

Date : April 12, 2019

CERTIFICATE OF ANALYSIS – GC PROFILING

SAMPLE IDENTIFICATION

Internal code : 19D02-ORA07-1-SCC

Customer identification : Lime

Type : Essential oil

Source : *Citrus aurantifolia*

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 : Alexis St-Gelais, M. Sc., chimiste

Analysis date : April 10, 2019

Checked and approved by :

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

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PHYSICOCHEMICAL DATA

Physical aspect: Dark yellow liquid

Refractive index: 1.4793 ± 0.0003 (20 °C)

CONCLUSION

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

ANALYSIS SUMMARY

Identification	DB-5 (%)	DB-WAX (%)	Classe
Ethanol	tr	tr	Aliphatic alcohol
2-Methyl-3-buten-2-ol	tr	0.01	Aliphatic alcohol
Toluene	tr	0.47*	Simple phenolic
Heptanal	0.01	0.01	Aliphatic aldehyde
Tricyclene	0.01	0.01	Monoterpene
α -Thujene	0.47	[0.47]*	Monoterpene
α -Pinene	2.22	2.23	Monoterpene
Camphene	0.08	0.08	Monoterpene
Thuja-2,4(10)-diene	0.10	1.78*	Monoterpene
β -Pinene	16.10*	14.42	Monoterpene
Sabinene	[16.10]*	[1.78]*	Monoterpene
3-Methyl-3-cyclohexenone	0.01	tr	Aliphatic ketone
6-Methyl-5-hepten-2-one	0.02	0.01	Aliphatic ketone
Myrcene	1.27	1.26	Monoterpene
α -Phellandrene	0.06*	0.05	Monoterpene
Octanal	[0.06]*	0.02	Aliphatic aldehyde
Δ^3 -Carene	0.01	0.01	Monoterpene
α -Terpinene	0.29	0.29	Monoterpene
para-Cymene	0.81	1.01	Monoterpene
Limonene	49.88*	49.46	Monoterpene
β -Phellandrene	[49.88]*	0.40	Monoterpene
(Z?)-Citroxide	[49.88]*	0.01	Monoterpenic ether
(Z)- β -Ocimene	0.07	12.87*	Monoterpene
(E)- β -Ocimene	0.18	0.18	Monoterpene
γ -Terpinene	12.76	[12.87]*	Monoterpene
cis-Sabinene hydrate	0.02	0.02	Monoterpenic alcohol
cis-Linalool oxide (fur.)	0.02	0.03*	Monoterpenic alcohol
Fenchone	0.02	0.02	Aliphatic alcohol
Terpinolene	0.54	0.54	Monoterpene
trans-Sabinene hydrate	0.02	0.03	Monoterpenic alcohol
Linalool	0.21	0.22*	Monoterpenic alcohol
Nonanal	0.02	0.01	Aliphatic aldehyde
1,3,8-para-Menthatriene	tr	tr	Monoterpene
endo-Fenchol	0.01	0.01*	Monoterpenic alcohol
trans-para-Mentha-2,8-dien-1-ol	0.02	0.01	Monoterpenic alcohol
Limona ketone	0.01	0.01	Normoterpenic ketone
cis-Limonene oxide	0.03*	[0.03]*	Monoterpenic ether
allo-Ocimene	[0.03]*	tr	Monoterpene
trans-Limonene oxide	0.01	0.02	Monoterpenic ether
1-Terpineol	0.03*	[0.01]*	Monoterpenic alcohol
trans-Pinocarveol	[0.03]*	0.04	Monoterpenic alcohol
Camphor	0.01	tr	Monoterpenic ketone
cis- β -Terpineol	0.03*	0.03	Monoterpenic alcohol
Epoxyterpinolene	[0.03]*	0.02	Monoterpenic ether
Citronellal	0.09	0.08	Monoterpenic aldehyde
Borneol	0.02	0.70*	Monoterpenic alcohol
trans- β -Terpineol	0.03*	0.03	Monoterpenic alcohol
Isoneral	[0.03]*	0.01	Monoterpenic aldehyde

Terpinen-4-ol	0.32	0.31	Monoterpenic alcohol
Isogeranial	0.02	tr	Monoterpenic aldehyde
para-Cymen-8-ol	0.01	0.01	Monoterpenic alcohol
α -Terpineol	0.64	[0.70]*	Monoterpenic alcohol
Myrtenol	0.01	tr	Monoterpenic alcohol
Unknown	tr	[0.22]*	Unknown
γ -Terpineol	0.02	0.03	Monoterpenic alcohol
Decanal	0.06	0.05	Aliphatic aldehyde
<i>trans</i> -Carveol	0.01	0.01	Monoterpenic alcohol
2,3-Epoxyneral?	0.01		Monoterpenic aldehyde
Nerol	0.07*	0.07	Monoterpenic alcohol
<i>cis</i> -Carveol	[0.07]*	0.01	Monoterpenic alcohol
2,3-Epoxygeranial?	0.07		Monoterpenic aldehyde
Neral	2.10	2.11*	Monoterpenic aldehyde
Geraniol	0.07	0.06	Monoterpenic alcohol
<i>trans</i> -Ascaridole glycol	tr	0.01	Monoterpenic alcohol
Perillaldehyde	0.01	0.01	Monoterpenic aldehyde
Geranial	3.46	3.58	Monoterpenic aldehyde
Unknown	0.03	0.02	Oxygenated monoterpene
Undecanal	0.01	0.02	Aliphatic aldehyde
Unknown	0.01	0.02	Monoterpenic alcohol
δ -Elemene	0.07	0.06	Sesquiterpene
Citronellyl acetate	0.01	0.01	Monoterpenic ester
Neryl acetate	0.56	0.64	Monoterpenic ester
β -Bourbonene	0.01	0.01	Sesquiterpene
Geranyl acetate	0.27	[0.50]*	Monoterpenic ester
β -Elemene	0.07	1.40*	Sesquiterpene
Dodecanal	0.03	0.03*	Aliphatic aldehyde
<i>cis</i> - α -Bergamotene	0.63*	0.08*	Sesquiterpene
β -Caryophyllene	[0.63]*	[1.40]*	Sesquiterpene
α -Santalene	0.02	[0.08]*	Sesquiterpene
γ -Elemene	0.02	0.01	Sesquiterpene
<i>trans</i> - α -Bergamotene	0.81	[1.40]*	Sesquiterpene
α -Humulene	0.05	0.04	Sesquiterpene
(<i>E</i>)- β -Farnesene	0.10*	0.08*	Sesquiterpene
β -Santalene	[0.10]*	0.01	Sesquiterpene
Selina-4,11-diene	0.02	[2.11]*	Sesquiterpene
α -Amorphene	0.01	0.03	Sesquiterpene
Germacrene D	0.05	0.06	Sesquiterpene
β -Selinene	0.02	0.03	Sesquiterpene
<i>trans</i> - β -Bergamotene	0.06*	[0.08]*	Sesquiterpene
Unknown	[0.06]*	0.03	Sesquiterpene
α -Selinene	0.03	[0.03]*	Sesquiterpene
(3 <i>Z</i> ,6 <i>E</i>)- α -Farnesene	0.01	tr	Sesquiterpene
(<i>Z</i>)- α -Bisabolene	0.04	0.05	Sesquiterpene
(3 <i>E</i> ,6 <i>E</i>)- α -Farnesene	1.37*	0.50*	Sesquiterpene
β -Bisabolene	[1.37]*	1.04	Sesquiterpene
γ -Cadinene	[1.37]*	0.01	Sesquiterpene
(<i>Z</i>)- γ -Bisabolene	0.02	0.01	Sesquiterpene
δ -Cadinene	0.01	[0.50]*	Sesquiterpene
Unknown	0.01	[0.50]*	Sesquiterpene
(<i>E</i>)- α -Bisabolene	0.04	0.03	Sesquiterpene

Germacrene B	0.10	0.09	Sesquiterpene
Caryophyllenyl alcohol	0.01	0.01	Sesquiterpenic alcohol
Caryophyllene oxide	0.05*	0.04	Sesquiterpenic ether
Caryophyllene oxide isomer	[0.05]*	0.01	Sesquiterpenic ether
Tetradecanal	0.02		Aliphatic aldehyde
10-epi- γ -Eudesmol	0.02	0.02	Sesquiterpenic alcohol
γ -Eudesmol	0.04	0.04*	Sesquiterpenic alcohol
Unknown	0.02	[0.04]*	Oxygenated sesquiterpene
Unknown	0.05	0.05	Oxygenated sesquiterpene
α -Bisabolol	0.06	0.06	Sesquiterpenic alcohol
Herniarin	0.11	0.12	Coumarin
(2E,6Z)-Farnesal	0.01		Sesquiterpenic aldehyde
(2E,6E)-Farnesal	0.01	0.01	Sesquiterpenic aldehyde
Myristic acid	0.07	0.07	Aliphatic acid
Citropten	0.20	0.22	Furanocoumarin
Palmitic acid	0.08	0.11	Aliphatic acid
Bergapten	0.10		Furanocoumarin
Methoxsalene	0.01		Furanocoumarin
Stearic acid	0.13	0.16	Aliphatic acid
Isopimpinellin	0.21		Furanocoumarin
Oxypeucedanin	0.01		Furanocoumarin
Heraclenin	0.04		Furanocoumarin
Total identified	97.96%	97.80%	

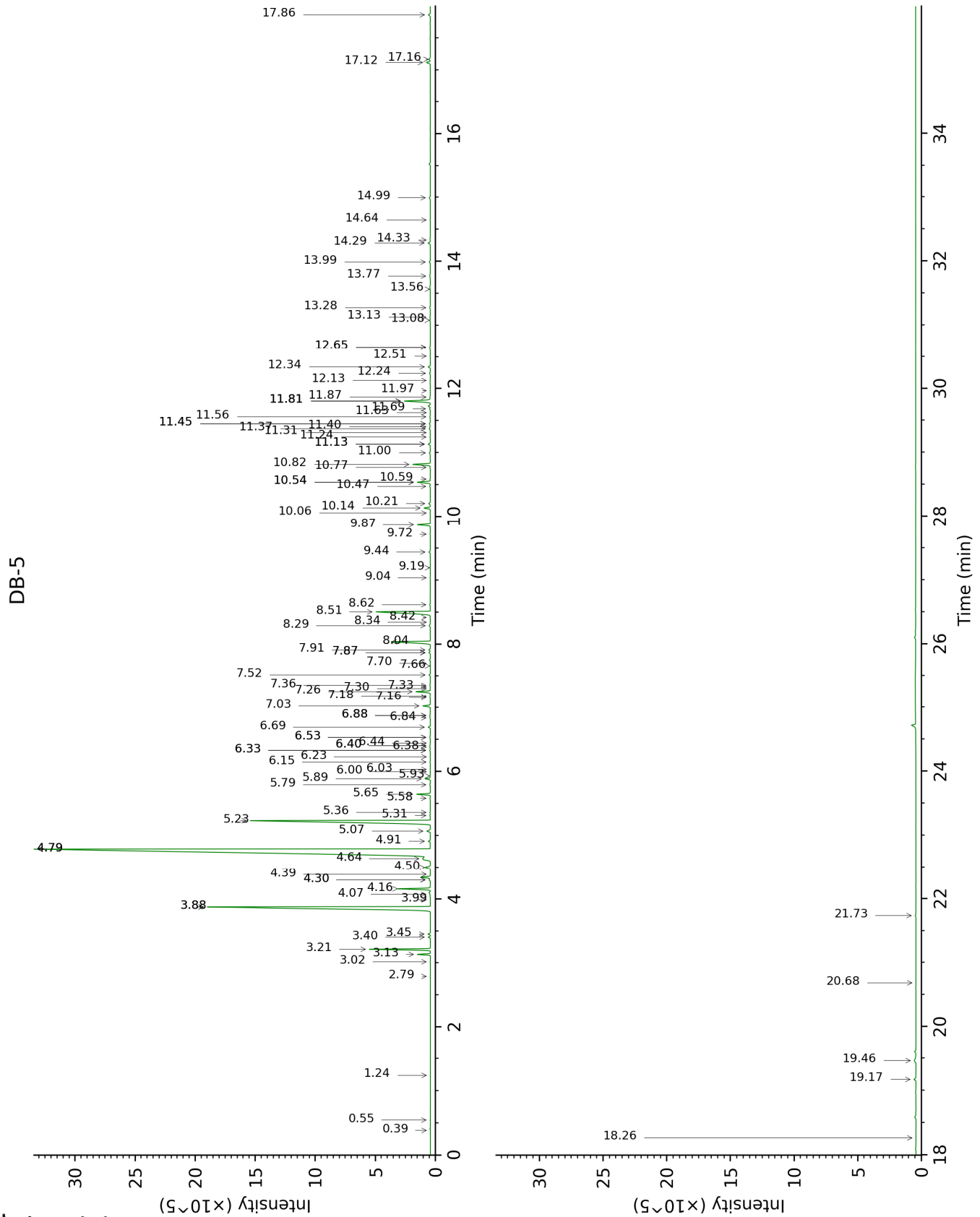
*: Two or more compounds are coeluting on this column

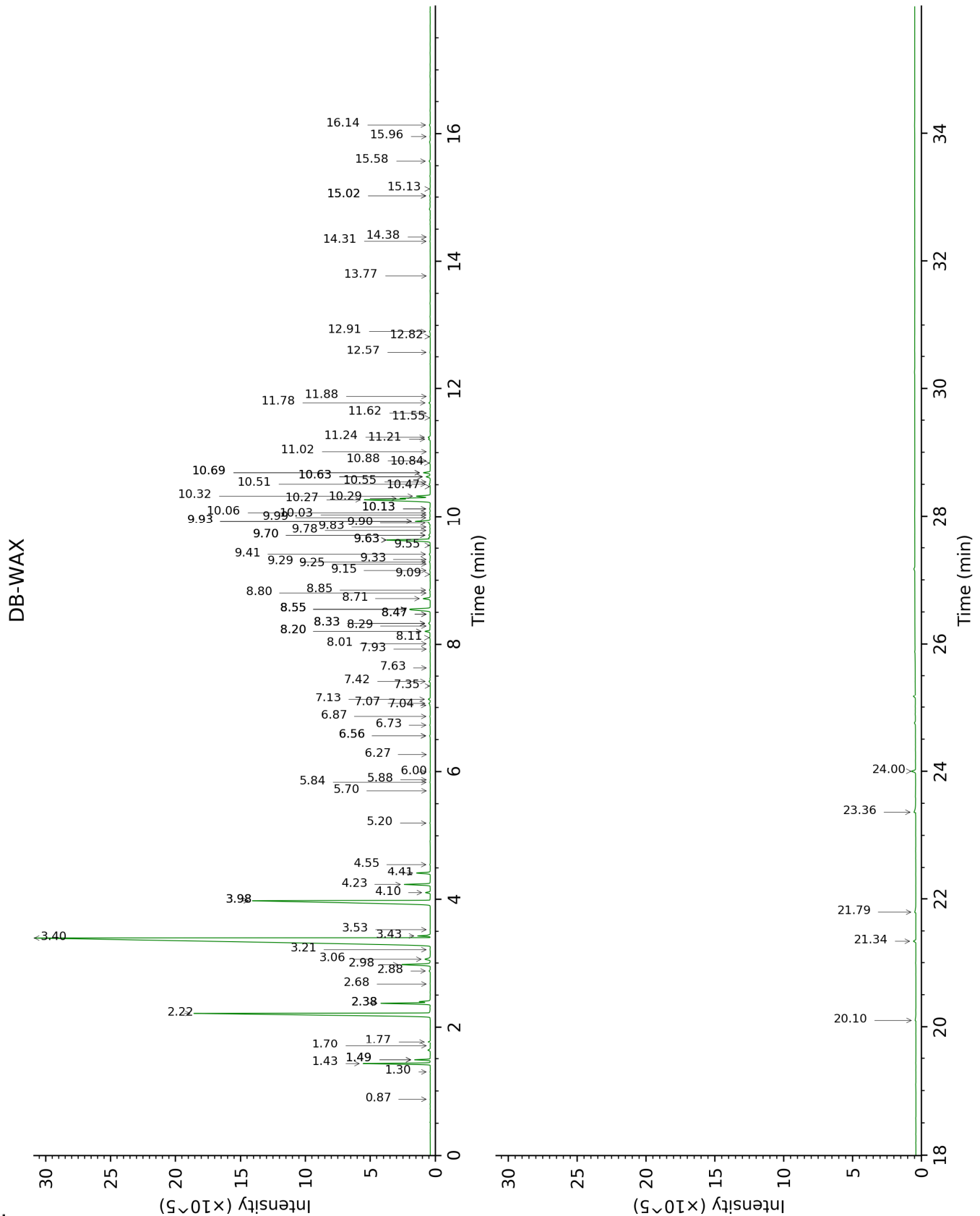
[xx]: Duplicate percentage due to coelutions, not taken account in the identified total

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	%
Ethanol	0.38	501	tr	0.87	904	tr
2-Methyl-3-buten-2-ol	0.55	608	tr	1.70	1020	0.01
Toluene	1.24	757	tr	1.49*	998	0.47
Heptanal	2.79	902	0.01	3.21	1152	0.01
Tricyclene	3.02	917	0.01	1.30	972	0.01
α -Thujene	3.13	924	0.47	1.49*	998	[0.47]
α -Pinene	3.21	930	2.22	1.43	992	2.23
Camphene	3.40	942	0.08	1.77	1026	0.08
Thuja-2,4(10)-diene	3.45	945	0.10	2.38*	1086	1.78
β -Pinene	3.88*	973	16.10	2.22	1070	14.42
Sabinene	3.88*	973	[16.10]	2.38*	1086	[1.78]
3-Methyl-3-cyclohexenone	3.99	981	0.01	6.27	1374	tr
6-Methyl-5-hepten-2-one	4.07	986	0.02	5.20	1297	0.01
Myrcene	4.16	992	1.27	2.98	1134	1.26
α -Phellandrene	4.30*	1001	0.06	2.88	1126	0.05
Octanal	4.30*	1001	[0.06]	4.55	1250	0.02
Δ^3 -Carene	4.39	1007	0.01	2.68	1110	0.01
α -Terpinene	4.50	1014	0.29	3.06	1140	0.29
para-Cymene	4.64	1023	0.81	4.23	1228	1.01
Limonene	4.79*	1032	49.88	3.40	1166	49.46
β -Phellandrene	4.79*	1032	[49.88]	3.43	1168	0.40
(Z?)-Citroxide	4.79*	1032	[49.88]	3.53	1176	0.01
(Z)- β -Ocimene	4.91	1040	0.07	3.98*	1209	12.87
(E)- β -Ocimene	5.07	1050	0.18	4.10	1218	0.18
γ -Terpinene	5.23	1060	12.76	3.98*	1209	[12.87]
cis-Sabinene hydrate	5.31	1065	0.02	7.04	1430	0.02
cis-Linalool oxide (fur.)	5.36	1068	0.02	6.56*	1395	0.03
Fenchone	5.58	1082	0.02	5.84	1343	0.02
Terpinolene	5.65	1086	0.54	4.41	1240	0.54
trans-Sabinene hydrate	5.79	1096	0.02	8.10	1509	0.03
Linalool	5.89	1102	0.21	8.20*	1517	0.22
Nonanal	5.93	1104	0.02	6.00	1354	0.01
1,3,8-para-Menthatriene	6.00	1109	tr	5.88	1346	tr
endo-Fenchol	6.03	1111	0.01	8.47*	1537	0.01
trans-para-Mentha-2,8-dien-1-ol	6.15	1118	0.02	9.09	1585	0.01
Limona ketone	6.23	1124	0.01	7.93	1496	0.01
cis-Limonene oxide	6.33*	1130	0.03	6.56*	1395	[0.03]

allo-Ocimene	6.33*	1130	[0.03]	5.70	1333	tr
<i>trans</i> -Limonene oxide	6.38	1133	0.01	6.73	1407	0.02
1-Terpineol	6.40*	1135	0.03	8.47*	1537	[0.01]
<i>trans</i> -Pinocarveol	6.40*	1135	[0.03]	9.29	1601	0.04
Camphor	6.44	1138	0.01	7.35	1453	tr
<i>cis</i> - β -Terpineol	6.53*	1143	0.03	9.15	1590	0.03
Epoxyterpinolene	6.53*	1143	[0.03]	6.86	1417	0.02
Citronellal	6.69	1154	0.09	7.13	1437	0.08
Borneol	6.84	1163	0.02	9.93*	1652	0.70
<i>trans</i> - β -Terpineol	6.88*	1165	0.03	9.83	1645	0.03
Isoneral	6.88*	1165	[0.03]	8.01	1502	0.01
Terpinen-4-ol	7.02	1175	0.32	8.72	1556	0.31
Isogeranial	7.16	1184	0.02	8.29	1523	tr
para-Cymen-8-ol	7.18	1185	0.01	11.62	1794	0.01
α -Terpineol	7.26	1190	0.64	9.93*	1652	[0.70]
Myrtenol	7.30	1193	0.01	11.02	1742	tr
Unknown [m/z 121, 79 (61), 93 (55), 94 (40), 91 (39), 84 (37)...]	7.33	1195	tr	8.20*	1517	[0.22]
γ -Terpineol	7.36	1197	0.02	9.99	1657	0.03
Decanal	7.52	1207	0.06	7.42	1458	0.05
<i>trans</i> -Carveol	7.66	1217	0.01	11.55	1787	0.01
2,3-Epoxyneral?	7.70	1220	0.01			
Nerol	7.87*	1231	0.07	11.21	1759	0.07
<i>cis</i> -Carveol	7.87*	1231	[0.07]	11.88	1816	0.01
2,3-Epoxygeranial?	7.91	1234	0.07			
Neral	8.04	1242	2.10	9.63*	1628	2.11
Geraniol	8.29	1260	0.07	11.78	1808	0.06
<i>trans</i> -Ascaridole glycol	8.34	1263	tr	14.38	2045	0.01
Perillaldehyde	8.42	1268	0.01	10.88	1730	0.01
Geranial	8.50	1274	3.46	10.27	1680	3.58
Unknown [m/z 95, 67 (45), 41 (42), 110 (42), 43 (41), 59 (36)]	8.62	1282	0.03	12.57	1877	0.02
Undecanal	9.04	1306	0.01	8.80	1563	0.02
Unknown [m/z 97, 112 (92), 83 (62), 43 (44), 41 (25)... 170? (4)]	9.19	1317	0.01	15.13	2119	0.02
δ -Elemene	9.44	1334	0.07	7.07	1432	0.06
Citronellyl acetate	9.72	1354	0.01	9.55	1622	0.01
Neryl acetate	9.87	1365	0.56	10.32	1684	0.64
β -Bourbonene	10.06	1378	0.01	7.63	1474	0.01
Geranyl acetate	10.14	1384	0.27	10.69*†	1715	[0.50]
β -Elemene	10.21	1389	0.07	8.55*	1543	1.40
Dodecanal	10.47	1408	0.03	10.13*	1668	0.03

<i>cis</i> - α -Bergamotene	10.54*	1413	0.63	8.33*	1526	0.08
β -Caryophyllene	10.54*	1413	[0.63]	8.55*	1543	[1.40]
α -Santalene	10.59	1417	0.02	8.33*	1526	[0.08]
γ -Elemene	10.77	1430	0.02	9.25	1598	0.01
<i>trans</i> - α -Bergamotene	10.82	1434	0.81	8.55*	1543	[1.40]
α -Humulene	11.00	1447	0.05	9.41	1610	0.04
(<i>E</i>)- β -Farnesene	11.13*	1457	0.10	9.70*	1634	0.08
β -Santalene	11.13*	1457	[0.10]	9.33	1604	0.01
Selina-4,11-diene	11.24	1466	0.02	9.63*	1628	[2.11]
α -Amorphene	11.31	1471	0.01	9.78	1640	0.03
Germacrene D	11.37	1475	0.05	9.90	1650	0.06
β -Selinene	11.40	1478	0.02	10.06	1663	0.03
<i>trans</i> - β -Bergamotene	11.45*	1481	0.06	9.70*	1634	[0.08]
Unknown [m/z 41, 69 (90), 79 (78), 93 (72), 91 (70)...204]	11.45*	1481	[0.06]	8.85	1566	0.03
α -Selinene	11.56	1489	0.03	10.13*	1668	[0.03]
(3 <i>Z</i> ,6 <i>E</i>)- α -Farnesene	11.63	1494	0.01	10.47	1697	tr
(<i>Z</i>)- α -Bisabolene	11.69	1498	0.04	10.51	1700	0.05
(3 <i>E</i> ,6 <i>E</i>)- α -Farnesene	11.81*	1508	1.37	10.63*†	1710	0.50
β -Bisabolene	11.81*	1508	[1.37]	10.29	1681	1.04
γ -Cadinene	11.81*	1508	[1.37]	10.55	1703	0.01
(<i>Z</i>)- γ -Bisabolene	11.87	1513	0.02	10.03	1660	0.01
δ -Cadinene	11.97	1521	0.01	10.63*†	1710	[0.50]
Unknown [m/z 189, 204 (92), 161 (65), 133 (51), 105 (51), 91 (51), 119 (45)]	12.13	1533	0.01	10.69*†	1715	[0.50]
(<i>E</i>)- α -Bisabolene	12.24	1542	0.04	10.84	1728	0.03
Germacrene B	12.34	1550	0.10	11.24	1761	0.09
Caryophyllenyl alcohol	12.51	1563	0.01	13.77	1987	0.01
Caryophyllene oxide	12.66*	1575	0.05	12.91	1908	0.04
Caryophyllene oxide isomer	12.66*	1575	[0.05]	12.82	1900	0.01
Tetradecanal	13.08	1608	0.02			
10-epi- γ -Eudesmol	13.13	1612	0.02	14.31	2039	0.02
γ -Eudesmol	13.28	1624	0.04	15.02*	2108	0.04
Unknown [m/z 94, 43 (89), 41 (67), 122 (46), 69 (41)...222]	13.56	1648	0.02	15.02*	2108	[0.04]
Unknown [m/z	13.77	1665	0.05	16.14	2220	0.05

69, 95 (100), 41 (89), 109 (68), 67 (61)...222]						
α-Bisabolol	13.99	1683	0.06	15.58	2163	0.06
Herniarin	14.29	1708	0.11	21.34	2817	0.12
(2E,6Z)-Farnesal	14.33	1712	0.01			
(2E,6E)-Farnesal	14.64	1739	0.01	15.96	2202	0.01
Myristic acid	14.99	1770	0.07	20.10	2663	0.07
Citropten	17.12	1964	0.20	24.00	3174	0.22
Palmitic acid	17.16	1968	0.08	21.79	2875	0.11
Bergapten	17.86	2036	0.10			
Methoxsalene	18.26	2076	0.01			
Stearic acid	19.17	2168	0.13	23.36	3084	0.16
Isopimpinellin	19.46	2198	0.21			
Oxypeucedanin	20.68	2331	0.01			
Heraclenin	21.74	2450	0.04			
Total identified		97.96%			97.80%	
Total reported		98.07%			97.92%	

*: 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