

## GC/MS BATCH NUMBER: T20107

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**ESSENTIAL OIL:** TEA TREE  
**BOTANICAL NAME:** MELALEUCA ALTERNIFOLIA  
**ORIGIN:** AUSTRALIA

KEY CONSTITUENTS PRESENT IN THIS BATCH OF TEA TREE OIL	%
TERPINEN-4-ol	41.2
γ-TERPINENE	19.3
α-TERPINENE	9.3
TERPINOLENE	3.3
α-TERPINEOL	3.0
1,8-CINEOLE + β-PHELLANDRENE	2.6
α-PINENE	2.2
p-CYMENE	2.0
δ-CADINENE + ZONARENE	1.5
BICYCLOGERMACRENE	1.3
VIRIDIFLORENE	1.0

Comments from Robert Tisserand: Intense fresh, green odor quality. All fifteen key ISO constituents are within range.

Date : August 07, 2018

CERTIFICATE OF ANALYSIS – GC PROFILING

SAMPLE IDENTIFICATION

**Internal code :** 18H03-PTH2-1-CC

**Customer identification :** Tea Tree - Australia - T2010777R

**Type :** Essential oil

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

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

**Analysis date :** August 06, 2018

Checked and approved by :



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	0.06	0.04	Aliphatic alcohol
Isobutyral	0.03	0.03	Aliphatic aldehyde
Ethyl acetate	tr	tr	Aliphatic ester
Isobutanol	tr	0.66*	Aliphatic alcohol
Isovaleral	tr	0.01	Aliphatic aldehyde
2-Methylbutyral	0.02	0.02	Aliphatic aldehyde
Isoamyl alcohol	tr	tr*	Aliphatic alcohol
2-Methylbutanol	tr	[tr]*	Aliphatic alcohol
Toluene	tr	0.86*	Simple phenolic
Prenol	0.01		Aliphatic alcohol
(3Z)-Hexenol	0.08	0.09	Aliphatic alcohol
Hexanol	0.01	0.01	Aliphatic alcohol
$\alpha$ -Thujene	0.85	[0.86]*	Monoterpene
$\alpha$ -Pinene	2.22	2.23	Monoterpene
Camphene	0.01	0.01	Monoterpene
$\beta$ -Pinene	0.95*	[0.66]*	Monoterpene
Sabinene	[0.95]*	0.30	Monoterpene
3-Methyl-3-cyclohexenone	tr	0.02*	Aliphatic ketone
Myrcene	0.81	0.82	Monoterpene
$\alpha$ -Phellandrene	0.42	0.42	Monoterpene
(3Z)-Hexenyl acetate	0.01	0.01	Aliphatic ester
$\alpha$ -Terpinene	9.27	9.31	Monoterpene
para-Cymene	1.99	2.00	Monoterpene
Limonene	3.32*	0.76	Monoterpene
1,8-Cineole	[3.32]*	2.55*	Monoterpenic ether
$\beta$ -Phellandrene	[3.32]*	[2.55]*	Monoterpene
(Z)- $\beta$ -Ocimene	0.01	19.37*	Monoterpene
(E)- $\beta$ -Ocimene	0.01	0.02	Monoterpene
$\gamma$ -Terpinene	19.29	[19.37]*	Monoterpene
cis-Sabinene hydrate	0.04	0.06*	Monoterpenic alcohol
Terpinolene	3.31*	3.28	Monoterpene
para-Cymenene	[3.31]*	0.05	Monoterpene
trans-Sabinene hydrate	0.05	0.06	Monoterpenic alcohol
Linalool	0.06	0.07	Monoterpenic alcohol
Unknown	0.01	0.02	Monoterpenic alcohol
para-Mentha-1,3,8-triene	0.01	[0.02]*	Monoterpene
endo-Fenchol	0.01	0.01	Monoterpenic alcohol
cis-para-Menth-2-en-1-ol	0.41	0.42	Monoterpenic alcohol
4-Hydroxy-4-methylcyclohex-2-enone	0.01	0.20	Aliphatic alcohol
Cosmene isomer I	0.02	0.01	Monoterpene
trans-Pinocarveol	0.01	0.01	Monoterpenic alcohol
Camphor	0.10	0.11*	Monoterpenic ketone
trans-para-Menth-2-en-1-ol	0.20	0.43*	Monoterpenic alcohol
Unknown	0.02		Oxygenated monoterpene
Unknown	0.03	0.04	Unknown
Borneol	0.01	3.02*	Monoterpenic alcohol
$\delta$ -Terpineol	0.01	0.01	Monoterpenic alcohol

Terpinen-4-ol	41.02*	41.15	Monoterpenic alcohol
Dill ether	[41.02]*	0.03	Monoterpenic ether
para-Cymen-8-ol	0.03	0.03	Monoterpenic alcohol
$\alpha$ -Terpineol	3.02	[3.02]*	Monoterpenic alcohol
<i>cis</i> -Piperitol	0.10	0.10*	Monoterpenic alcohol
Unknown	tr		Oxygenated monoterpene
<i>trans</i> -Piperitol	0.17	0.17	Monoterpenic alcohol
exo-2-Hydroxycineole	0.03	0.02	Monoterpenic alcohol
<i>cis</i> -para-Mentha-1(7),8-dien-2-ol	tr	tr	Monoterpenic alcohol
Nerol	0.03	0.04*	Monoterpenic alcohol
Unknown	0.02	0.11	Oxygenated monoterpene
Piperitone	0.05	0.05	Monoterpenic ketone
<i>cis</i> -Carvenone oxide?	0.01		Monoterpenic ketone
<i>trans</i> -Ascaridole glycol	0.04	0.03	Monoterpenic alcohol
<i>cis</i> -Ascaridole glycol?	0.02	0.02	Monoterpenic alcohol
Thymol	0.02	0.03	Monoterpenic alcohol
Carvacrol	0.01	0.02	Monoterpenic alcohol
Unknown	0.03	0.05	Monoterpenic alcohol
Bicycloelemene	0.02	0.03	Sesquiterpene
$\alpha$ -Cubebene	0.06	0.06	Sesquiterpene
Unknown	0.02	0.38*	Unknown
Isoledene	0.07	[0.06]*	Sesquiterpene
$\alpha$ -Copaene	0.11*	0.05*	Sesquiterpene
7-Cubebene	[0.11]*	[0.05]*	Sesquiterpene
7-Cubebene epimer?	0.05	[0.11]*	Aliphatic alcohol
$\beta$ -Cubebene	0.01	0.04	Sesquiterpene
$\beta$ -Elemene	0.05	0.23*	Sesquiterpene
$\alpha$ -Gurjunene	0.39*	0.33	Sesquiterpene
Methyleugenol	[0.39]*	0.04	Phenylpropanoid
$\beta$ -Maaliene	0.01	0.02	Sesquiterpene
$\beta$ -Caryophyllene	0.38	[0.23]*	Sesquiterpene
$\gamma$ -Maaliene	0.07	[0.23]*	Sesquiterpene
$\beta$ -Gurjunene	0.02	0.03	Sesquiterpene
$\alpha$ -Maaliene	0.07	0.06	Sesquiterpene
Aromadendrene	0.98	0.95	Sesquiterpene
Selina-5,11-diene	0.12	0.13	Sesquiterpene
Cadina-3,5-diene isomer I?	0.14		Sesquiterpene
<i>trans</i> -Muurolo-3,5-diene	0.13	[0.43]*	Sesquiterpene
$\alpha$ -Humulene	0.11	0.32*	Sesquiterpene
allo-Aromadendrene	0.55	0.54	Sesquiterpene
Valerena-4,7(11)-diene	0.03	0.04	Sesquiterpene
$\gamma$ -Gurjunene	0.05	0.05	Sesquiterpene
<i>trans</i> -Cadina-1(6),4-diene	0.33*	[0.32]*	Sesquiterpene
Selina-4,11-diene	[0.33]*	0.10	Sesquiterpene
$\gamma$ -Muurolole	0.04	0.04	Sesquiterpene
Germacrene D	0.02	[3.02]*	Sesquiterpene
$\beta$ -Selinene	0.10*	0.12*	Sesquiterpene
(1S,2S,4S)-para-Menthane-1,2,4-triol	[0.10]*	0.03	Monoterpenic alcohol
allo-Aromadendr-9-ene	0.10*	0.03	Sesquiterpene
<i>trans</i> -Muurolo-4(15),5-diene	[0.10]*	[0.12]*	Sesquiterpene
$\delta$ -Selinene	0.10	[0.10]*	Sesquiterpene
$\alpha$ -Selinene	0.12	0.10	Sesquiterpene

Viridiflorene	2.14*	1.02	Sesquiterpene
Bicyclogermacrene	[2.14]*	1.26	Sesquiterpene
Epizonarene	[2.14]*	0.01	Sesquiterpene
$\alpha$ -Muurolene	0.18	0.09	Sesquiterpene
$\gamma$ -Cadinene	0.05	1.57*	Sesquiterpene
<i>trans</i> -Calamenene	1.61*	0.03	Sesquiterpene
$\delta$ -Cadinene	[1.61]*	[1.57]	Sesquiterpene
Zonarene	[1.61]*	[1.57]*	Sesquiterpene
<i>trans</i> -Cadina-1,4-diene	0.21	0.22	Sesquiterpene
$\alpha$ -Calacorene	0.02	0.02	Sesquiterpene
Epiglobulol?	0.09	0.02	Sesquiterpenic alcohol
Eudesma-5,7(11)-diene	0.02	[0.04]*	Sesquiterpene
Maaliol	0.11*	0.01	Sesquiterpenic alcohol
Unknown	[0.11]*	0.02	Oxygenated sesquiterpene
Palustrol	[0.11]*	0.03	Sesquiterpenic alcohol
Spathulenol	0.09	0.17	Sesquiterpenic alcohol
Globulol	0.38	0.22	Sesquiterpenic alcohol
Gleenol	0.04	0.06	Sesquiterpenic alcohol
Viridiflorol	0.20	[0.38]*	Sesquiterpenic alcohol
Cubeban-11-ol	0.16	0.26*	Sesquiterpenic alcohol
Eudesm-5-en-11-ol analog	0.15*	0.01	Sesquiterpenic alcohol
Ledol	[0.15]*	0.10	Sesquiterpenic alcohol
Eudesm-5-en-11-ol	0.01	0.08*	Sesquiterpenic alcohol
10-epi-Cubenol	0.02	[0.38]*	Sesquiterpenic alcohol
Rosifoliol	0.16	[0.08]*	Sesquiterpenic alcohol
1-epi-Cubenol	0.23	[0.26]*	Sesquiterpenic alcohol
Isospathulenol	0.06	0.06	Sesquiterpenic alcohol
Cubenol	0.14	[0.26]*	Sesquiterpenic alcohol
$\alpha$ -Muurolol	0.05	0.06	Sesquiterpenic alcohol
<b>Total identified</b>	<b>98.53%</b>	<b>97.99%</b>	

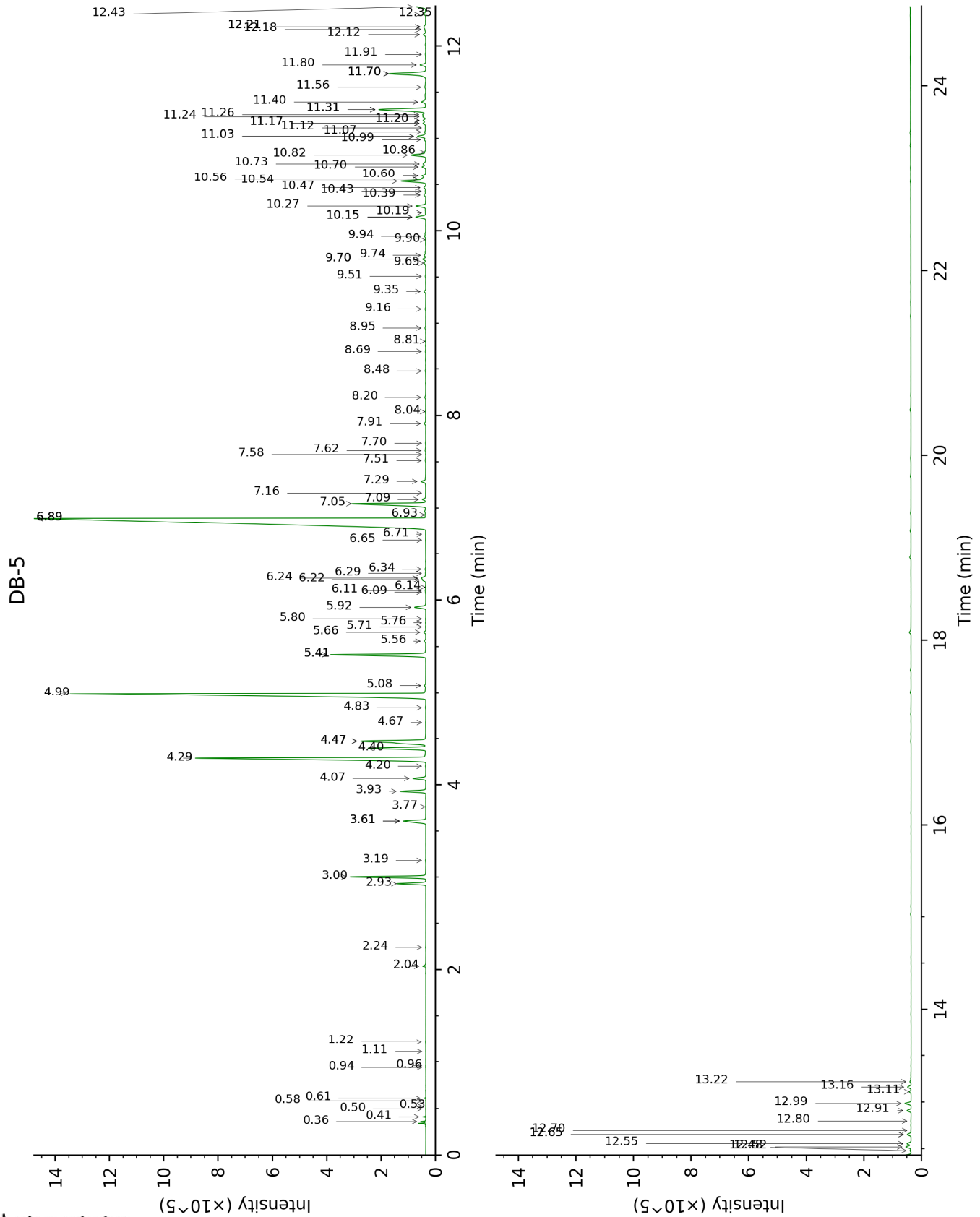
\*: Two or more compounds are coeluting on this column

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

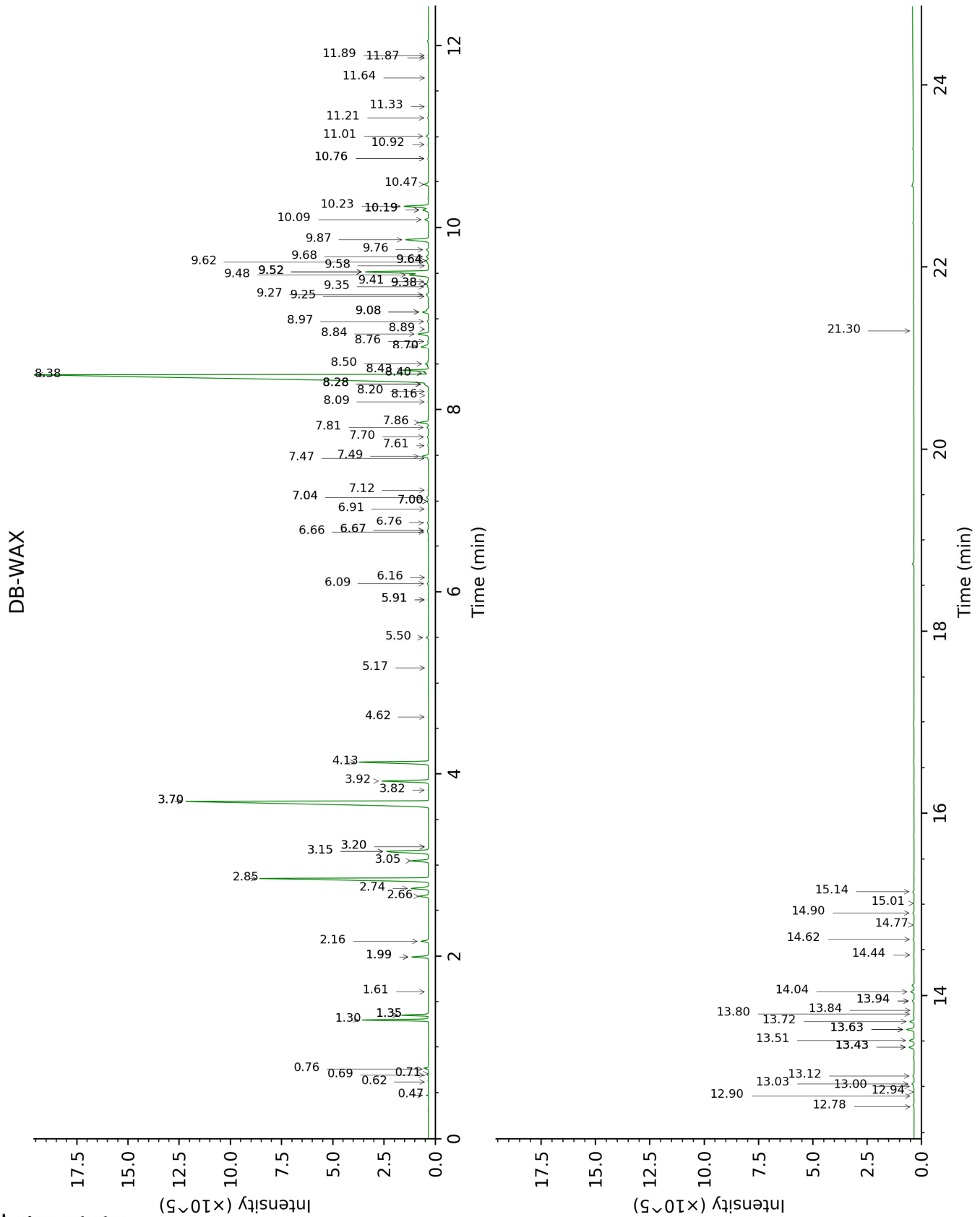
tr: The compound has been detected below 0.005% of total signal.

Note: no correction factor was applied

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FULL ANALYSIS DATA

Identification	Column DB-5			Column DB-WAX		
	R.T	R.I	%	R.T	R.I	%
Ethanol	0.36	498	0.06	0.76	905	0.04
Isobutyral	0.41	540	0.03	0.47	783	0.03
Ethyl acetate	0.50	609	tr	0.62	857	tr
Isobutanol	0.53	620	tr	1.99*	1070	0.66
Isovaleral	0.58	639	tr	0.71	888	0.01
2-Methylbutyral	0.61	649	0.02	0.69	883	0.02
Isoamyl alcohol	0.94	728	tr	3.20*	1172	tr
2-Methylbutanol	0.96	731	tr	3.20*	1172	[tr]
Toluene	1.11	754	tr	1.36*	1006	0.86
Prenol	1.22	770	0.01			
(3Z)-Hexenol	2.04	853	0.08	5.50	1341	0.09
Hexanol	2.24	871	0.01	5.17	1317	0.01
$\alpha$ -Thujene	2.93	923	0.85	1.36*	1006	[0.86]
$\alpha$ -Pinene	3.00	928	2.22	1.30	998	2.23
Camphene	3.19	941	0.01	1.61	1034	0.01
$\beta$ -Pinene	3.61*	969	0.95	1.99*	1070	[0.66]
Sabinene	3.61*	969	[0.95]	2.16	1087	0.30
3-Methyl-3-cyclohexenone	3.76	980	tr	5.91*	1371	0.02
Myrcene	3.93	991	0.81	2.74	1136	0.82
$\alpha$ -Phellandrene	4.07	1000	0.42	2.66	1130	0.42
(3Z)-Hexenyl acetate	4.20	1009	0.01	4.62	1277	0.01
$\alpha$ -Terpinene	4.29	1014	9.27	2.85	1145	9.31
para-Cymene	4.40	1021	1.99	3.92	1226	2.00
Limonene	4.47*	1026	3.32	3.05	1160	0.76
1,8-Cineole	4.47*	1026	[3.32]	3.15*	1168	2.55
$\beta$ -Phellandrene	4.47*	1026	[3.32]	3.15*	1168	[2.55]
(Z)- $\beta$ -Ocimene	4.67	1038	0.01	3.70*	1210	19.37
(E)- $\beta$ -Ocimene	4.83	1048	0.01	3.82	1219	0.02
$\gamma$ -Terpinene	4.99	1058	19.29	3.70*	1210	[19.37]
cis-Sabinene hydrate	5.08	1064	0.04	6.67*	1428	0.06
Terpinolene	5.41*	1085	3.31	4.13	1241	3.28
para-Cymenene	5.41*	1085	[3.31]	6.09	1384	0.05
trans-Sabinene hydrate	5.56	1094	0.05	7.70	1507	0.06
Linalool	5.66	1100	0.06	7.81	1515	0.07
Unknown [m/z 119, 109 (94), 43 (61), 95 (56), 91 (48), 77 (32), 152 (32), 137 (31), 134 (24)]	5.71	1104	0.01	8.20	1543	0.02
para-Mentha-1,3,8-triene	5.76	1107	0.01	5.91*	1371	[0.02]
endo-Fenchol	5.80	1110	0.01	8.16	1540	0.01
cis-para-Menth-2-	5.92	1118	0.41	7.86	1516	0.42

en-1-ol						
4-Hydroxy-4-methylcyclohex-2-enone	6.09	1128	0.01	13.72	2031	0.20
Cosmene isomer I	6.11	1129	0.02	6.16	1389	0.01
<i>trans</i> -Pinocarveol	6.14	1132	0.01	8.89	1599	0.01
Camphor	6.22	1137	0.10	7.04*	1456	0.11
<i>trans</i> -para-Menth-2-en-1-ol	6.24	1138	0.20	8.70*	1584	0.43
Unknown [m/z 109, 43 (73), 71 (54), 124 (51), 69 (37), 41 (35)...152 (5)]	6.29	1141	0.02			
Unknown [m/z 109, 124 (45), 119 (41), 43 (35), 91 (28), 95 (25)...]	6.34	1144	0.03	6.66	1426	0.04
Borneol	6.65	1164	0.01	9.52*	1652	3.02
$\delta$ -Terpineol	6.71	1168	0.01	9.25	1629	0.01
Terpinen-4-ol	6.89*	1180	41.02	8.38	1558	41.15
Dill ether	6.89*	1180	[41.02]	7.12	1462	0.03
para-Cymen-8-ol	6.93	1182	0.03	11.21	1798	0.03
$\alpha$ -Terpineol	7.05	1190	3.02	9.52*	1652	[3.02]
<i>cis</i> -Piperitol	7.10	1193	0.10	9.38*	1640	0.10
Unknown [m/z 121, 43 (99), 91 (85), 77 (73), 93 (41), 136 (33)... 166 (3)]	7.16	1197	tr			
<i>trans</i> -Piperitol	7.29	1205	0.17	10.09	1700	0.17
exo-2-Hydroxycineole	7.52	1220	0.03	11.33	1809	0.02
<i>cis</i> -para-Mentha-1(7),8-dien-2-ol	7.58	1225	tr	11.64	1837	tr
Nerol	7.62	1228	0.03	10.76*	1759	0.04
Unknown [m/z 137, 152 (28), 43 (25), 91 (24), 109 (23), 119 (19)]	7.70	1233	0.02	11.01	1780	0.11
Piperitone	7.91	1247	0.05	9.62	1661	0.05
<i>cis</i> -Carvenone oxide?	8.04	1256	0.01			
<i>trans</i> -Ascaridole glycol	8.20	1266	0.04	13.80	2039	0.03
<i>cis</i> -Ascaridole glycol?	8.48	1285	0.02	14.44	2103	0.02
Thymol	8.69	1300	0.02	14.77	2135	0.03
Carvacrol	8.81	1308	0.01	15.01	2159	0.02
Unknown [m/z 97, 112 (92), 83 (62), 43 (44), 41 (25)...]	8.95	1318	0.03	14.62	2120	0.05

170? (4)]						
Bicycloelemene	9.16	1332	0.02	6.91	1446	0.03
α-Cubebene	9.35	1346	0.06	6.76	1434	0.06
Unknown [m/z 43, 95 (62), 107 (45), 110 (41), 55 (28), 67 (25)...]	9.51	1357	0.02	13.63*	2022	0.38
Isoledene	9.65	1367	0.07	6.67*	1428	[0.06]
α-Copaene	9.70*	1370	0.11	7.00*	1453	0.05
7-Cubebene	9.70*	1370	[0.11]	7.00*	1453	[0.05]
7-Cubebene epimer?	9.74	1373	0.05	7.04*	1456	[0.11]
β-Cubebene	9.90	1385	0.01	7.61	1500	0.04
β-Elemene	9.94	1388	0.05	8.28*	1550	0.23
α-Gurjunene	10.15*	1402	0.39	7.49	1491	0.33
Methyleugenol	10.15*	1402	[0.39]	13.00	1963	0.04
β-Maaliene	10.19	1406	0.01	7.47	1489	0.02
β-Caryophyllene	10.27	1411	0.38	8.28*	1550	[0.23]
γ-Maaliene	10.39	1420	0.07	8.28*	1550	[0.23]
β-Gurjunene	10.43	1423	0.02	8.09	1534	0.03
α-Maaliene	10.47	1426	0.07	8.40	1559	0.06
Aromadendrene	10.54	1431	0.98	8.43	1562	0.95
Selina-5,11-diene	10.56	1433	0.12	8.50	1568	0.13
Cadina-3,5-diene isomer I?	10.60	1436	0.14			
<i>trans</i> -Muuro-la-3,5-diene	10.70	1443	0.13	8.70*	1584	[0.43]
α-Humulene	10.73	1446	0.11	9.08*	1614	0.32
allo-Aromadendrene	10.82	1453	0.55	8.84	1595	0.54
Valerena-4,7(11)-diene	10.86	1455	0.03	8.76	1588	0.04
γ-Gurjunene	10.99	1465	0.05	8.97	1606	0.05
<i>trans</i> -Cadina-1(6),4-diene	11.03*	1468	0.33	9.08*	1614	[0.32]
Selina-4,11-diene	11.03*	1468	[0.33]	9.27	1630	0.10
γ-Muuro-lene	11.07	1471	0.04	9.35	1638	0.04
Germacrene D	11.12	1475	0.02	9.52*	1652	[3.02]
β-Selinene	11.17*	1478	0.10	9.64*	1662	0.12
(1S,2S,4S)-para-Menthane-1,2,4-triol	11.17*	1478	[0.10]	21.30	2874	0.03
allo-Aromadendr-9-ene	11.20*	1481	0.10	9.41	1642	0.03
<i>trans</i> -Muuro-la-4(15),5-diene	11.20*	1481	[0.10]	9.64*	1662	[0.12]
δ-Selinene	11.24	1484	0.10	9.38*	1640	[0.10]
α-Selinene	11.26	1485	0.12	9.68	1666	0.10
Viridiflorene	11.32*	1489	2.14	9.48	1649	1.02
Bicyclogermacrene	11.32*	1489	[2.14]	9.87	1681	1.26
Epizonarene	11.32*	1489	[2.14]	9.58	1657	0.01
α-Muuro-lene	11.40	1495	0.18	9.76	1672	0.09

$\gamma$ -Cadinene	11.56	1508	0.05	10.19*†	1709	1.57
<i>trans</i> -Calamenene	11.70*	1519	1.61	10.92	1772	0.03
$\delta$ -Cadinene	11.70*	1519	[1.61]	10.23†	1712	[1.57]
Zonarene	11.70*	1519	[1.61]	10.19*†	1709	[1.57]
<i>trans</i> -Cadina-1,4-diene	11.80	1527	0.21	10.47	1733	0.22
$\alpha$ -Calacorene	11.91	1536	0.02	11.86	1857	0.02
Epiglobulol?	12.12	1552	0.09	12.94	1957	0.02
Eudesma-5,7(11)-diene	12.18	1557	0.02	10.76*	1759	[0.04]
Maaliol	12.21*	1559	0.11	12.78	1941	0.01
Unknown [m/z 161, 109 (98), 82 (93), 43 (72), 105 (68), 93 (59), 69 (56), 119 (55)... 222 (7)]	12.21*	1559	[0.11]	12.90	1953	0.02
Palustrol	12.21*	1559	[0.11]	11.89	1859	0.03
Spathulenol	12.35	1570	0.09	14.04	2063	0.17
Globulol	12.42	1576	0.38	13.51	2011	0.22
Gleenol	12.48	1580	0.04	13.12	1973	0.06
Viridiflorol	12.52	1584	0.20	13.63*	2022	[0.38]
Cubeban-11-ol	12.56	1586	0.16	13.43*	2003	0.26
Eudesm-5-en-11-ol analog	12.65*	1594	0.15	13.84	2043	0.01
Ledol	12.65*	1594	[0.15]	13.03	1965	0.10
Eudesm-5-en-11-ol	12.70	1597	0.01	13.94*	2053	0.08
10-epi-Cubenol	12.80	1606	0.02	13.63*	2022	[0.38]
Rosifoliol	12.91	1615	0.16	13.94*	2053	[0.08]
1-epi-Cubenol	12.99	1621	0.23	13.43*	2003	[0.26]
Isospathulenol	13.11	1631	0.06	15.14	2172	0.06
Cubenol	13.16	1636	0.14	13.43*	2003	[0.26]
$\alpha$ -Muurolol	13.22	1640	0.05	14.90	2149	0.06
<b>Total identified</b>		<b>98.53%</b>			<b>97.99%</b>	
<b>Total reported</b>		<b>98.65%</b>			<b>98.22%</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