

Date : May 22, 2019

CERTIFICATE OF ANALYSIS – GC PROFILING

SAMPLE IDENTIFICATION

**Internal code :** 19E21-PTH05-1-SCC

**Customer identification :** Persian Lime - PW010093R

**Type :** Essential oil

**Source :** *Citrus latifolia*

**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 :** May 21, 2019

Checked and approved by :



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

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*PHYSICOCHEMICAL DATA*

**Physical aspect:** Dark yellowish green liquid

**Refractive index:** 1.4807 ± 0.0003 (20 °C)

*ISO 23954:2010 - OIL OF LIME EXPRESSED, PERSIAN TYPE*

Compound	Min. %	Max. %	Observed %	Complies?
β-Bisabolene	1.5	2.0	1.5	Yes
trans-α-Bergamotene	0.8	1.3	0.9	Yes
β-Caryophyllene	0.4	0.6	0.5	Yes
Geranyl acetate	0.2	0.4	0.2	Yes
Neryl acetate	0.6	1.3	0.8	Yes
Geranial	2.0	3.0	2.0	Yes
Neral	1.0	2.0	1.2	Yes
γ-Terpinene	11.0	14.0	12.5	Yes
Limonene	47.0	53.0	56.3	No
para-Cymene		0.5	0.4	Yes
Myrcene	1.2	2.0	1.5	Yes
β-Pinene	10.0	12.0	11.3	Yes
α-Pinene	2.0	2.5	2.0	Yes
<b>Refractive index</b>	1.4760	1.4860	1.4807	Yes

*CONCLUSION*

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

The oil marginally does not comply with the ISO standard for expressed Persian lime oil.

## ANALYSIS SUMMARY

Identification	DB-5 (%)	DB-WAX (%)	Classe
Nonane	tr		Alkane
Tricyclene	0.01	0.01	Monoterpene
$\alpha$ -Thujene	0.53	0.52	Monoterpene
$\alpha$ -Pinene	2.05	2.02	Monoterpene
Camphene	0.07*	0.06	Monoterpene
$\alpha$ -Fenchene	[0.07]*	tr	Monoterpene
Thuja-2,4(10)-diene	0.02	1.97*	Monoterpene
Sabinene	13.42*	[1.97]*	Monoterpene
$\beta$ -Pinene	[13.42]*	11.33	Monoterpene
6-Methyl-5-hepten-2-one	0.02	0.02	Aliphatic ketone
Myrcene	1.45	1.45	Monoterpene
$\alpha$ -Phellandrene	0.07*	0.05	Monoterpene
Octanal	[0.07]*	0.02	Aliphatic aldehyde
$\Delta^3$ -Carene	0.01	0.01	Monoterpene
$\alpha$ -Terpinene	0.20	0.20	Monoterpene
para-Cymene	0.44	0.45	Monoterpene
Limonene	56.62*	56.27	Monoterpene
1,8-Cineole	[56.62]*	0.49	Monoterpenic ether
(Z)- $\beta$ -Ocimene	0.06	12.64*	Monoterpene
(E)- $\beta$ -Ocimene	0.14	0.13	Monoterpene
$\gamma$ -Terpinene	12.48	[12.64]*	Monoterpene
cis-Sabinene hydrate	0.05	0.05	Monoterpenic alcohol
Octanol	0.01	0.08*	Aliphatic alcohol
Terpinolene	0.47	0.48	Monoterpene
trans-Sabinene hydrate	0.05	0.04	Monoterpenic alcohol
Linalool	0.14	0.15*	Monoterpenic alcohol
Nonanal	0.02	0.01	Aliphatic aldehyde
trans-para-Mentha-2,8-dien-1-ol	0.02	0.01	Monoterpenic alcohol
cis-Limonene oxide	0.01	0.02	Monoterpenic ether
trans-Limonene oxide	0.01	0.01	Monoterpenic ether
Epoxyterpinolene	0.01	0.01	Monoterpenic ether
Citronellal	0.04	0.04	Monoterpenic aldehyde
Borneol	0.02	0.32*	Monoterpenic alcohol
Isoneral	0.01	0.02	Monoterpenic aldehyde
Terpinen-4-ol	0.09	0.06	Monoterpenic alcohol
Isogeranial	0.03	[0.08]*	Monoterpenic aldehyde
$\alpha$ -Terpineol	0.21	[0.32]*	Monoterpenic alcohol
Unknown	0.01	[0.15]*	Unknown
$\gamma$ -Terpineol	0.01	0.02	Monoterpenic alcohol
Decanal	0.06	0.06	Aliphatic aldehyde
2,3-Epoxyneral?	0.02		Monoterpenic aldehyde
Nerol	0.13	0.14	Monoterpenic alcohol
2,3-Epoxygeranial?	0.06		Monoterpenic aldehyde
Neral	1.22	1.29*	Monoterpenic aldehyde
Geraniol	0.06	0.07	Monoterpenic alcohol
Unknown	0.01	0.01	Unknown
Geranial	1.95	2.05	Monoterpenic aldehyde
Unknown	0.02	0.02	Oxygenated monoterpene

Undecanal	0.01	0.01	Aliphatic aldehyde
para-Mentha-1,8-diene-4-hydroperoxide	0.01		Monoterpenic peroxide
δ-Elemene	0.09	0.09	Sesquiterpene
Citronellyl acetate	0.01	[1.29]*	Monoterpenic ester
Neryl acetate	0.84	0.95*	Monoterpenic ester
Geranyl acetate	0.20	0.22*	Monoterpenic ester
β-Elemene	0.10	1.46*	Sesquiterpene
Dodecanal	0.05	0.04	Aliphatic aldehyde
β-Caryophyllene	0.61*	[1.46]*	Sesquiterpene
cis-α-Bergamotene	[0.61]*	[0.08]*	Sesquiterpene
γ-Elemene	0.02	0.02	Sesquiterpene
trans-α-Bergamotene	0.86	[1.46]*	Sesquiterpene
α-Humulene	0.06	0.06	Sesquiterpene
(E)-β-Farnesene	0.13*	0.09	Sesquiterpene
β-Santalene	[0.13]*	0.04	Sesquiterpene
Germacrene D	0.07	[0.32]*	Sesquiterpene
γ-Curcumene	0.03	[0.32]*	Sesquiterpene
trans-β-Bergamotene	0.05	0.07	Sesquiterpene
(3Z,6E)-α-Farnesene	0.07	[0.95]*	Sesquiterpene
(Z)-α-Bisabolene	0.11	0.08	Sesquiterpene
β-Bisabolene	1.47	1.35	Sesquiterpene
(Z)-γ-Bisabolene	0.02	0.01	Sesquiterpene
Unknown	0.01	[0.22]*	Sesquiterpene
(E)-α-Bisabolene	0.05	0.05	Sesquiterpene
Germacrene B	0.13	0.14	Sesquiterpene
Caryophyllenyl alcohol	0.01		Sesquiterpenic alcohol
Caryophyllene oxide isomer	0.02	0.02	Sesquiterpenic ether
Guaia-6,10(14)-dien-4β-ol	0.04	0.04	Sesquiterpenic alcohol
Unknown	0.05	0.04	Oxygenated sesquiterpene
Unknown	0.04	0.04	Oxygenated sesquiterpene
α-Bisabolol	0.08	0.07	Sesquiterpenic alcohol
Herniarin	0.24	0.26	Coumarin
(2E,6Z)-Farnesal	0.03		Sesquiterpenic aldehyde
(2E,6E)-Farnesal	0.02	0.02	Sesquiterpenic aldehyde
Myristic acid	0.01		Aliphatic acid
Hexadecanal	0.01	0.01	Aliphatic aldehyde
Citropten	0.20	0.23	Furanocoumarin
Palmitic acid	0.09		Aliphatic acid
Bergapten	0.10		Furanocoumarin
Stearic acid	0.04		Aliphatic acid
Isopimpinellin	0.11		Furanocoumarin
<b>Total identified</b>	<b>98.27%</b>	<b>97.88%</b>	

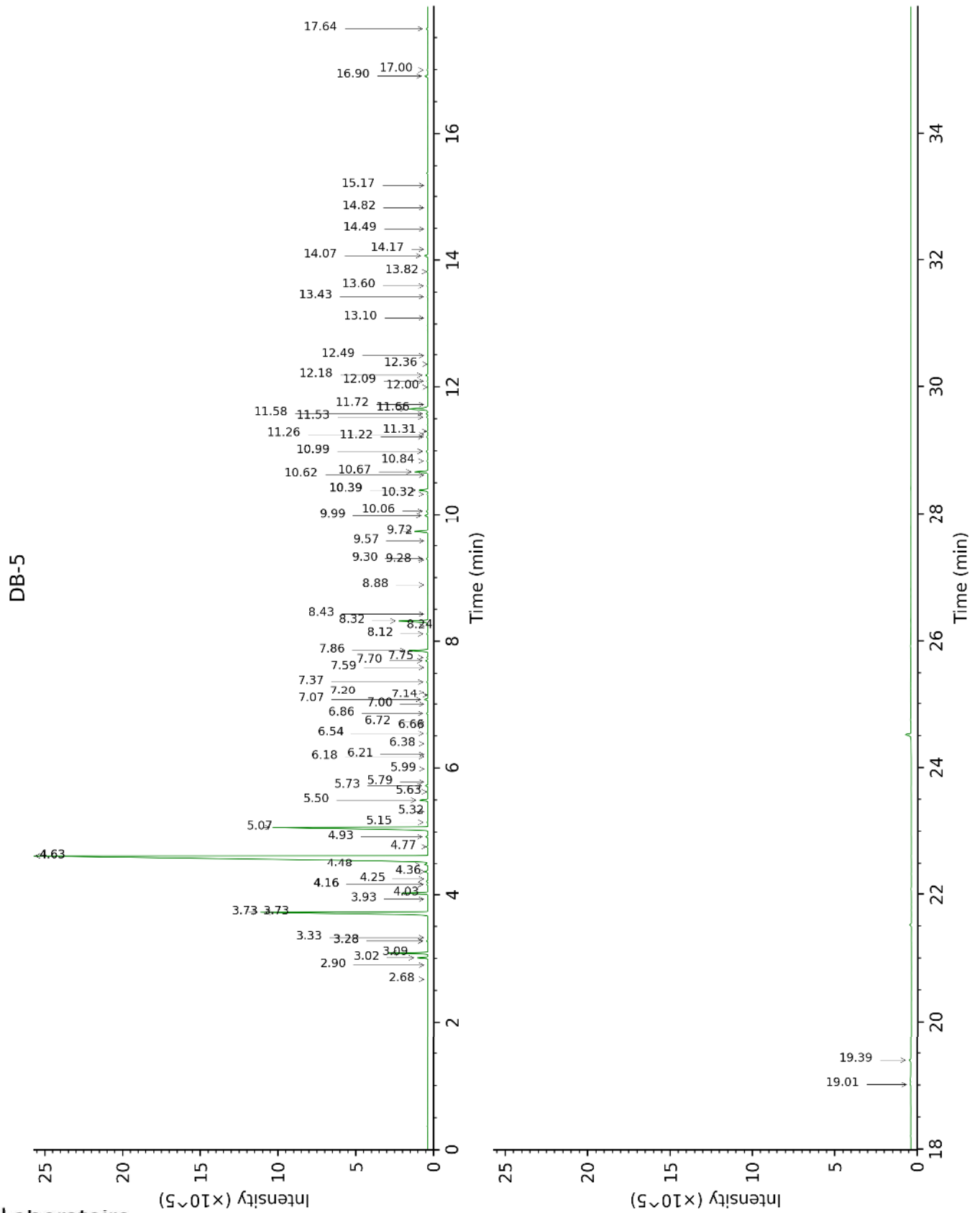
\*: Two or more compounds are coeluting on this column

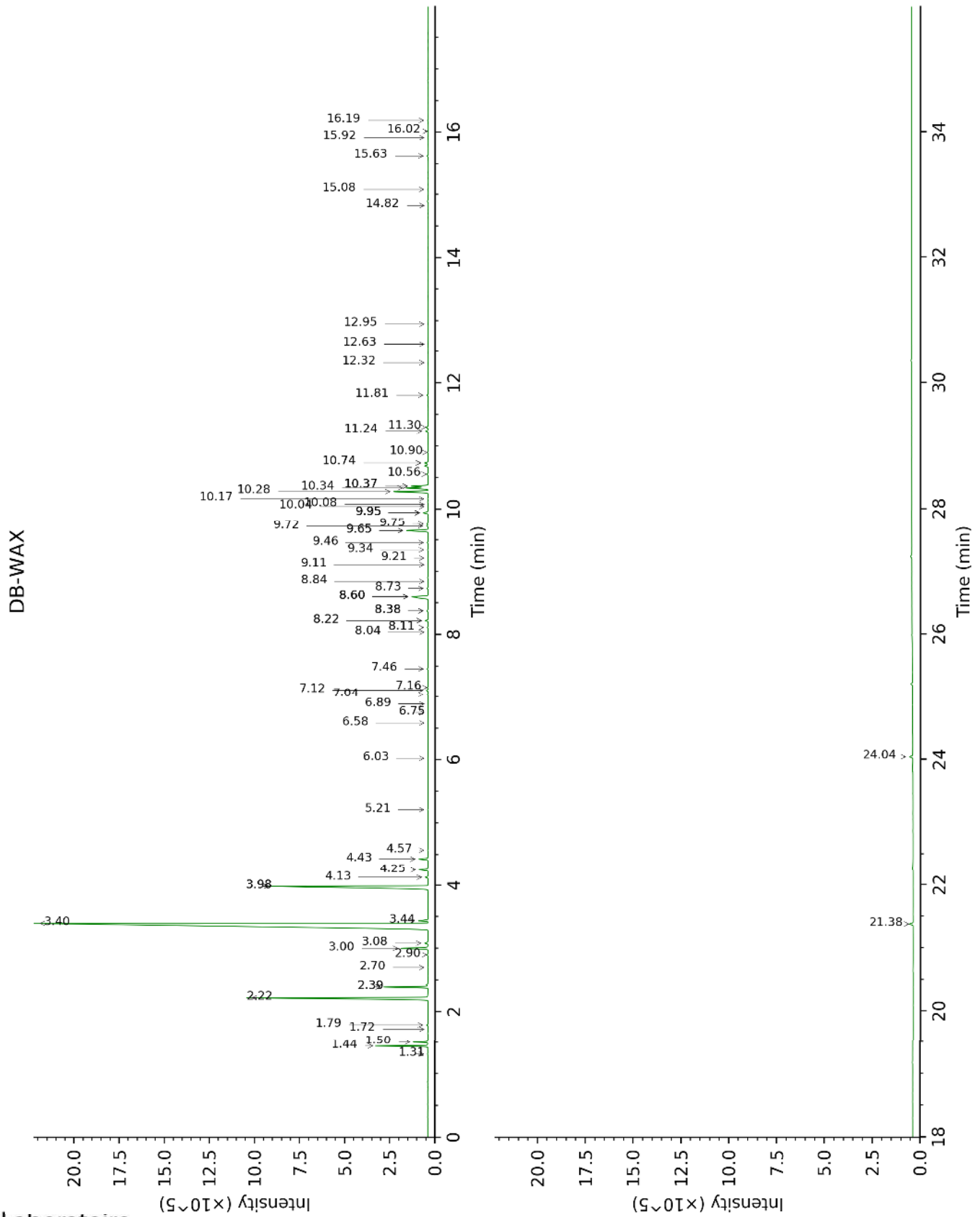
[xx]: Duplicate percentage due to coelutions, not taken account in the identified total

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	%
Nonane	2.68	903	tr			
Tricyclene	2.90	918	0.01	1.31	971	0.01
$\alpha$ -Thujene	3.02	925	0.53	1.50	998	0.52
$\alpha$ -Pinene	3.09	930	2.05	1.44	991	2.02
Camphene	3.28*	942	0.07	1.79	1026	0.06
$\alpha$ -Fenchene	3.28*	942	[0.07]	1.72	1019	tr
Thuja-2,4(10)-diene	3.33	946	0.02	2.39*	1084	1.97
Sabinene	3.73*	972	13.42	2.39*	1084	[1.97]
$\beta$ -Pinene	3.73*	972	[13.42]	2.22	1067	11.33
6-Methyl-5-hepten-2-one	3.93	986	0.02	5.21	1294	0.02
Myrcene	4.02	992	1.45	3.00	1132	1.45
$\alpha$ -Phellandrene	4.16*	1001	0.07	2.90	1125	0.05
Octanal	4.16*	1001	[0.07]	4.57	1248	0.02
$\Delta^3$ -Carene	4.25	1006	0.01	2.70	1109	0.01
$\alpha$ -Terpinene	4.36	1014	0.20	3.08	1139	0.20
para-Cymene	4.48	1021	0.44	4.25	1225	0.45
Limonene	4.63*	1030	56.62	3.40	1162	56.27
1,8-Cineole	4.63*	1030	[56.62]	3.44	1166	0.49
(Z)- $\beta$ -Ocimene	4.77	1040	0.06	3.98*	1206	12.64
(E)- $\beta$ -Ocimene	4.93	1050	0.14	4.13	1217	0.13
$\gamma$ -Terpinene	5.07	1059	12.48	3.98*	1206	[12.64]
cis-Sabinene hydrate	5.15	1064	0.05	7.04	1426	0.05
Octanol	5.32	1074	0.01	8.38*	1525	0.08
Terpinolene	5.50	1086	0.47	4.43	1238	0.48
trans-Sabinene hydrate	5.63	1094	0.05	8.11	1505	0.04
Linalool	5.73	1100	0.14	8.22*	1513	0.15
Nonanal	5.78	1104	0.02	6.03	1352	0.01
trans-para-Mentha-2,8-dien-1-ol	5.99	1117	0.02	9.11	1581	0.01
cis-Limonene oxide	6.18	1130	0.01	6.58	1392	0.02
trans-Limonene oxide	6.22	1132	0.01	6.75	1404	0.01
Epoxyterpinolene	6.38	1143	0.01	6.89	1414	0.01
Citronellal	6.54	1154	0.04	7.16	1434	0.04
Borneol	6.66	1161	0.02	9.95*	1648	0.32
Isoneral	6.72	1165	0.01	8.04	1499	0.02
Terpinen-4-ol	6.86	1174	0.09	8.73	1552	0.06
Isogeranial	7.00	1184	0.03	8.38*	1525	[0.08]
$\alpha$ -Terpineol	7.07	1188	0.21	9.95*	1648	[0.32]
Unknown [m/z 121, 79 (61), 93 (55), 94 (40), 91	7.14	1193	0.01	8.22*	1513	[0.15]



(39), 84 (37)...						
γ-Terpineol	7.20	1196	0.01	10.04	1656	0.02
Decanal	7.37	1208	0.06	7.46	1456	0.06
2,3-Epoxyneral?	7.59	1224	0.02			
Nerol	7.70	1231	0.13	11.24	1755	0.14
2,3-Epoxygeranial?	7.75	1234	0.06			
Neral	7.86	1242	1.22	9.65*	1624	1.29
Geraniol	8.12	1260	0.06	11.81	1804	0.07
Unknown [m/z 43, 128 (61), 79 (60), 127 (52), 58 (50)...	8.24	1269	0.01	12.32	1849	0.01
Geranial	8.32	1274	1.95	10.28	1675	2.05
Unknown [m/z 95, 67 (45), 41 (42), 110 (42), 43 (41), 59 (36)]	8.43	1282	0.02	12.63	1876	0.02
Undecanal	8.88	1307	0.01	8.84	1561	0.01
para-Mentha-1,8-diene-4-hydroperoxide	9.28	1335	0.01			
δ-Elemene	9.30	1336	0.09	7.12	1431	0.09
Citronellyl acetate	9.57	1356	0.01	9.65*	1624	[1.29]
Neryl acetate	9.72	1367	0.84	10.37*	1682	0.95
Geranyl acetate	9.99	1386	0.20	10.74*	1713	0.22
β-Elemene	10.06	1391	0.10	8.60*	1542	1.46
Dodecanal	10.32	1410	0.05	10.17	1666	0.04
β-Caryophyllene	10.39*	1414	0.61	8.60*	1542	[1.46]
cis-α-Bergamotene	10.39*	1414	[0.61]	8.38*	1525	[0.08]
γ-Elemene	10.62	1432	0.02	9.21	1589	0.02
trans-α-Bergamotene	10.67	1436	0.86	8.60*	1542	[1.46]
α-Humulene	10.84	1448	0.06	9.46	1609	0.06
(E)-β-Farnesene	11.00*	1460	0.13	9.72	1630	0.09
β-Santalene	11.00*	1460	[0.13]	9.34	1600	0.04
Germacrene D	11.22	1477	0.07	9.95*	1648	[0.32]
γ-Curcumene	11.26	1479	0.03	9.95*	1648	[0.32]
trans-β-Bergamotene	11.31	1483	0.05	9.75	1633	0.07
(3Z,6E)-α-Farnesene	11.53	1500	0.07	10.37*	1682	[0.95]
(Z)-α-Bisabolene	11.58	1504	0.11	10.56	1698	0.08
β-Bisabolene	11.66	1510	1.47	10.34	1680	1.35
(Z)-γ-Bisabolene	11.72	1515	0.02	10.08	1659	0.01
Unknown [m/z 189, 204 (92), 161 (65), 133 (51), 105 (51), 91 (51), 119 (45)]	12.00	1536	0.01	10.74*	1713	[0.22]

(E)- $\alpha$ -Bisabolene	12.09	1544	0.05	10.90	1727	0.05
Germacrene B	12.18	1551	0.13	11.30	1760	0.14
Caryophyllenyl alcohol	12.36	1565	0.01			
Caryophyllene oxide isomer	12.49	1575	0.02	12.95	1905	0.02
Guaia-6,10(14)-dien-4 $\beta$ -ol	13.10	1624	0.04	15.92	2189	0.04
Unknown [m/z 94, 43 (89), 41 (67), 122 (46), 69 (41)...222]	13.43	1652	0.05	15.08	2105	0.04
Unknown [m/z 69, 95 (100), 41 (89), 109 (68), 67 (61)...222]	13.60	1666	0.04	16.19	2217	0.04
$\alpha$ -Bisabolol	13.82	1684	0.08	15.63	2160	0.07
Herniarin	14.07	1705	0.24	21.38	2808	0.26
(2E,6Z)-Farnesal	14.17	1714	0.03			
(2E,6E)-Farnesal	14.49	1741	0.02	16.02	2199	0.02
Myristic acid	14.82	1770	0.01			
Hexadecanal	15.17	1800	0.01	14.82	2080	0.01
Citropten	16.90	1959	0.20	24.04	3162	0.23
Palmitic acid	17.00	1968	0.09			
Bergapten	17.64	2031	0.10			
Stearic acid	19.01	2168	0.04			
Isopimpinellin	19.39	2208	0.11			
<b>Total identified</b>		<b>98.27%</b>			<b>97.88%</b>	
<b>Total reported</b>		<b>98.41%</b>			<b>97.99%</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