

**Date :** February 23, 2018

**CERTIFICATE OF ANALYSIS - GC PROFILING**

*SAMPLE IDENTIFICATION*

**Internal code :** 18B20-PLG1-1-CC

**Customer identification :** Tea Tree - Australia

**Type :** Essential oil

**Source :** *Melaleuca alternifolia* ct. Terpinen-4-ol

**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 :** February 23, 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:** Clear liquid

**Refractive index:**  $1.4775 \pm 0.0003$  (20 °C)

*CONCLUSION*

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

## ANALYSIS SUMMARY

Identification	DB-5 (%)	DB-WAX (%)	Classe
Ethanol	0.08	0.08	Aliphatic alcohol
Isobutyral	0.02	0.02	Aliphatic aldehyde
Ethyl acetate	tr	tr	Aliphatic ester
Isobutanol	tr	tr	Aliphatic alcohol
Isovaleral	tr	tr	Aliphatic aldehyde
2-Methylbutyral	0.02	0.02	Aliphatic aldehyde
Isoamyl alcohol	tr	0.01*	Aliphatic alcohol
2-Methylbutanol	tr	[0.01]*	Aliphatic alcohol
Prenol	0.01		Aliphatic alcohol
(3Z)-Hexenol	0.06	0.07	Aliphatic alcohol
Hexanol	tr	tr	Aliphatic alcohol
$\alpha$ -Thujene	0.83	0.83	Monoterpene
$\alpha$ -Pinene	2.25	2.26	Monoterpene
Camphene	0.02*	0.01	Monoterpene
$\alpha$ -Fenchene	[0.02]*	tr	Monoterpene
Thuja-2,4(10)-diene	tr	0.21*	Monoterpene
$\beta$ -Pinene	0.86*	0.66	Monoterpene
Sabinene	[0.86]*	[0.21]*	Monoterpene
3-Methyl-3-cyclohexenone?	0.01	0.02*	Aliphatic ketone
Myrcene	0.80	0.81	Monoterpene
$\alpha$ -Phellandrene	0.40*	0.40	Monoterpene
Menthatriene isomer I	[0.40]*	tr	Monoterpene
Pseudolimonene	[0.40]*	0.01	Monoterpene
(3Z)-Hexenyl acetate	0.01	0.02*	Aliphatic ester
$\alpha$ -Terpinene	9.29	9.35	Monoterpene
para-Cymene	5.14	1.94	Monoterpene
Limonene	[5.14]*	0.76	Monoterpene
1,8-Cineole	[5.14]*	2.46*	Monoterpenic ether
$\beta$ -Phellandrene	[5.14]*	[2.46]*	Monoterpene
(Z)- $\beta$ -Ocimene	0.01	19.46*	Monoterpene
(E)- $\beta$ -Ocimene	0.02	0.02	Monoterpene
$\gamma$ -Terpinene	19.40	[19.46]*	Monoterpene
Unknown	0.06*	[0.02]*	Oxygenated monoterpene
cis-Sabinene hydrate	[0.06]*	0.04	Monoterpenic alcohol
para-Cymenene	3.32*	0.05	Monoterpene
Terpinolene	[3.32]*	3.28	Monoterpene
trans-Sabinene hydrate	0.06	0.07	Monoterpenic alcohol
Linalool	0.06	0.41*	Monoterpenic alcohol
para-Mentha-1,3,8-triene	0.01	[0.02]*	Monoterpene
endo-Fenchol	0.01	0.03*	Monoterpenic alcohol
cis-para-Menth-2-en-1-ol	0.39	[0.41]*	Monoterpenic alcohol
4-Hydroxy-4-methylcyclohex-2-enone	0.02	0.01	Aliphatic alcohol
Cosmene isomer I	0.02*	0.01	Monoterpene
trans-Pinocarveol	[0.02]*	0.06	Monoterpenic alcohol
Cosmene isomer II	0.09		Monoterpene
trans-para-Menth-2-en-1-ol	0.19	0.29	Monoterpenic alcohol
Unknown	0.03	0.06*	Unknown

δ-Terpineol	0.02	0.02	Monoterpenic alcohol
Dill ether	41.51*	0.01	Monoterpenic ether
Terpinen-4-ol	[41.51]*	42.54*	Monoterpenic alcohol
para-Cymen-8-ol	0.06	0.05	Monoterpenic alcohol
α-Terpineol	3.23	3.12	Monoterpenic alcohol
cis-Piperitol	[3.23]	0.19*	Monoterpenic alcohol
trans-Piperitol	0.17	1.22*	Monoterpenic alcohol
exo-2-Hydroxycineole	0.03	0.02	Monoterpenic alcohol
Nerol	0.03	0.05*	Monoterpenic alcohol
Unknown	0.01	0.01	Oxygenated monoterpene
Piperitone	0.06	0.10*	Monoterpenic ketone
cis-Carvenone oxide?	0.02		Monoterpenic ketone
trans-Ascaridole glycol	0.04	0.11	Monoterpenic alcohol
cis-Ascaridole glycol?	0.02	0.08	Monoterpenic alcohol
Thymol	0.04	0.03	Monoterpenic alcohol
Carvacrol	0.02	0.02	Monoterpenic alcohol
Unknown	0.03	0.04	Monoterpenic alcohol
Bicycloelemene	0.02	0.02	Sesquiterpene
α-Cubebene	0.05	0.05	Sesquiterpene
Unknown	0.03	0.27*	Unknown
Isoledene	0.06	[0.06]*	Sesquiterpene
α-Copaene	0.11	0.10	Sesquiterpene
7-Cubebene	0.05	0.05	Sesquiterpene
7-Cubebene epimer?	0.02	0.02	Aliphatic alcohol
β-Cubebene	0.03	0.04*	Sesquiterpene
β-Elemene	0.03	0.34*	Sesquiterpene
α-Gurjunene	0.35	0.34	Sesquiterpene
Methyleugenol	0.04	0.04	Phenylpropanoid
β-Maaliene	0.02	[0.04]*	Sesquiterpene
β-Caryophyllene	0.36	[0.34]*	Sesquiterpene
γ-Maaliene	0.06	0.09	Sesquiterpene
β-Gurjunene	0.02	[0.03]*	Sesquiterpene
α-Maaliene	0.06	[42.54]*	Sesquiterpene
Aromadendrene	1.08	[42.54]*	Sesquiterpene
Selina-5,11-diene	0.15	0.15	Sesquiterpene
trans-Muuroala-3,5-diene	0.11	0.11	Sesquiterpene
α-Humulene	0.12	0.08	Sesquiterpene
allo-Aromadendrene	0.55	0.51	Sesquiterpene
trans-Cadina-1(6),4-diene	0.32*	0.29	Sesquiterpene
Selina-4,11-diene	[0.32]*	0.02	Sesquiterpene
γ-Muurolole	0.03	0.04	Sesquiterpene
β-Selinene	0.09	[0.10]*	Sesquiterpene
allo-Aromadendr-9-ene	0.11	[0.19]*	Sesquiterpene
δ-Selinene	0.08	1.04*	Sesquiterpene
trans-Muuroala-4(15),5-diene	0.11	0.11	Sesquiterpene
Viridiflorene	1.85*	[1.04]*	Sesquiterpene
Bicyclogermacrene	[1.85]*	0.86*	Sesquiterpene
α-Selinene	[1.85]*	0.13	Sesquiterpene
α-Muurolole	0.18*	[0.86]*	Sesquiterpene
Epizonarene	[0.18]*	0.09	Sesquiterpene
γ-Cadinene	0.03	0.32*	Sesquiterpene
Zonarene	1.62*	[0.32]*	Sesquiterpene

δ-Cadinene	[1.62]*	[1.22]*	Sesquiterpene
<i>trans</i> -Calamenene	[1.62]*	0.11	Sesquiterpene
<i>trans</i> -Cadina-1,4-diene	0.20	0.20	Sesquiterpene
α-Calacorene	0.02	0.03	Sesquiterpene
Unknown	0.10	0.12	Oxygenated sesquiterpene
Eudesma-5,7(11)-diene	0.03	[0.05]*	Sesquiterpene
Palustrol	0.14*	0.06	Sesquiterpenic alcohol
Maaliol	[0.14]*	0.06	Sesquiterpenic alcohol
Unknown	0.01	0.02	Oxygenated sesquiterpene
Spathulenol	0.12	0.12	Sesquiterpenic alcohol
Globulol	0.47	0.45	Sesquiterpenic alcohol
Gleenol	0.05	0.04	Sesquiterpenic alcohol
Viridiflorol	0.24	[0.27]*	Sesquiterpenic alcohol
Cubeban-11-ol	0.21	0.33*	Sesquiterpenic alcohol
Ledol	0.20*	0.07	Sesquiterpenic alcohol
Eudesm-5-en-11-ol	[0.20]*	0.20*	Sesquiterpenic alcohol
10-epi-Cubenol	0.02		Sesquiterpenic alcohol
Rosifoliol	0.20	[0.20]*	Sesquiterpenic alcohol
1-epi-Cubenol	0.29	0.28	Sesquiterpenic alcohol
Cubenol	0.17	[0.33]*	Sesquiterpenic alcohol
α-Muurolol	0.05	0.07	Sesquiterpenic alcohol
<b>Total identified</b>	<b>98.82%</b>	<b>98.45%</b>	

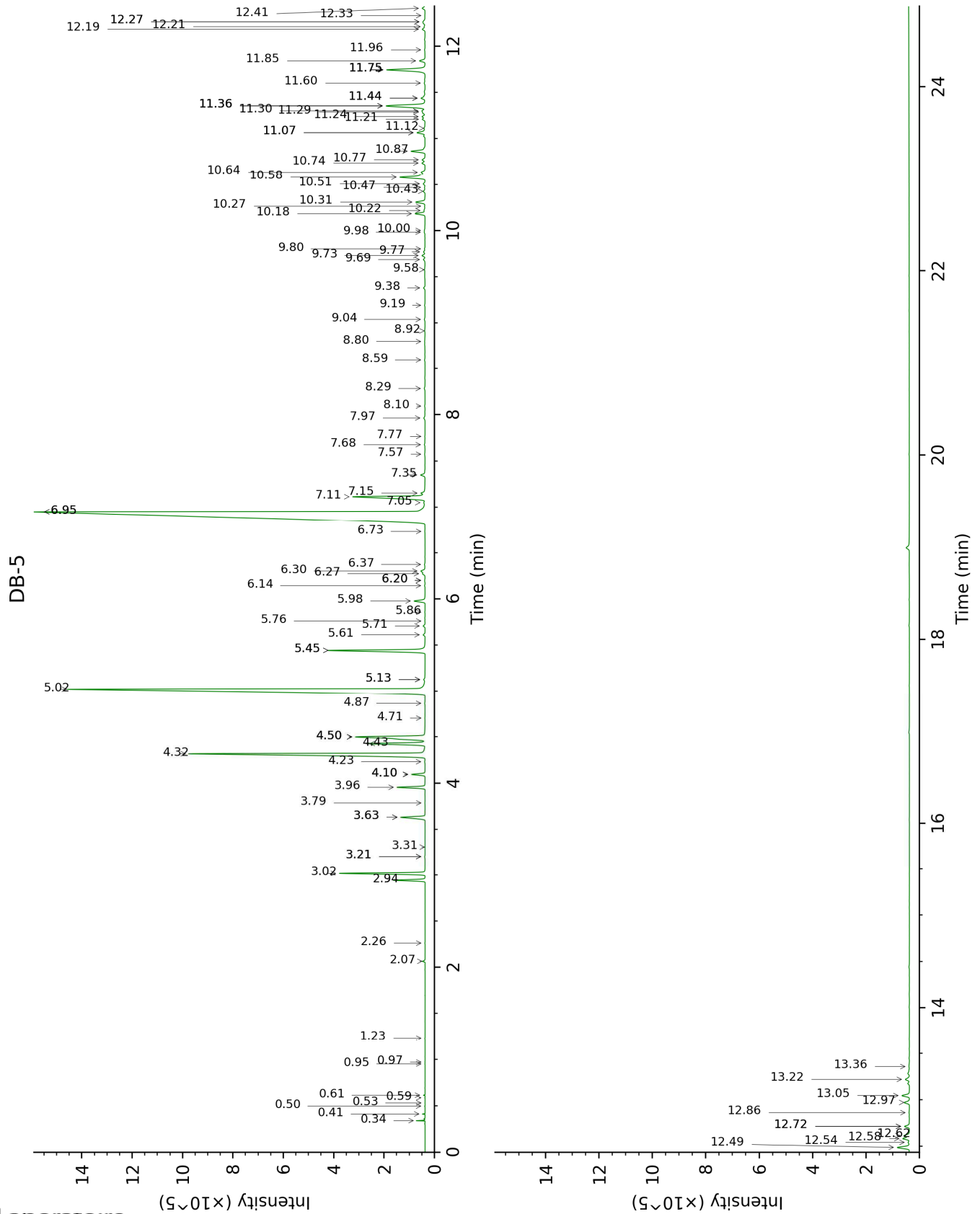
\*: Two or more compounds are coeluting on this column

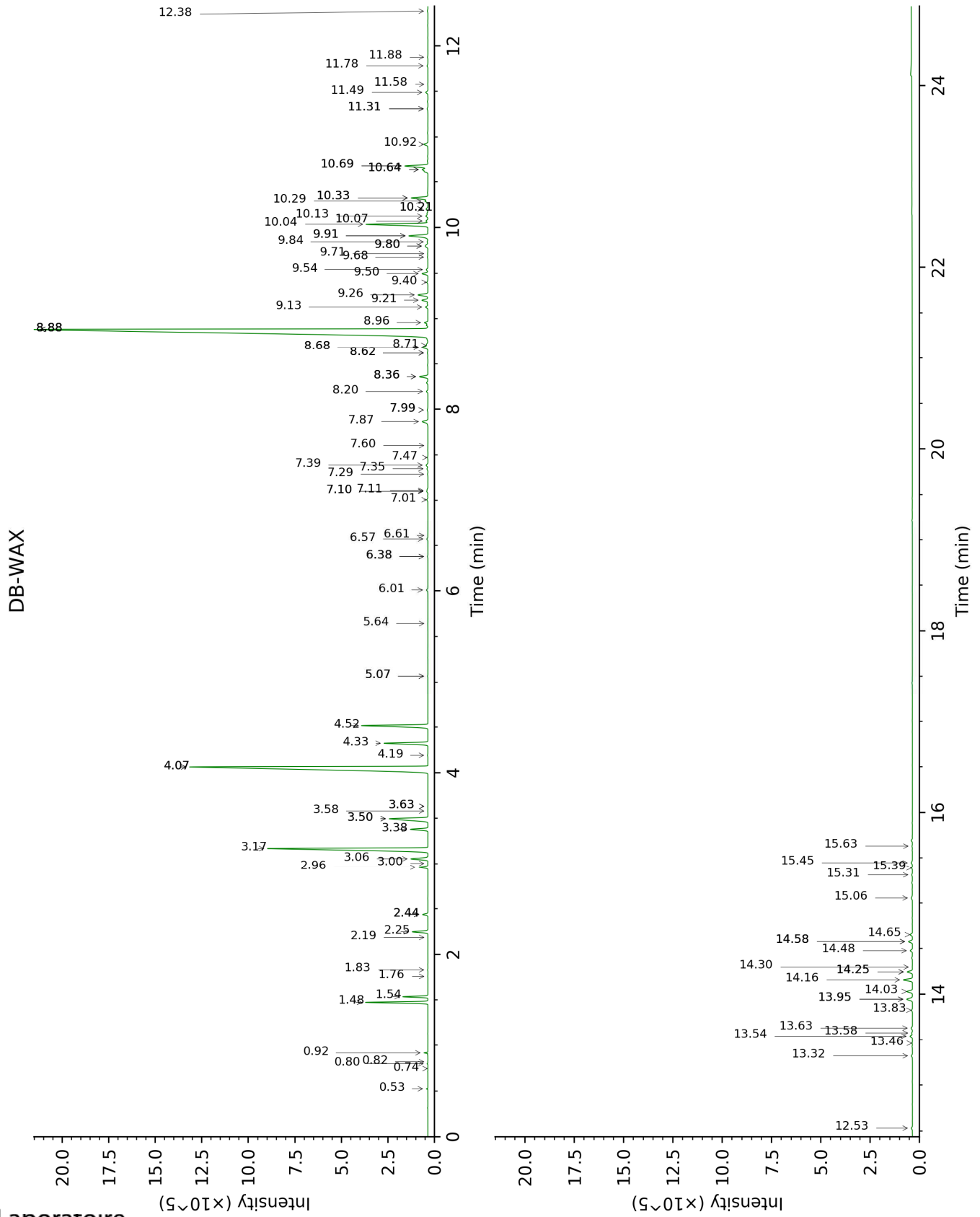
[xx]: Duplicate percentage due to coelutions, not taken account in the identified total

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	%
Ethanol	0.34	495	0.08	0.92	906	0.08
Isobutyral	0.41	538	0.02	0.52	766	0.02
Ethyl acetate	0.50	607	tr	0.74	859	tr
Isobutanol	0.53	619	tr	2.19	1063	tr
Isovaleral	0.59	638	tr	0.82	886	tr
2-Methylbutyral	0.62	648	0.02	0.80	878	0.02
Isoamyl alcohol	0.95	727	tr	3.63*	1178	0.01
2-Methylbutanol	0.97	730	tr	3.63*	1178	[0.01]
Prenol	1.23	769	0.01			
(3Z)-Hexenol	2.07	852	0.06	6.01	1349	0.07
Hexanol	2.26	869	tr	5.64	1322	tr
$\alpha$ -Thujene	2.94	921	0.83	1.54	1002	0.83
$\alpha$ -Pinene	3.02	926	2.25	1.48	995	2.26
Camphene	3.21*	938	0.02	1.83	1030	0.01
$\alpha$ -Fenchene	3.21*	938	[0.02]	1.76	1023	tr
Thuja-2,4(10)-diene	3.31	945	tr	2.44*	1086	0.21
$\beta$ -Pinene	3.63*	966	0.86	2.25	1069	0.66
Sabinene	3.63*	966	[0.86]	2.44*	1086	[0.21]
3-Methyl-3-cyclohexenone?	3.79	977	0.01	6.38*	1375	0.02
Myrcene	3.96	988	0.80	3.06	1135	0.81
$\alpha$ -Phellandrene	4.10*	997	0.40	2.96	1128	0.40
Menthatriene isomer I	4.10*	997	[0.40]	3.58	1175	tr
Pseudolimonene	4.10*	997	[0.40]	3.00	1131	0.01
(3Z)-Hexenyl acetate	4.23	1006	0.01	5.07*	1281	0.02
$\alpha$ -Terpinene	4.32	1011	9.29	3.17	1143	9.35
para-Cymene	4.43†	1018	5.14	4.32	1229	1.94
Limonene	4.50*†	1023	[5.14]	3.38	1159	0.76
1,8-Cineole	4.50*†	1023	[5.14]	3.50*	1168	2.46
$\beta$ -Phellandrene	4.50*†	1023	[5.14]	3.50*	1168	[2.46]
(Z)- $\beta$ -Ocimene	4.70	1036	0.01	4.06*	1210	19.46
(E)- $\beta$ -Ocimene	4.86	1046	0.02	4.19	1219	0.02
$\gamma$ -Terpinene	5.02	1056	19.40	4.06*	1210	[19.46]
Unknown [m/z 79, 93 (60), 43 (40), 94 (35), 137 (33), 77 (26), 91 (20), 152 (18)]	5.13*	1062	0.06	5.07*	1281	[0.02]
cis-Sabinene hydrate	5.13*	1062	[0.06]	7.11	1428	0.04
para-Cymenene	5.44*	1082	3.32	6.57	1388	0.05
Terpinolene	5.44*	1082	[3.32]	4.52	1242	3.28
trans-Sabinene hydrate	5.61	1093	0.06	8.20	1509	0.07
Linalool	5.71	1099	0.06	8.36*	1521	0.41

para-Mentha-1,3,8-triene	5.76	1102	0.01	6.38*	1375	[0.02]
endo-Fenchol	5.86	1108	0.01	8.62*	1541	0.03
cis-para-Menth-2-en-1-ol	5.98	1116	0.39	8.36*	1521	[0.41]
4-Hydroxy-4-methylcyclohex-2-enone	6.14	1126	0.02	14.30	2027	0.01
Cosmene isomer I	6.20*	1130	0.02	6.61	1391	0.01
trans-Pinocarveol	6.20*	1130	[0.02]	9.40	1602	0.06
Cosmene isomer II	6.27	1135	0.09			
trans-para-Menth-2-en-1-ol	6.30	1136	0.19	9.20	1586	0.29
Unknown [m/z 109, 124 (45), 119 (41), 43 (35), 91 (28), 95 (25)...]	6.37	1141	0.03	7.10*	1427	0.06
δ-Terpineol	6.73	1164	0.02	9.72	1627	0.02
Dill ether	6.95*	1178	41.51	7.60	1464	0.01
Terpinen-4-ol	6.95*	1178	[41.51]	8.88*	1562	42.54
para-Cymen-8-ol	7.05	1184	0.06	11.78	1799	0.05
α-Terpineol	7.11†	1188	3.23	10.04	1653	3.12
cis-Piperitol	7.15†	1191	[3.23]	9.80*	1634	0.19
trans-Piperitol	7.35	1203	0.17	10.68*	1706	1.22
exo-2-Hydroxycineole	7.57	1218	0.03	11.88	1807	0.02
Nerol	7.68	1225	0.03	11.31*	1758	0.05
Unknown [m/z 137, 152 (28), 43 (25), 91 (24), 109 (23), 119 (19)]	7.77	1231	0.01	11.58	1781	0.01
Piperitone	7.97	1244	0.06	10.20*	1666	0.10
cis-Carvenone oxide?	8.10	1253	0.02			
trans-Ascaridole glycol	8.28	1266	0.04	14.48	2045	0.11
cis-Ascaridole glycol?	8.59	1286	0.02	15.06	2100	0.08
Thymol	8.80	1300	0.04	15.39	2134	0.03
Carvacrol	8.92	1308	0.02	15.63	2158	0.02
Unknown [m/z 97, 112 (92), 83 (62), 43 (44), 41 (25)... 170? (4)]	9.04	1317	0.03	15.31	2126	0.04
Bicycloelemene	9.19	1328	0.02	7.29	1441	0.02
α-Cubebene	9.38	1341	0.05	7.01	1420	0.05
Unknown [m/z 43, 95 (62), 107 (45), 110 (41), 55 (28), 67 (25)...]	9.58	1355	0.03	14.25*	2022	0.27
Isoledene	9.69	1363	0.06	7.10*	1427	[0.06]
α-Copaene	9.73	1366	0.11	7.39	1448	0.10

7-Cubebene	9.77	1368	0.05	7.35	1446	0.05
7-Cubebene epimer?	9.80	1371	0.02	7.47	1455	0.02
β-Cubebene	9.98	1384	0.03	7.99*	1493	0.04
β-Elemene	10.00	1385	0.03	8.68*	1546	0.34
α-Gurjunene	10.18	1398	0.35	7.87	1484	0.34
Methyleugenol	10.22	1400	0.04	13.58	1959	0.04
β-Maaliene	10.26	1404	0.02	7.99*	1493	[0.04]
β-Caryophyllene	10.31	1407	0.36	8.68*	1546	[0.34]
γ-Maaliene	10.43	1416	0.06	8.71	1548	0.09
β-Gurjunene	10.47	1419	0.02	8.62*	1541	[0.03]
α-Maaliene	10.51	1422	0.06	8.88*	1562	[42.54]
Aromadendrene	10.58	1427	1.08	8.88*	1562	[42.54]
Selina-5,11-diene	10.64	1431	0.15	8.96	1567	0.15
<i>trans</i> -Muuro-la-3,5-diene	10.74	1439	0.11	9.13	1580	0.11
α-Humulene	10.77	1441	0.12	9.54	1613	0.08
allo-Aromadendrene	10.87	1448	0.55	9.26	1591	0.51
<i>trans</i> -Cadina-1(6),4-diene	11.07*	1463	0.32	9.50	1610	0.29
Selina-4,11-diene	11.07*	1463	[0.32]	9.68	1624	0.02
γ-Muuro-lene	11.12	1467	0.03	9.84	1637	0.04
β-Selinene	11.21	1474	0.09	10.20*	1666	[0.10]
allo-Aromadendr-9-ene	11.24	1476	0.11	9.80*	1634	[0.19]
δ-Selinene	11.29	1480	0.08	9.91*	1643	1.04
<i>trans</i> -Muuro-la-4(15),5-diene	11.30	1481	0.11	10.13	1660	0.11
Viridiflorene	11.36*	1485	1.85	9.91*	1643	[1.04]
Bicyclogermacrene	11.36*	1485	[1.85]	10.33*	1676	0.86
α-Selinene	11.36*	1485	[1.85]	10.29	1673	0.13
α-Muuro-lene	11.44*	1491	0.18	10.33*	1676	[0.86]
Epizonarene	11.44*	1491	[0.18]	10.07	1656	0.09
γ-Cadinene	11.60	1503	0.03	10.64*	1702	0.32
Zonarene	11.75*	1514	1.62	10.64*	1702	[0.32]
δ-Cadinene	11.75*	1514	[1.62]	10.68*	1706	[1.22]
<i>trans</i> -Calamenene	11.75*	1514	[1.62]	11.49	1774	0.11
<i>trans</i> -Cadina-1,4-diene	11.84	1522	0.20	10.92	1726	0.20
α-Calacorene	11.96	1531	0.02	12.38	1851	0.03
Unknown [m/z 161, 109 (98), 82 (93), 43 (72), 105 (68), 93 (59), 69 (56), 119 (55)... 222 (7)]	12.19	1549	0.10	13.54	1956	0.12
Eudesma-5,7(11)-diene	12.21	1551	0.03	11.31*	1758	[0.05]
Palustrol	12.27*	1555	0.14	12.53	1865	0.06
Maaliol	12.27*	1555	[0.14]	13.32	1936	0.06
Unknown [m/z	12.33	1560	0.01	13.46	1948	0.02

107, 163 (88), 59 (60), 93 (49), 43 (47), 81 (46... 204 (5)...						
Spathulenol	12.41	1566	0.12	14.66	2062	0.12
Globulol	12.49	1572	0.47	14.16	2014	0.45
Gleenol	12.54	1577	0.05	13.83	1982	0.04
Viridiflorol	12.58	1580	0.24	14.25*	2022	[0.27]
Cubeban-11-ol	12.62	1582	0.21	13.95*	1994	0.33
Ledol	12.72*	1590	0.20	13.63	1964	0.07
Eudesm-5-en-11-ol	12.72*	1590	[0.20]	14.58*	2054	0.20
10-epi-Cubenol	12.86	1602	0.02			
Rosifoliol	12.97	1611	0.20	14.58*	2054	[0.20]
1-epi-Cubenol	13.05	1617	0.29	14.03	2002	0.28
Cubenol	13.22	1631	0.17	13.95*	1994	[0.33]
α-Muurolol	13.36	1642	0.05	15.45	2140	0.07
<b>Total identified</b>		<b>98.82%</b>			<b>98.45%</b>	
<b>Total reported</b>		<b>99.03%</b>			<b>98.64%</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