Date : March 22, 2019

Certificate of Analysis – GC Profiling

Sample identification

Internal code : 19C11-PTH02-1-SCC
Customer identification : Mandarin Green Organic - Italy - MI0103811R
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 : Lindsay Girard, B. Sc.
Analysis date : March 14, 2019

Checked and approved by :

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

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PHYSICOCHEMICAL DATA

Physical aspect: Dark greenish Brown liquid
Refractive index: 1.4725 ± 0.0003 (20 °C)

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

Compound	Min. %	Max. %	Observed %	Complies?
α-Sinensal	0.2	0.5	0.4	Yes
Dimethyl anthranilate	0.4	0.7	0.6	Yes
Decanal	0.04	0.14	0.09	Yes
Linalool	0.05	0.20	0.14	Yes
Limonene	65.0	74.0	65.9	Yes
γ-Terpinene	17.0	22.0	20.9	Yes
Octanal		0.14	0.11	Yes
Myrcene	1.4	2.0	1.7	Yes
β-Pinene	1.0	2.0	1.7	Yes
α-Pinene	1.6	2.7	2.2	Yes
Refractive index	1.4732	1.4758	1.4725	No

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
α-Thujene	0.84	0.83	Monoterpene
α-Pinene	2.18	2.17	Monoterpene
Camphene	0.02	0.02	Monoterpene
Sabinene	1.94*	0.29	Monoterpene
β-Pinene	[1.94]*	1.66	Monoterpene
Myrcene	1.71	1.71	Monoterpene
Octanal	0.19*	0.11	Aliphatic aldehyde
α-Phellandrene	[0.19]*	0.07	Monoterpene
α-Terpinene	0.43	0.43	Monoterpene
para-Cymene	0.47	0.52	Monoterpene
Limonene	65.88*	65.88	Monoterpene
β-Phellandrene	[65.88]*	[65.88]*	Monoterpene
1,8-Cineole	[65.88]*	[65.88]*	Monoterpenic ether
(*Z*)-β-Ocimene	0.01	20.92*	Monoterpene
(*E*)-β-Ocimene	0.03	0.03	Monoterpene
γ-Terpinene	20.91	[20.92]*	Monoterpene
cis-Sabinene hydrate	0.04	0.04	Monoterpenic alcohol
Octanol	0.01	0.02	Aliphatic alcohol
Terpinolene	0.93	0.94	Monoterpene
trans-Sabinene hydrate	0.07	0.07	Monoterpenic alcohol
Linalool	0.14	0.15	Monoterpenic alcohol
Nonanal	0.03	0.03	Aliphatic aldehyde
trans-para-Mentha-2,8-dien-1-ol	0.01	0.01	Monoterpenic alcohol
trans-Limonene oxide	0.01	0.01	Monoterpenic ether
Epoxyterpinolene	0.01	0.01	Monoterpenic ether
Citronellal	0.03	0.03	Monoterpenic aldehyde
trans-β-Terpineol	0.02	0.02	Monoterpenic alcohol
Terpinen-4-ol	0.08*	0.05	Monoterpenic alcohol
Nonanol	[0.08]*	0.04*	Aliphatic alcohol
para-Cymen-8-ol	0.01	0.01	Monoterpenic alcohol
α-Terpineol	0.20	0.20	Monoterpenic alcohol
γ-Terpineol	0.01	0.02	Monoterpenic alcohol
Decanal	0.09	0.09	Aliphatic aldehyde
Nerol	0.01	0.02	Monoterpenic alcohol
Citronellol	0.02	0.04	Monoterpenic alcohol
Neral	0.02	[0.04]*	Monoterpenic aldehyde
Geraniol	0.01	0.04*	Monoterpenic alcohol
Geranial	0.02	0.08	Monoterpenic aldehyde
Unknown	0.01	0.01	Oxygenated monoterpene
cis-Ascaridole glycol?	0.02	0.01	Monoterpenic alcohol
Perillyl alcohol	0.01	0.01	Monoterpenic alcohol
Thymol	0.17	0.16	Monoterpenic alcohol
Undecanal	0.02	0.01	Aliphatic aldehyde
α-Copaene	0.01	0.01	Sesquiterpene
Geranyl acetate	0.01	0.06	Monoterpenic ester
β-Cubebene	0.01	0.01	Sesquiterpene
Dimethyl anthranilate	0.59	0.59	Phenolic ester

Dodecanal	0.03	0.02	Aliphatic aldehyde
β-Caryophyllene	0.16	0.16	Sesquiterpene
α-Humulene	0.02	0.02	Sesquiterpene
(2*E*)-Dodecenal	0.03	[0.04]*	Aliphatic aldehyde
Germacrene D	0.01	0.01	Sesquiterpene
α-Selinene	0.08	0.07	Sesquiterpene
(3*E*,6*E*)-α-Farnesene	0.37	0.36	Sesquiterpene
δ-Cadinene	0.01	0.02	Sesquiterpene
Spathulenol	0.01		Sesquiterpenic alcohol
(2*E*)-Tetradecenal	0.01	0.02	Aliphatic aldehyde
β-Sinensal	0.03		Sesquiterpenic aldehyde
α-Sinensal	0.38	0.38	Sesquiterpenic aldehyde
Myristic acid	0.04	0.05	Aliphatic acid
Palmitic acid	0.11	0.14	Aliphatic acid
Linoleic acid	0.04		Aliphatic acid
Oleic acid	0.04	0.06*	Aliphatic acid
cis-Vaccenic acid?	0.01	[0.06]*	Aliphatic acid
Stearic acid	0.20	0.26	Aliphatic acid
Tangeretin	0.17		Flavonoid
3,3',4',5,6,7,8-Heptamethoxyflavone	0.04		Flavonoid
Nobiletin	0.08		Flavonoid
Total identified	**99.10%**	**99.03%**	

*: Two or more compounds are coeluting on this column
[xx]: Duplicate percentage due to coelutions, not taken account in the identified total
Note: no correction factor was applied

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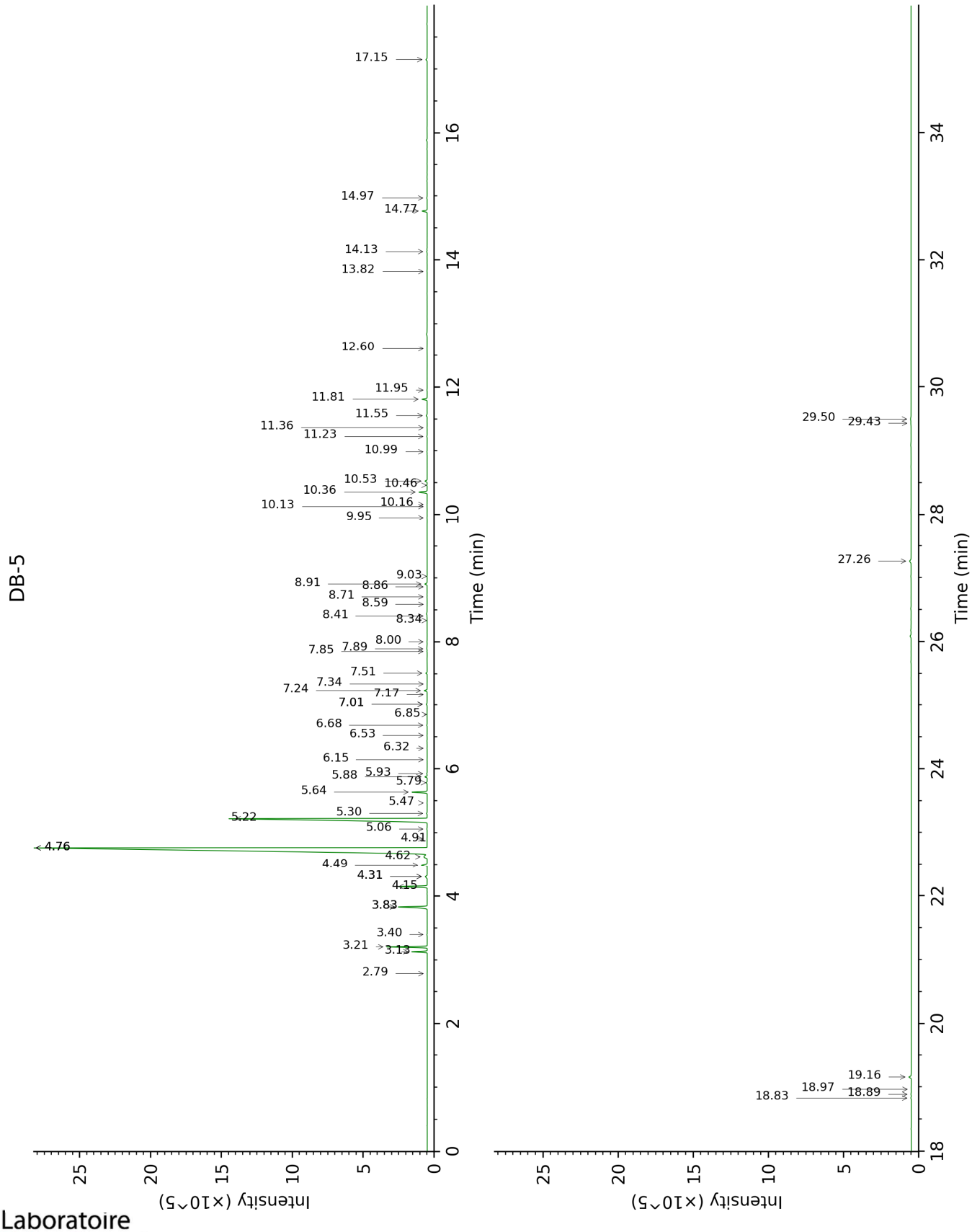
DB-5
17.15
14.97
14.77
14.13
13.82
12.60
11.95
11.81
11.55
11.36
11.23
10.99
10.53
10.46
10.36
10.13
10.16
9.95
9.03
8.91
8.86
8.71
8.59
8.41
8.34
8.00
7.85
7.89
7.51
7.34
7.24
7.17
7.01
6.85
6.68
6.53
6.32
6.15
5.88
5.93
5.79
5.64
5.47
5.30
5.22
5.06
4.91
4.76
4.62
4.49
4.31
4.15
3.83
3.40
3.21
3.13
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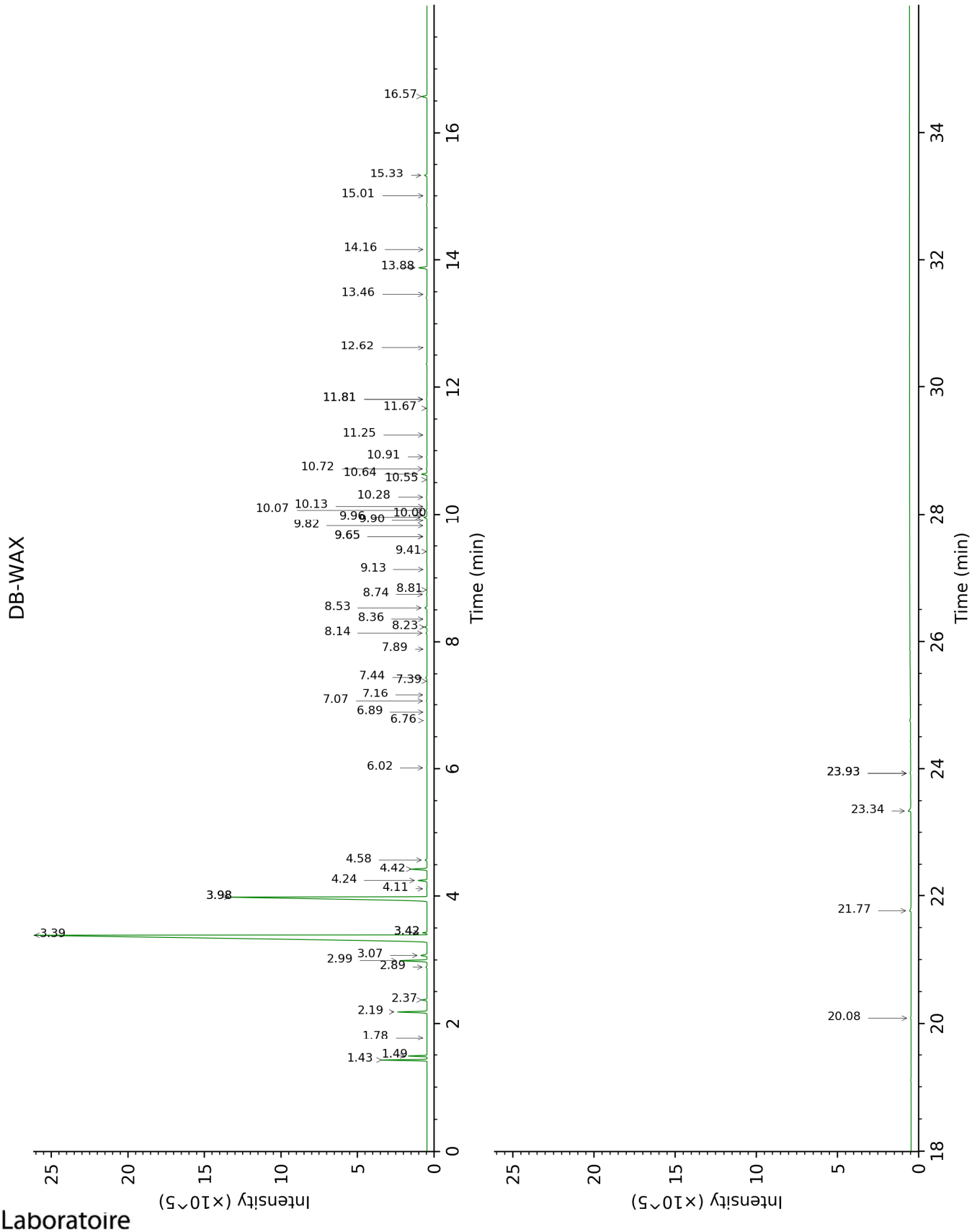
29.43
27.26
19.16
18.97
18.89
18.83
Time (min)
Intensity (×10^5)


DB-WAX
Intensity (×10^5)
Time (min)
16.57
15.33
15.01
14.16
13.88
13.46
12.62
11.81
11.67
11.25
10.91
10.72
10.64
10.55
10.28
10.07
10.13
9.96
10.00
9.90
9.82
9.65
9.41
9.13
8.74
8.81
8.53
8.36
8.23
8.14
7.89
7.44
7.39
7.07
7.16
6.89
6.76
6.02
4.58
4.42
4.24
4.11
3.98
3.39
3.42
2.99
3.07
2.89
2.37
2.19
1.78
1.43
1.49
23.93
23.34
21.77
20.08

FULL ANALYSIS DATA

Identification	Column DB-5			Column DB-WAX		
	R.T	R.I	%	R.T	R.I	%
Heptanal	2.79	901	0.01			
α-Thujene	3.13	924	0.84	1.49	999	0.83
α-Pinene	3.20	929	2.18	1.42	992	2.17
Camphene	3.40	942	0.02	1.78	1027	0.02
Sabinene	3.83*	970	1.94	2.37	1085	0.29
β-Pinene	3.83*	970	[1.94]	2.19	1067	1.66
Myrcene	4.15	992	1.71	2.99	1134	1.71
Octanal	4.31*	1002	0.19	4.58	1252	0.11
α-Phellandrene	4.31*	1002	[0.19]	2.89	1126	0.07
α-Terpinene	4.49	1014	0.43	3.07	1141	0.43
para-Cymene	4.62	1022	0.47	4.24	1228	0.52
Limonene	4.76*	1031	65.88	3.39†	1165	65.88
β-Phellandrene	4.76*	1031	[65.88]	3.42*†	1168	[65.88]
1,8-Cineole	4.76*	1031	[65.88]	3.42*†	1168	[65.88]
(*Z*)-β-Ocimene	4.90	1040	0.01	3.98*	1210	20.92
(*E*)-β-Ocimene	5.06	1049	0.03	4.11	1219	0.03
γ-Terpinene	5.22	1060	20.91	3.98*	1210	[20.92]
cis-Sabinene hydrate	5.30	1065	0.04	7.06	1432	0.04
Octanol	5.47	1075	0.01	8.36	1529	0.02
Terpinolene	5.64	1086	0.93	4.42	1241	0.94
trans-Sabinene hydrate	5.78	1095	0.07	8.14	1512	0.07
Linalool	5.88	1101	0.14	8.23	1519	0.15
Nonanal	5.93	1104	0.03	6.02	1356	0.03
trans-para-Mentha-2,8-dien-1-ol	6.15	1118	0.01	9.13	1588	0.01
trans-Limonene oxide	6.32	1130	0.01	6.76	1409	0.01
Epoxyterpinolene	6.53	1143	0.01	6.89	1419	0.01
Citronellal	6.68	1153	0.03	7.16	1439	0.03
trans-β-Terpineol	6.85	1164	0.02	9.82	1644	0.02
Terpinen-4-ol	7.01*	1174	0.08	8.74	1558	0.05
Nonanol	7.01*	1174	[0.08]	9.65*	1630	0.04
para-Cymen-8-ol	7.16	1184	0.01	11.67	1798	0.01
α-Terpineol	7.24	1189	0.20	9.96	1655	0.20
γ-Terpineol	7.34	1196	0.01	10.00	1658	0.02
Decanal	7.51	1207	0.09	7.44	1460	0.09
Nerol	7.85	1230	0.01	11.25	1762	0.02
Citronellol	7.89	1233	0.02	10.91	1733	0.04
Neral	8.00	1240	0.02	9.65*	1630	[0.04]
Geraniol	8.34	1263	0.01	11.81*	1810	0.04
Geranial	8.41	1268	0.02	10.28	1680	0.08
Unknown [m/z 95, 67 (45), 41 (42), 110 (42), 43 (41), 59 (36)]	8.59	1280	0.01	12.62	1881	0.01
cis-Ascaridole glycol?	8.71	1288	0.02	15.00	2106	0.01
Perillyl alcohol	8.86	1299	0.01	13.46	1959	0.01
Thymol	8.91	1302	0.17	15.33	2138	0.16
Undecanal	9.03	1305	0.02	8.82	1564	0.01

α-Copaene	9.95	1371	0.01	7.39	1455	0.01
Geranyl acetate	10.13	1383	0.01	10.72	1717	0.06
β-Cubebene	10.16	1386	0.01	7.89	1492	0.01
Dimethyl anthranilate	10.36	1400	0.59	13.88	1997	0.59
Dodecanal	10.46	1407	0.03	10.13	1668	0.02
β-Caryophyllene	10.53	1412	0.16	8.53	1542	0.16
α-Humulene	10.99	1446	0.02	9.41	1611	0.02
(2*E*)-Dodecenal	11.23	1464	0.03	11.81*	1810	[0.04]
Germacrene D	11.36	1474	0.01	9.90	1650	0.01
α-Selinene	11.55	1489	0.08	10.07	1664	0.07
(3*E*,6*E*)-α-Farnesene	11.81	1508	0.37	10.64	1710	0.36
δ-Cadinene	11.95	1519	0.01	10.55	1703	0.02
Spathulenol	12.60	1571	0.01			
(2*E*)-Tetradecenal	13.82	1670	0.01	14.16	2025	0.02
β-Sinensal	14.13	1695	0.03			
α-Sinensal	14.77	1750	0.38	16.57	2265	0.38
Myristic acid	14.97	1768	0.04	20.08	2661	0.05
Palmitic acid	17.15	1967	0.11	21.77	2871	0.14
Linoleic acid	18.83	2133	0.04			
Oleic acid	18.89	2139	0.04	23.93*	3163	0.06
cis-Vaccenic acid?	18.97	2147	0.01	23.93*	3163	[0.06]
Stearic acid	19.16	2167	0.20	23.34	3081	0.26
Tangeretin	27.26	3140	0.17			
3,3',4',5,6,7,8-Heptamethoxyflavone	29.43	3322	0.04			
Nobiletin	29.50	3326	0.08			
Total identified		**99.10%**			**99.03%**	
Total reported		**99.11%**			**99.04%**	

*: 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

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