

**Date :** March 07, 2018

**CERTIFICATE OF ANALYSIS - GC PROFILING**

*SAMPLE IDENTIFICATION*

**Internal code :** 18B20-PLG34-1-CC

**Customer identification :** Citronella

**Type :** Essential oil

**Source :** *Cymbopogon winterianus*

**Customer :** Plant Guru

*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 :** Sarah-Eve Tremblay, M. Sc. A., Chimiste

**Analysis date :** March 06, 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:** Faintly yellow liquid

**Refractive index:**  $1.4685 \pm 0.0003$  (20 °C)

*CONCLUSION*

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

ANALYSIS SUMMARY

Identification	DB-5 (%)	DB-WAX (%)	Classe
3-Methylcyclopentene	0.01		Alkene
Methylcyclopentane	tr		Alkane
Toluene	tr	0.01*	Simple phenolic
Unknown	0.01	0.03*	Unknown
Unknown	0.01	[0.03]*	Unknown
Tricyclene	0.01	tr	Monoterpene
$\alpha$ -Thujene	0.01	[0.01]*	Monoterpene
$\alpha$ -Pinene	0.03	0.03	Monoterpene
Camphene	0.02	0.02	Monoterpene
$\beta$ -Pinene	0.02*	tr	Monoterpene
Sabinene	[0.02]*	0.01	Monoterpene
6-Methyl-5-hepten-2-one	0.04	0.05	Aliphatic ketone
Myrcene	0.05	0.04	Monoterpene
$\alpha$ -Phellandrene	0.01	0.01	Monoterpene
Octanal	0.01	0.01	Aliphatic aldehyde
$\Delta^3$ -Carene	0.01	tr	Monoterpene
$\alpha$ -Terpinene	0.01	0.01	Monoterpene
para-Cymene	0.01	0.01	Monoterpene
Limonene	3.08*	3.08	Monoterpene
1,8-Cineole	[3.08]*	0.03*	Monoterpenic ether
$\beta$ -Phellandrene	[3.08]*	[0.03]*	Monoterpene
(Z)- $\beta$ -Ocimene	0.08	0.09	Monoterpene
(E)- $\beta$ -Ocimene	0.06	0.05	Monoterpene
2,6-Dimethyl-5-heptenal (melonal)	0.08	0.11*	Aliphatic aldehyde
$\gamma$ -Terpinene	0.01	0.02	Monoterpene
cis-Sabinene hydrate	tr	0.01	Monoterpenic alcohol
Terpinolene	0.05	0.05	Monoterpene
Linalool	0.55	0.58	Monoterpenic alcohol
cis-Rose oxide	0.02	[0.11]*	Monoterpenic ether
Unknown	0.01	0.01	Oxygenated monoterpene
trans-Rose oxide	0.01	0.01	Monoterpenic ether
Melonol ?	0.07		Normonoterpene
Isopulegol	0.90	0.93	Monoterpenic alcohol
neo-Isopulegol	0.02	0.05	Monoterpenic alcohol
Citronellal	38.04*	37.55*	Monoterpenic aldehyde
iso-Isopulegol	[38.04]*	0.31	Monoterpenic alcohol
Isomenthone	[38.04]*	[37.55]*	Monoterpenic ketone
Borneol	0.09*	1.53*	Monoterpenic alcohol
neoiso-Isopulegol	[0.09]*	0.06	Monoterpenic alcohol
Terpinen-4-ol	0.04	0.05	Monoterpenic alcohol
$\alpha$ -Terpineol	0.07	[1.53]*	Monoterpenic alcohol
Decanal	0.14	0.18	Aliphatic aldehyde
Nerol	0.18	0.23	Monoterpenic alcohol
Citronellol	13.22	13.03	Monoterpenic alcohol
Neral	[13.22]	0.38	Monoterpenic aldehyde
Geraniol	20.87	21.30	Monoterpenic alcohol
Geranial	0.74	0.73	Monoterpenic aldehyde
Citronellyl formate	0.04	0.05	Monoterpenic ester

Geranyl formate	0.04	0.10*	Monoterpenic ester
Citronellic acid	0.54*	0.31	Monoterpenic acid
8-Hydroxy-neo-menthol	[0.54]*	0.18	Monoterpenic alcohol
δ-Elemene isomer	[0.54]*	0.02	Sesquiterpene
Citronellyl acetate	2.66	1.67	Monoterpenic ester
Eugenol	[2.66]	1.00	Phenylpropanoid
Neryl acetate	0.04	0.02	Monoterpenic ester
α-Copaene	0.03	0.11	Sesquiterpene
β-Bourbonene	0.11	0.11	Sesquiterpene
cis-β-Elemene	0.07	0.06	Sesquiterpene
Geranyl acetate	1.69	1.72	Monoterpenic ester
β-Elemene	1.54	1.65*	Sesquiterpene
Methyleugenol	0.02	0.03	Phenylpropanoid
Dodecanal	0.02	0.03	Aliphatic aldehyde
β-Caryophyllene	0.15	[1.65]*	Sesquiterpene
β-Copaene	0.03	0.03	Sesquiterpene
trans-α-Bergamotene	0.04	[1.65]*	Sesquiterpene
α-Humulene	0.11	0.10	Sesquiterpene
trans-Cadina-1(6),4-diene	0.04	0.04	Sesquiterpene
γ-Muurolene	0.14	0.17	Sesquiterpene
Germacrene D	1.52	[1.53]*	Sesquiterpene
β-Selinene	0.06	[0.10]*	Sesquiterpene
α-Selinene	0.17*	0.03	Sesquiterpene
epi-Cubebol	[0.17]*	0.10	Sesquiterpenic alcohol
α-Muurolene	0.41	0.37	Sesquiterpene
Germacrene A	0.51	0.53	Sesquiterpene
Cubebol	0.52*	0.11	Sesquiterpenic alcohol
γ-Cadinene	[0.52]*	1.73*	Sesquiterpene
δ-Cadinene	1.42*	[1.73]*	Sesquiterpene
trans-Calamenene	[1.42]*	0.02	Sesquiterpene
Unknown	0.07		Sesquiterpene
α-Cadinene	0.11	0.16	Sesquiterpene
α-Elemol	2.77	2.78	Sesquiterpenic alcohol
Geranyl butyrate	0.04	0.06	Monoterpenic ester
Germacrene D-4-ol	1.42	1.46	Sesquiterpenic alcohol
Caryophyllene oxide	0.02*	0.04	Sesquiterpenic ether
Caryophyllene oxide isomer	[0.02]*	0.01	Sesquiterpenic ether
10-epi-Cubebol	0.03		Sesquiterpenic alcohol
γ-Eudesmol	0.19	0.14	Sesquiterpenic alcohol
τ-Muurolol	0.51*	0.32	Sesquiterpenic alcohol
τ-Cadinol	[0.51]*	0.26	Sesquiterpenic alcohol
α-Muurolol	0.27*	0.09	Sesquiterpenic alcohol
β-Eudesmol	[0.27]*	0.22	Sesquiterpenic alcohol
α-Cadinol	0.58	0.57	Sesquiterpenic alcohol
(2E,6Z)-Farnesal	0.01		Sesquiterpenic aldehyde
(2E,6E)-Farnesol	0.07	0.11	Sesquiterpenic alcohol
(2E,6E)-Farnesal	0.03	0.20	Sesquiterpenic aldehyde
Cryptomeridiol	0.01		Sesquiterpenic alcohol
Unknown	0.01	0.01	Oxygenated diterpene
Unknown	0.10	0.10	Oxygenated diterpene
Citronellyl citronellate	0.01	0.01	Monoterpenic ester
Unknown	0.04		Unknown

Unknown	0.15		Unknown
Unknown	0.13		Unknown
<b>Total identified</b>	<b>96.56%</b>	<b>97.28%</b>	

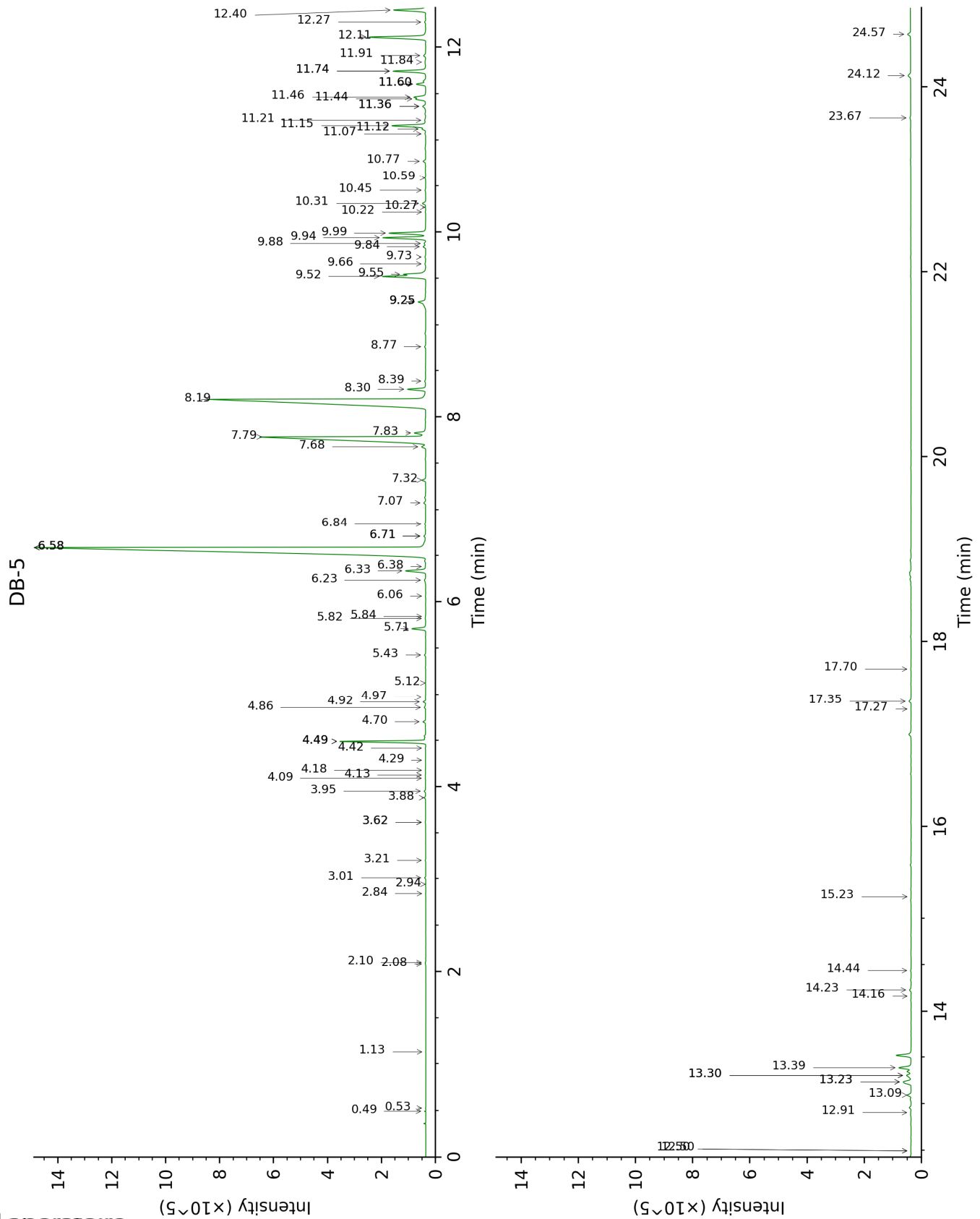
\*: Two or more compounds are coeluting on this column

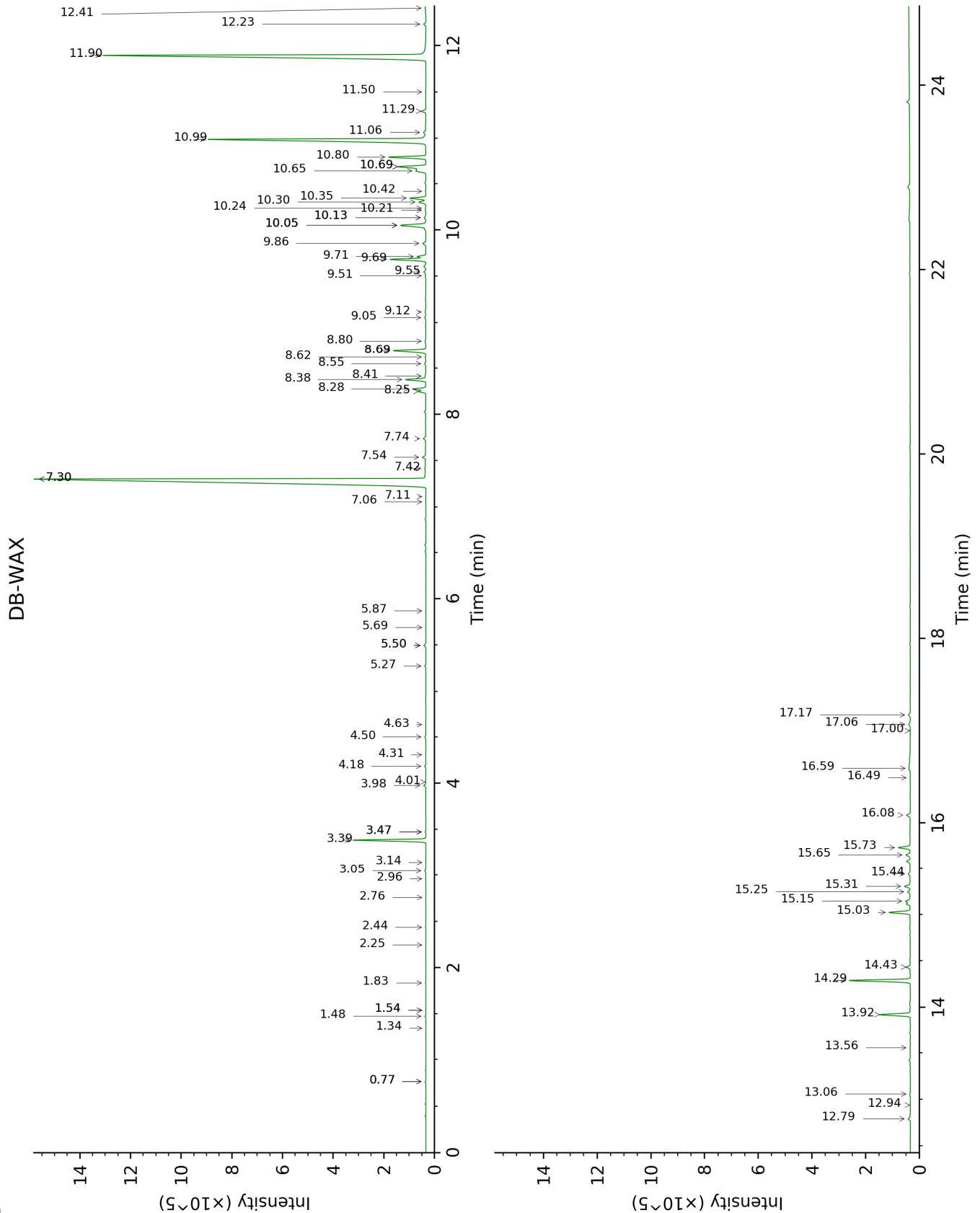
[xx]: Duplicate percentage due to coelutions, not taken account in the identified total

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	%
3-Methylcyclopentene	0.49	605	0.01			
Methylcyclopentane	0.53	616	tr			
Toluene	1.13	753	tr	1.54*	1002	0.01
Unknown [m/z 55, 83 (89), 82 (70), 67 (66), 41 (55), 69 (46), 111 (37)... 126 (2)]	2.08	853	0.01	0.76*	866	0.03
Unknown [m/z 55, 83 (79), 67 (65), 41 (63), 82 (60), 69 (58)... 111 (27), 126 (9)]	2.10	855	0.01	0.76*	866	[0.03]
Tricyclene	2.84	914	0.01	1.34	975	tr
$\alpha$ -Thujene	2.94	920	0.01	1.54*	1002	[0.01]
$\alpha$ -Pinene	3.01	925	0.03	1.48	995	0.03
Camphene	3.21	938	0.02	1.83	1030	0.02
$\beta$ -Pinene	3.62*	965	0.02	2.24	1068	tr
Sabinene	3.62*	965	[0.02]	2.44	1086	0.01
6-Methyl-5-hepten-2-one	3.88	983	0.04	5.27	1296	0.05
Myrcene	3.95	988	0.05	3.05	1134	0.04
$\alpha$ -Phellandrene	4.09	997	0.01	2.96	1127	0.01
Octanal	4.13	999	0.01	4.63	1250	0.01
$\Delta^3$ -Carene	4.18	1002	0.01	2.76	1112	tr
$\alpha$ -Terpinene	4.29	1009	0.01	3.14	1141	0.01
para-Cymene	4.42	1018	0.01	4.31	1227	0.01
Limonene	4.49*†	1022	3.08	3.39	1160	3.08
1,8-Cineole	4.49*†	1022	[3.08]	3.47*	1166	0.03
$\beta$ -Phellandrene	4.49*†	1022	[3.08]	3.47*	1166	[0.03]
(Z)- $\beta$ -Ocimene	4.70	1035	0.08	3.98	1204	0.09
(E)- $\beta$ -Ocimene	4.86	1045	0.06	4.18	1219	0.05
2,6-Dimethyl-5-heptenal (melonal)	4.92	1049	0.08	5.50*	1312	0.11
$\gamma$ -Terpinene	4.97	1052	0.01	4.01	1207	0.02
cis-Sabinene hydrate	5.12	1062	tr	7.11	1428	0.01
Terpinolene	5.43	1081	0.05	4.50	1241	0.05
Linalool	5.71	1099	0.55	8.28	1515	0.58
cis-Rose oxide	5.82	1106	0.02	5.50*	1312	[0.11]
Unknown [m/z 111, 69 (70), 41 (68), 55 (53), 43 (51)... 154 (7)]	5.84	1107	0.01	5.87	1338	0.01
trans-Rose oxide	6.06	1121	0.01	5.69	1326	0.01
Melonol ?	6.23	1132	0.07			
Isopulegol	6.34	1138	0.90	8.38	1523	0.93
neo-Isopulegol	6.38	1141	0.02	8.42	1526	0.05

Citronellal	6.58*	1154	38.04	7.30*	1442	37.55
iso-Isopulegol	6.58*	1154	[38.04]	8.25	1513	0.31
Isomenthone	6.58*	1154	[38.04]	7.30*	1442	[37.55]
Borneol	6.71*	1162	0.09	10.05*	1654	1.53
neoiso-Isopulegol	6.71*	1162	[0.09]	9.05	1575	0.06
Terpinen-4-ol	6.84	1171	0.04	8.80	1555	0.05
$\alpha$ -Terpineol	7.07	1186	0.07	10.05*	1654	[1.53]
Decanal	7.32	1201	0.14	7.54	1460	0.18
Nerol	7.68	1225	0.18	11.29	1757	0.23
Citronellol	7.78†	1232	13.22	10.99	1731	13.03
Neral	7.83†	1235	[13.22]	9.71	1627	0.38
Geraniol	8.19	1260	20.87	11.90	1809	21.30
Geranial	8.30	1267	0.74	10.35	1678	0.73
Citronellyl formate	8.39	1273	0.04	9.12	1579	0.05
Geranyl formate	8.76	1298	0.04	10.13*	1661	0.10
Citronellic acid	9.25*	1332	0.54	16.59	2256	0.31
8-Hydroxy-neo-menthol	9.25*	1332	[0.54]	14.43	2040	0.18
$\delta$ -Elemene isomer	9.25*	1332	[0.54]	7.06	1424	0.02
Citronellyl acetate	9.52†	1351	2.66	9.68	1625	1.67
Eugenol	9.55†	1353	[2.66]	15.02	2097	1.00
Neryl acetate	9.66	1361	0.04	10.42	1684	0.02
$\alpha$ -Copaene	9.73	1366	0.03	7.42	1450	0.11
$\beta$ -Bourbonene	9.84	1374	0.11	7.74	1474	0.11
<i>cis</i> - $\beta$ -Elemene	9.88	1376	0.07	8.55	1536	0.06
Geranyl acetate	9.94	1380	1.69	10.80	1715	1.72
$\beta$ -Elemene	9.99	1384	1.54	8.69*	1547	1.65
Methyleugenol	10.22	1400	0.02	13.56	1958	0.03
Dodecanal	10.27	1404	0.02	10.24	1669	0.03
$\beta$ -Caryophyllene	10.31	1407	0.15	8.69*	1547	[1.65]
$\beta$ -Copaene	10.45	1417	0.03	8.62	1541	0.03
<i>trans</i> - $\alpha$ -Bergamotene	10.59	1427	0.04	8.69*	1547	[1.65]
$\alpha$ -Humulene	10.77	1441	0.11	9.55	1614	0.10
<i>trans</i> -Cadina-1(6),4-diene	11.07	1463	0.04	9.51	1610	0.04
$\gamma$ -Muurolene	11.12	1467	0.14	9.86	1638	0.17
Germacrene D	11.16	1470	1.52	10.05*	1654	[1.53]
$\beta$ -Selinene	11.21	1474	0.06	10.13*	1661	[0.10]
$\alpha$ -Selinene	11.36*	1485	0.17	10.21	1667	0.03
epi-Cubebol	11.36*	1485	[0.17]	12.23	1838	0.10
$\alpha$ -Muurolene	11.44	1491	0.41	10.30	1674	0.37
Germacrene A	11.46	1492	0.51	10.65	1703	0.53
Cubebol	11.60*†	1503	0.52	12.79	1888	0.11
$\gamma$ -Cadinene	11.60*†	1503	[0.52]	10.69*	1706	1.73
$\delta$ -Cadinene	11.74*	1514	1.42	10.69*	1706	[1.73]
<i>trans</i> -Calamenene	11.74*	1514	[1.42]	11.50	1774	0.02
Unknown [m/z 119, 105 (53), 161 (33), 93 (28), 91 (25), 40 (20)...204]	11.84	1522	0.07			
$\alpha$ -Cadinene	11.91	1527	0.11	11.06	1738	0.16

α-Elemol	12.11	1543	2.77	14.29	2026	2.78
Geranyl butyrate	12.27	1555	0.04	12.41	1854	0.06
Germacrene D-4-ol	12.40	1566	1.42	13.92	1991	1.46
Caryophyllene oxide	12.50*	1573	0.02	13.06	1912	0.04
Caryophyllene oxide isomer	12.50*	1573	[0.02]	12.94	1901	0.01
10-epi-Cubenol	12.91	1605	0.03			
γ-Eudesmol	13.09	1621	0.19	15.25	2120	0.14
τ-Muurolol	13.23*	1632	0.51	15.31	2125	0.32
τ-Cadinol	13.23*	1632	[0.51]	15.15	2110	0.26
α-Muurolol	13.30*	1638	0.27	15.44	2139	0.09
β-Eudesmol	13.30*	1638	[0.27]	15.65	2160	0.22
α-Cadinol	13.39	1645	0.58	15.73	2168	0.57
(2E,6Z)-Farnesal	14.16	1709	0.01			
(2E,6E)-Farnesol	14.23	1715	0.07	17.06	2306	0.11
(2E,6E)-Farnesal	14.44	1733	0.03	16.08	2204	0.20
Cryptomeridiol	15.24	1802	0.01			
Unknown [m/z 81, 137 (70), 95 (46), 69 (45), 41 (39), 55 (29)...]	17.27	1990	0.01	16.49	2245	0.01
Unknown [m/z 41, 69 (98), 55 (55), 81 (46), 109 (46)... 290 (8)]	17.35	1998	0.10	17.17	2317	0.10
Citronellyl citronellate	17.70	2033	0.01	17.00	2298	0.01
Unknown [m/z 69, 81 (79), 81 (70), 137 (53), 139 (35), 95 (30)...]	23.67	2699	0.04			
Unknown [m/z 69, 81 (84), 137 (53), 83 (30), 95 (27), 41 (19)...]	24.12	2758	0.15			
Unknown [m/z 69, 81 (64), 95 (29), 137 (19), 41 (19)...]	24.57	2816	0.13			
<b>Total identified</b>		<b>96.56%</b>			<b>97.28%</b>	
<b>Total reported</b>		<b>97.10%</b>			<b>97.40%</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