene
Neryl acetate	0.41	0.41	Monoterpenic ester
Geranyl acetate	0.42	0.43	Monoterpenic ester
Dodecanal	0.01	0.02	Aliphatic aldehyde
$\beta$ -Caryophyllene	0.36*	0.63*	Sesquiterpene
<i>cis</i> - $\alpha$ -Bergamotene	[0.36]*	0.02	Sesquiterpene
<i>trans</i> - $\alpha$ -Bergamotene	0.30	[0.63]*	Sesquiterpene
$\alpha$ -Humulene	0.03	0.03	Sesquiterpene
( <i>E</i> )- $\beta$ -Farnesene	0.06	0.05	Sesquiterpene
Germacrene D	0.05	[0.29]*	Sesquiterpene
( <i>Z</i> )- $\alpha$ -Bisabolene	0.01	0.01	Sesquiterpene
$\beta$ -Bisabolene	0.40	0.44	Sesquiterpene
( <i>E</i> )- $\alpha$ -Bisabolene	0.02	[0.02]*	Sesquiterpene
( <i>E</i> )-Nerolidol	0.02	0.02	Sesquiterpenic alcohol
Caryophyllene oxide	0.01	0.01	Sesquiterpenic ether
$\alpha$ -Bisabolol	0.01	0.02	Sesquiterpenic alcohol
Nootkatone	0.01	0.01	Sesquiterpenic ketone
<b>Total identified</b>	<b>98.85%</b>	<b>98.76%</b>	

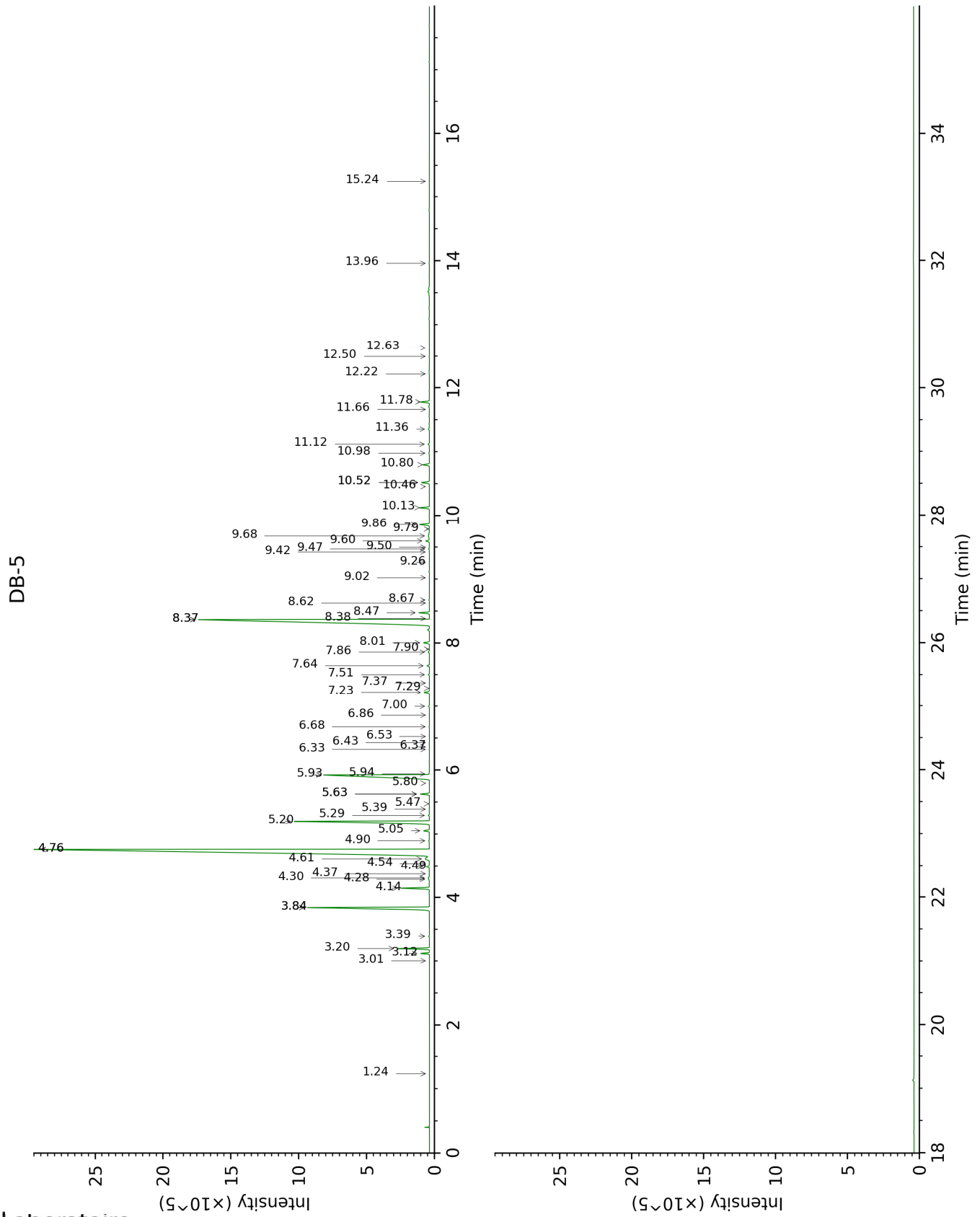
\*: Two or more compounds are coeluting on this column

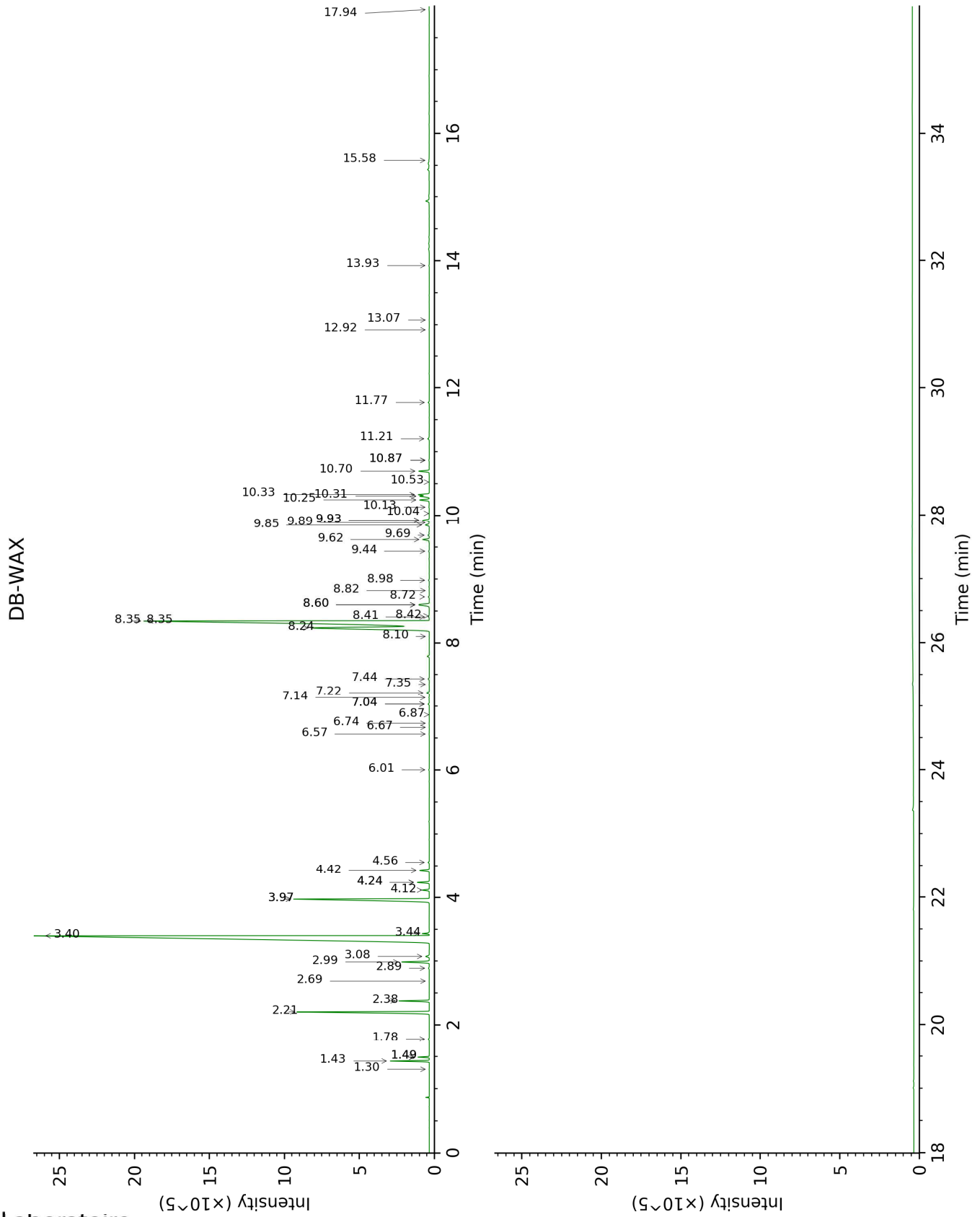
[xx]: Duplicate percentage due to coelutions, not taken account in the identified total

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	1.24	757	tr	1.49*	1001	0.30
Tricyclene	3.01	917	tr	1.30	974	tr
$\alpha$ -Thujene	3.12	925	0.31	1.49*	1001	[0.30]
$\alpha$ -Pinene	3.20	930	1.13	1.43	993	1.12
Camphene	3.39	942	0.03	1.78	1028	0.03
Sabinene	3.84*	972	6.51	2.38	1085	0.99
$\beta$ -Pinene	3.84*	972	[6.51]	2.21	1069	5.45
Myrcene	4.14	992	1.08	2.99	1134	1.07
$\alpha$ -Phellandrene	4.28	1001	0.03	2.89	1127	0.03
Octanal	4.30	1002	0.05	4.56	1255	0.04
$\Delta$ 3-Carene	4.37	1006	tr	2.69	1111	tr
$\alpha$ -Terpinene	4.49	1014	0.16	3.08	1141	0.16
ortho-Cymene	4.54	1017	tr	4.24*	1231	0.42
para-Cymene	4.61	1022	0.38	4.24*	1231	[0.42]
1,8-Cineole	4.76*	1031	44.19	3.44	1169	0.21
Limonene	4.76*	1031	[44.19]	3.40	1166	43.51
(Z)- $\beta$ -Ocimene	4.90	1040	0.02	3.97*	1211	7.45
(E)- $\beta$ -Ocimene	5.05	1049	0.25	4.12	1222	0.25
$\gamma$ -Terpinene	5.20	1059	7.48	3.97*	1211	[7.45]
cis-Sabinene hydrate	5.29	1064	0.04	7.04*	1430	0.05
cis-Linalool oxide (fur.)	5.39	1071	tr	6.67	1404	0.01
Octanol	5.48	1076	0.01	8.34*	1529	24.25
Terpinolene	5.63*	1086	0.35	4.42	1245	0.35
trans-Linalool oxide (fur.)	5.63*	1086	[0.35]	7.04*	1430	[0.05]
trans-Sabinene hydrate	5.80	1096	0.01	8.10	1510	0.01
Linalool	5.93	1105	9.04	8.24	1520	9.36
Nonanal	5.94	1106	0.02	6.01	1356	0.02
cis-Limonene oxide	6.33	1130	0.01	6.57	1396	0.01
trans-Limonene oxide	6.37	1133	0.01	6.74	1408	0.01
Camphor	6.43	1137	0.01	7.35	1454	0.01
Epoxyterpinolene	6.53	1144	0.01	6.87	1418	tr
Citronellal	6.68	1153	0.02	7.14	1438	0.02
Borneol	6.86	1165	0.01	9.89	1650	0.01
Terpinen-4-ol	7.00	1174	0.04	8.72	1558	0.04
$\alpha$ -Terpineol	7.23	1189	0.24	9.93*	1653	0.29
$\gamma$ -Terpineol	7.29	1193	tr	10.04	1662	0.01
Unknown [m/z 43, 71 (80), 67 (55), 59 (51), 68 (44), 41 (43)...]	7.37	1199	tr			
Decanal	7.51	1207	0.05	7.44	1460	0.05
Octyl acetate	7.64	1217	0.10	7.22	1444	0.10



Nerol	7.86	1231	0.06	11.21	1759	0.07
Citronellol	7.90	1235	0.01	10.87*	1731	0.02
Neral	8.00	1242	0.27	9.62	1628	0.27
Geraniol	8.37*	1266	24.14	11.77	1808	0.04
Linalyl acetate	8.37*	1266	[24.14]	8.34*	1529	[24.25]
Unknown [m/z 43, 111 (47), 93 (41), 55 (28), 67 (23), 41 (22)...]	8.38	1267	0.01	8.82	1565	0.01
Geranial	8.48	1274	0.40	10.25	1679	0.40
Unknown [m/z 43, 121 (74), 93 (42), 95 (38), 107 (29), 41 (29), 136 (28)...]	8.62	1284	tr			
Bornyl acetate	8.67	1288	0.02	8.41	1534	0.03
<i>cis</i> -para-Mentha- 2,8-diene-1- hydroperoxide	9.02	1305	0.01			
<i>trans</i> -para- Mentha-2,8- diene-1- hydroperoxide	9.26	1322	0.01			
para-Mentha-1,8- diene-4- hydroperoxide	9.42	1334	0.01			
Linalyl propionate	9.47	1337	0.03	8.98	1578	0.03
Hodiendiol derivative	9.50	1339	tr	13.07	1924	0.01
$\alpha$ -Terpinyl acetate	9.60	1346	0.16	9.85	1647	0.19
Unknown [m/z 43, 121 (52), 93 (48), 79 (33), 41 (30), 136 (26), 81 (25)...]	9.68	1352	0.09			
Hodiendiol derivative III	9.78	1360	0.01			
Neryl acetate	9.86	1365	0.41	10.31	1684	0.41
Geranyl acetate	10.13	1384	0.42	10.70	1716	0.43
Dodecanal	10.46	1408	0.01	10.14	1670	0.02
$\beta$ -Caryophyllene	10.52*	1413	0.36	8.60*	1548	0.63
<i>cis</i> - $\alpha$ - Bergamotene	10.52*	1413	[0.36]	8.42	1535	0.02
<i>trans</i> - $\alpha$ - Bergamotene	10.80	1434	0.30	8.60*	1548	[0.63]
$\alpha$ -Humulene	10.98	1447	0.03	9.44	1614	0.03
( <i>E</i> )- $\beta$ -Farnesene	11.12	1458	0.06	9.69	1634	0.05
Germacrene D	11.36	1476	0.05	9.93*	1653	[0.29]
( <i>Z</i> )- $\alpha$ -Bisabolene	11.66	1499	0.01	10.53	1702	0.01
$\beta$ -Bisabolene	11.78	1508	0.40	10.33	1686	0.44

(E)- $\alpha$ -Bisabolene	12.22	1542	0.02	10.87*	1731	[0.02]
(E)-Nerolidol	12.50	1564	0.02	13.93	2003	0.02
Caryophyllene oxide	12.63	1575	0.01	12.92	1910	0.01
$\alpha$ -Bisabolol	13.96	1684	0.01	15.58	2164	0.02
Nootkatone	15.24	1795	0.01	17.94	2413	0.01
<b>Total identified</b>		<b>98.85%</b>			<b>98.76%</b>	
<b>Total reported</b>		<b>98.95%</b>			<b>98.77%</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

R.T.: Retention time (minutes)

R.I.: Retention index