

**Date :** April 09, 2019

**CERTIFICATE OF ANALYSIS – GC PROFILING**

**SAMPLE IDENTIFICATION**

**Internal code :** 19D02-PTH01-1-SCC

**Customer identification :** Mandarin Green - M1010389R

**Type :** Essential oil

**Source :** *Citrus reticulata* cv. Mandarine

**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 :** Benoit Roger, Ph. D.

**Analysis date :** April 04, 2019

Checked and approved by :

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

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*PHYSICOCHEMICAL DATA*

**Physical aspect:** Dark yellowish brown liquid

**Refractive index:** 1.4746 ± 0.0003 (20 °C)

*ISO 3528:2012 - OIL OF MANDARIN, ITALIAN TYPE - GREEN*

<b>Compound</b>	<b>Min. %</b>	<b>Max. %</b>	<b>Observed %</b>	<b>Complies?</b>
α-Sinensal	0.2	0.5	0.2	Yes
Dimethyl anthranilate	0.4	0.7	0.3	No
Decanal	0.04	0.14	0.06	Yes
Linalool	0.05	0.20	0.10	Yes
Limonene	65.0	74.0	69.4	Yes
γ-Terpinene	17.0	22.0	15.8	No
Octanal		0.14	0.10	Yes
Myrcene	1.4	2.0	1.7	Yes
β-Pinene	1.0	2.0	1.5	Yes
α-Pinene	1.6	2.7	2.0	Yes
<b>Refractive index</b>	1.4732	1.4758	1.4746	Yes

*CONCLUSION*

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

## ANALYSIS SUMMARY

Identification	DB-5 (%)	DB-WAX (%)	Classe
Heptanal	0.01		Aliphatic aldehyde
$\alpha$ -Thujene	0.61	0.61	Monoterpene
$\alpha$ -Pinene	2.01	1.94	Monoterpene
Camphene	0.02*	0.01	Monoterpene
$\alpha$ -Fenchene	[0.02]*	tr	Monoterpene
Sabinene	1.80*	0.26	Monoterpene
$\beta$ -Pinene	[1.80]*	1.52	Monoterpene
Myrcene	1.65	1.61	Monoterpene
$\alpha$ -Phellandrene	0.05	0.05	Monoterpene
Octanal	0.10	0.08	Aliphatic aldehyde
$\Delta^3$ -Carene	0.01	0.01	Monoterpene
para-Cymene	72.21	0.70	Monoterpene
Limonene	[72.21]*	69.37	Monoterpene
$\beta$ -Phellandrene	[72.21]*	0.22*	Monoterpene
1,8-Cineole	[72.21]*	[0.22]*	Monoterpenic ether
(Z)- $\beta$ -Ocimene	tr	15.48*	Monoterpene
(E)- $\beta$ -Ocimene	0.05	0.05	Monoterpene
$\gamma$ -Terpinene	15.85	[15.48]*	Monoterpene
cis-Sabinene hydrate	0.02	0.03	Monoterpenic alcohol
Octanol	0.02	0.02	Aliphatic alcohol
Terpinolene	0.46	0.45	Monoterpene
trans-Sabinene hydrate	0.04	0.04	Monoterpenic alcohol
Linalool	0.10	0.10*	Monoterpenic alcohol
Nonanal	0.02	0.01	Aliphatic aldehyde
trans-para-Mentha-2,8-dien-1-ol	0.01	0.01	Monoterpenic alcohol
cis-Limonene oxide	0.01	0.01	Monoterpenic ether
cis-para-Mentha-2,8-dien-1-ol	0.01	0.02*	Monoterpenic alcohol
trans-Limonene oxide	0.01	0.01	Monoterpenic ether
Epoxyterpinolene	0.01	0.01	Monoterpenic ether
Citronellal	0.02	0.02	Monoterpenic aldehyde
Borneol	0.01	0.16*	Monoterpenic alcohol
Terpinen-4-ol	0.06	0.04	Monoterpenic alcohol
$\alpha$ -Terpineol	0.16	[0.16]*	Monoterpenic alcohol
Unknown	0.01	0.02	Unknown
Unknown	0.01	[0.10]*	Unknown
Decanal	0.06	0.06	Aliphatic aldehyde
trans-Carveol	0.01	0.01	Monoterpenic alcohol
Nerol	0.01	0.01	Monoterpenic alcohol
Citronellol	0.02	0.02	Monoterpenic alcohol
Carvone	0.02*	0.02	Monoterpenic ketone
Neral	[0.02]*	[0.02]*	Monoterpenic aldehyde
Geranial	0.04	0.01	Monoterpenic aldehyde
Thymol	0.06	0.06	Monoterpenic alcohol
Undecanal	0.01	0.01	Aliphatic aldehyde
$\alpha$ -Copaene	0.02	0.02	Sesquiterpene
Geranyl acetate	0.02	0.03	Monoterpenic ester
$\beta$ -Elemene	0.01	0.08*	Sesquiterpene
Dimethyl anthranilate	0.28	0.27	Phenolic ester

Dodecanal	0.02	0.01	Aliphatic aldehyde
$\beta$ -Caryophyllene	0.08	[0.08]*	Sesquiterpene
$\alpha$ -Humulene	0.01	0.01	Sesquiterpene
(2E)-Dodecenal	0.02	0.01	Aliphatic aldehyde
Germacrene D	0.02	[0.16]*	Sesquiterpene
$\alpha$ -Selinene	0.05	0.04	Sesquiterpene
(3E,6E)- $\alpha$ -Farnesene	0.18	0.15	Sesquiterpene
$\delta$ -Cadinene	0.03	0.02	Sesquiterpene
Caryophyllene oxide	0.02*		Sesquiterpenic ether
Spathulenol	[0.02]*		Sesquiterpenic alcohol
(2E)-Tetradecenal	0.01		Aliphatic aldehyde
$\alpha$ -Sinensal	0.13	0.18	Sesquiterpenic aldehyde
Myristic acid	0.03		Aliphatic acid
Palmitic acid	0.18		Aliphatic acid
Tangeretin	0.21		Flavonoid
3,3',4',5,6,7,8-Heptamethoxyflavone	0.07		Flavonoid
Nobiletin	0.07		Flavonoid
$\alpha$ -Terpinene		0.24	Monoterpene
<b>Total identified</b>	<b>97.02%</b>	<b>94.10%</b>	

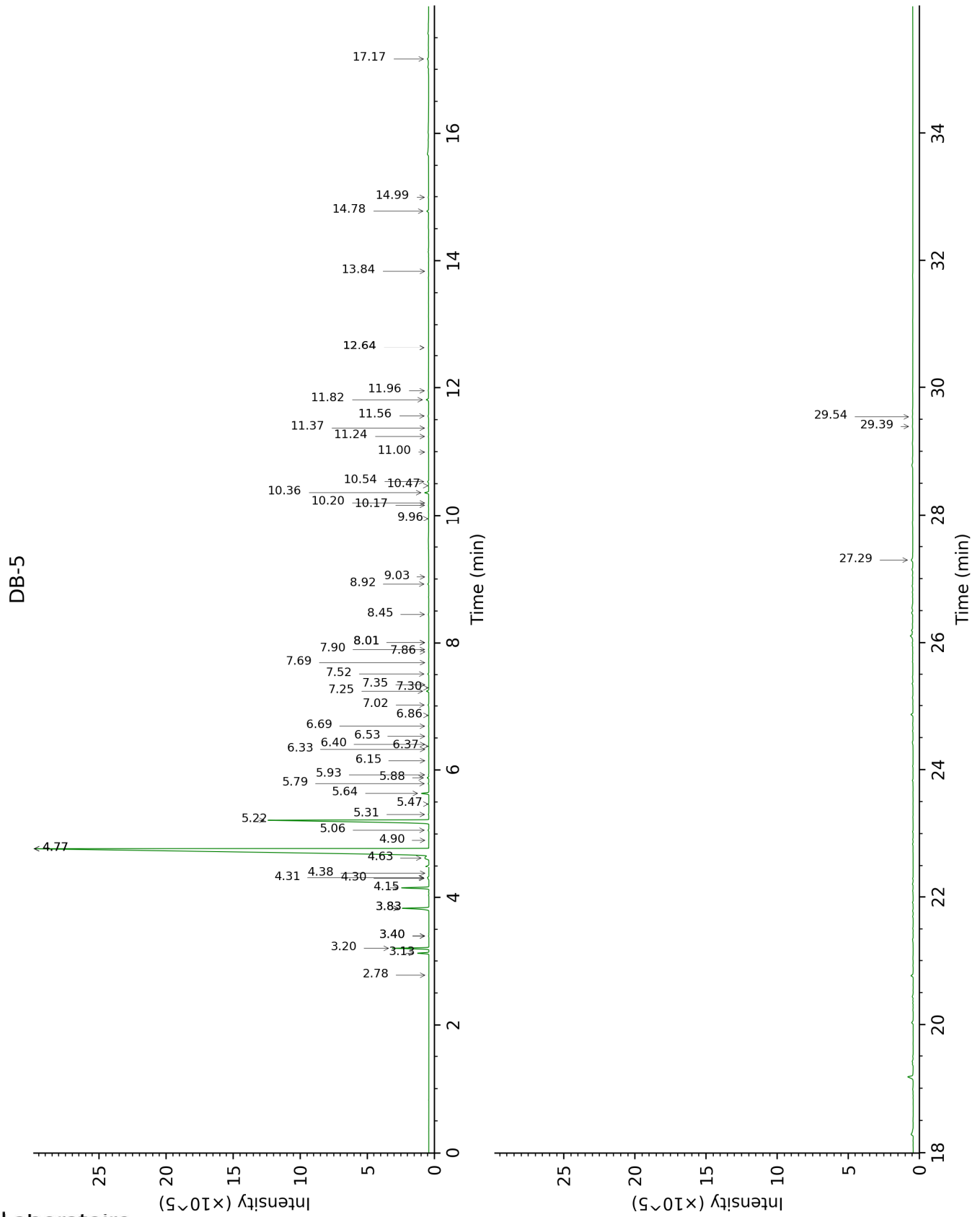
\*: Two or more compounds are coeluting on this column

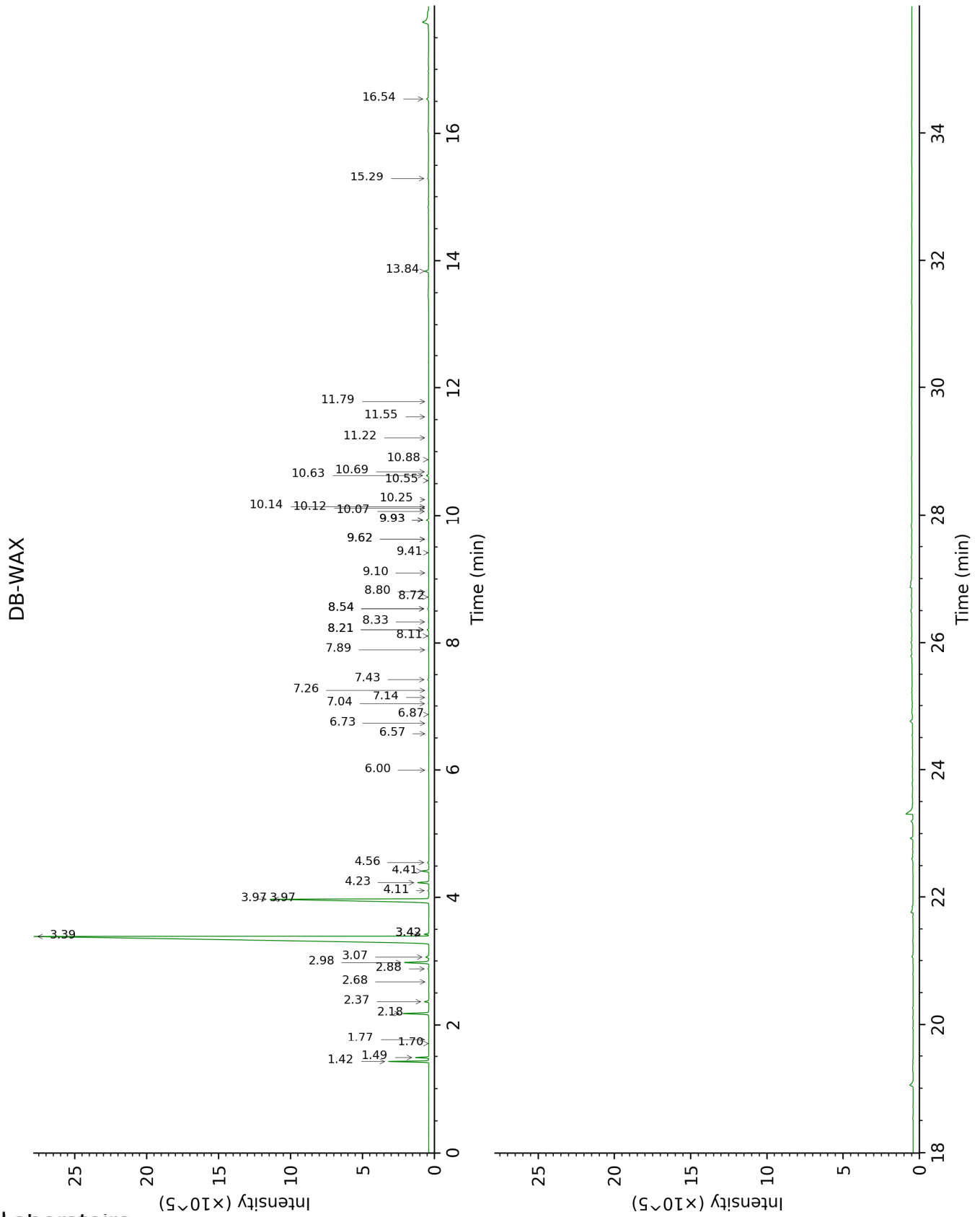
[xx]: Duplicate percentage due to coelutions, not taken account in the identified total

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	%
Heptanal	2.78	901	0.01			
α-Thujene	3.13	924	0.61	1.49	998	0.61
α-Pinene	3.20	929	2.01	1.42	992	1.94
Camphene	3.40*	942	0.02	1.77	1027	0.01
α-Fenchene	3.40*	942	[0.02]	1.70	1020	tr
Sabinene	3.83*	970	1.80	2.37	1085	0.26
β-Pinene	3.83*	970	[1.80]	2.18	1067	1.52
Myrcene	4.15	992	1.65	2.98	1134	1.61
α-Phellandrene	4.30	1001	0.05	2.88	1126	0.05
Octanal	4.31	1002	0.10	4.56	1251	0.08
Δ3-Carene	4.38	1006	0.01	2.68	1110	0.01
para-Cymene	4.63†	1022	72.21	4.23	1228	0.70
Limonene	4.77*†	1031	[72.21]	3.39	1165	69.37
β-Phellandrene	4.77*†	1031	[72.21]	3.42*	1168	0.22
1,8-Cineole	4.77*†	1031	[72.21]	3.42*	1168	[0.22]
(Z)-β-Ocimene	4.90	1040	tr	3.97*	1209	15.48
(E)-β-Ocimene	5.06	1050	0.05	4.10	1218	0.05
γ-Terpinene	5.22	1059	15.85	3.97*	1209	[15.48]
cis-Sabinene hydrate	5.31	1065	0.02	7.04	1430	0.03
Octanol	5.47	1075	0.02	8.33	1527	0.02
Terpinolene	5.64	1086	0.46	4.41	1240	0.45
trans-Sabinene hydrate	5.79	1096	0.04	8.11	1510	0.04
Linalool	5.88	1101	0.10	8.21*	1517	0.10
Nonanal	5.93	1104	0.02	6.00	1354	0.01
trans-para-Mentha-2,8-dien-1-ol	6.15	1118	0.01	9.10	1586	0.01
cis-Limonene oxide	6.32	1130	0.01	6.57	1395	0.01
cis-para-Mentha-2,8-dien-1-ol	6.37	1133	0.01	9.62*	1628	0.02
trans-Limonene oxide	6.40	1135	0.01	6.73	1407	0.01
Epoxyterpinolene	6.53	1143	0.01	6.87	1418	0.01
Citronellal	6.69	1153	0.02	7.14	1437	0.02
Borneol	6.86	1164	0.01	9.93*	1653	0.16
Terpinen-4-ol	7.02	1175	0.06	8.72	1556	0.04
α-Terpineol	7.25	1190	0.16	9.93*	1653	[0.16]
Unknown [m/z 121, 79 (98), 93 (87), 94 (73), 91 (63), 105 (45)...]	7.30	1193	0.01	7.89	1493	0.02
Unknown [m/z 121, 79 (61), 93 (55), 94 (40), 91 (39), 84 (37)...]	7.35	1196	0.01	8.21*	1517	[0.10]
Decanal	7.52	1207	0.06	7.43	1458	0.06
trans-Carveol	7.69	1219	0.01	11.55	1787	0.01
Nerol	7.86	1230	0.01	11.22	1760	0.01
Citronellol	7.90	1233	0.02	10.88	1731	0.02
Carvone	8.01*	1240	0.02	10.12	1668	0.02



Neral	8.01*	1240	[0.02]	9.62*	1628	[0.02]
Geranial	8.45	1270	0.04	10.25	1678	0.01
Thymol	8.92	1303	0.06	15.29	2134	0.06
Undecanal	9.03	1306	0.01	8.80	1563	0.01
$\alpha$ -Copaene	9.96	1371	0.02	7.26	1446	0.02
Geranyl acetate	10.17	1386	0.02	10.69	1715	0.03
$\beta$ -Elemene	10.20	1388	0.01	8.54*	1542	0.08
Dimethyl anthranilate	10.36	1400	0.28	13.84	1993	0.27
Dodecanal	10.47	1408	0.02	10.14	1670	0.01
$\beta$ -Caryophyllene	10.54	1413	0.08	8.54*	1542	[0.08]
$\alpha$ -Humulene	11.00	1447	0.01	9.41	1611	0.01
(2E)-Dodecenal	11.24	1465	0.02	11.79	1808	0.01
Germacrene D	11.37	1475	0.02	9.93*	1653	[0.16]
$\alpha$ -Selinene	11.56	1489	0.05	10.07	1664	0.04
(3E,6E)- $\alpha$ -Farnesene	11.82	1508	0.18	10.63	1710	0.15
$\delta$ -Cadinene	11.96	1520	0.03	10.55	1703	0.02
Caryophyllene oxide	12.64*	1573	0.02			
Spathulenol	12.64*	1573	[0.02]			
(2E)-Tetradecenal	13.84	1671	0.01			
$\alpha$ -Sinensal	14.78	1751	0.13	16.54	2262	0.18
Myristic acid	14.99	1770	0.03			
Palmitic acid	17.17	1969	0.18			
Tangeretin	27.29	3144	0.21			
3,3',4',5,6,7,8- Heptamethoxyflavone	29.39	3319	0.07			
Nobiletin	29.54	3329	0.07			
$\alpha$ -Terpinene				3.07	1140	0.24
<b>Total identified</b>		<b>97.02%</b>			<b>94.10%</b>	
<b>Total reported</b>		<b>97.03%</b>			<b>94.11%</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