

Date : May 22, 2018

CERTIFICATE OF ANALYSIS - GC PROFILING

SAMPLE IDENTIFICATION

**Internal code :** 18E09-VIV6-1-CC

**Customer identification :** Organic Tea Tree - South Africa - 1709000255

**Type :** Essential oil

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

**Customer :** Viva Naturals

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 :** May 18, 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:**  $1.4770 \pm 0.0003$  (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	0.06	Aliphatic alcohol
2-Methylbutyral	0.01	tr	Aliphatic aldehyde
Toluene	tr	0.49*	Simple phenolic
(3Z)-Hexenol	0.01	0.01	Aliphatic alcohol
Hashishene	tr	2.48*	Monoterpene
$\alpha$ -Thujene	0.49	[0.49]*	Monoterpene
$\alpha$ -Pinene	2.47	[2.48]*	Monoterpene
Camphene	0.04*	0.02	Monoterpene
$\alpha$ -Fenchene	[0.04]*	0.02	Monoterpene
Thuja-2,4(10)-diene	tr	0.67*	Monoterpene
Sabinene	1.39*	[0.67]*	Monoterpene
$\beta$ -Pinene	[1.39]*	0.72	Monoterpene
3-Methyl-3-cyclohexenone?	0.03	0.01	Aliphatic ketone
Myrcene	0.45	0.46	Monoterpene
$\alpha$ -Phellandrene	0.29*	0.28	Monoterpene
Pseudolimonene	[0.29]*	0.01	Monoterpene
$\Delta^3$ -Carene	0.01	0.01	Monoterpene
(3Z)-Hexenyl acetate	tr	0.01	Aliphatic ester
$\alpha$ -Terpinene	8.92	8.95	Monoterpene
Carvomenthene	0.03*	0.02	Aliphatic alcohol
ortho-Cymene	[0.03]*	2.44*	Simple phenolic
para-Cymene	2.45	[2.44]*	Monoterpene
$\beta$ -Phellandrene	4.63*	3.31*	Monoterpene
Limonene	[4.63]*	1.29	Monoterpene
1,8-Cineole	[4.63]*	[3.31]*	Monoterpenic ether
(Z)- $\beta$ -Ocimene	tr	18.93*	Monoterpene
(E)- $\beta$ -Ocimene	0.05	0.05	Monoterpene
$\gamma$ -Terpinene	18.87	[18.93]*	Monoterpene
cis-Sabinene hydrate	0.07	0.11*	Monoterpenic alcohol
Unknown	0.12	0.08	Oxygenated monoterpene
cis-Linalool oxide (fur.)	0.06	0.06	Monoterpenic alcohol
Terpinolene	3.37*	3.24	Monoterpene
Isoterpinolene	[3.37]*	tr	Monoterpene
para-Cymenene	[3.37]*	0.10	Monoterpene
trans-Sabinene hydrate	0.12	0.13	Monoterpenic alcohol
Linalool	0.06	0.07	Monoterpenic alcohol
Unknown	0.05	0.05	Monoterpenic alcohol
para-Mentha-1,3,8-triene	tr	tr	Monoterpene
cis-para-Menth-2-en-1-ol	0.24	0.25	Monoterpenic alcohol
trans-Pinocarveol	0.07*	0.06	Monoterpenic alcohol
Cosmene isomer I	[0.07]*	tr	Monoterpene
Camphor	0.17*	0.02	Monoterpenic ketone
Cosmene isomer II	[0.17]*	0.01	Monoterpene
trans-para-Menth-2-en-1-ol	[0.17]	0.18*	Monoterpenic alcohol
Unknown	0.13	0.14	Unknown
Borneol	0.02	2.98*	Monoterpenic alcohol
$\delta$ -Terpineol	0.01	0.06	Monoterpenic alcohol
Terpinen-4-ol	41.40	42.81*	Monoterpenic alcohol

Dill ether	0.05*	0.03*	Monoterpenic ether
para-Cymen-8-ol	[0.05]*	0.04	Monoterpenic alcohol
$\alpha$ -Terpineol	2.90	[2.98]*	Monoterpenic alcohol
<i>cis</i> -Piperitol	0.06	0.05	Monoterpenic alcohol
Unknown	0.02		Oxygenated monoterpene
<i>trans</i> -Piperitol	0.08	0.60*	Monoterpenic alcohol
endo-Fenchyl acetate	0.03	0.03	Monoterpenic ester
exo-2-Hydroxycineole	0.01	0.03	Monoterpenic alcohol
<i>cis</i> -para-Mentha-1(7),8-dien-2-ol	0.02	0.02	Monoterpenic alcohol
Nerol	0.02	0.02	Monoterpenic alcohol
Piperitone	0.09	0.18*	Monoterpenic ketone
<i>cis</i> -Carvenone oxide?	0.05		Monoterpenic ketone
<i>trans</i> -Ascaridole glycol	0.05	0.09	Monoterpenic alcohol
<i>cis</i> -Ascaridole glycol?	0.03	0.03	Monoterpenic alcohol
Thymol	0.02	0.05*	Monoterpenic alcohol
Carvacrol	0.01	0.04*	Monoterpenic alcohol
Unknown	0.03	0.03	Monoterpenic alcohol
Myrtenyl acetate	0.01	1.25*	Monoterpenic ester
Bicycloelemene	0.02	0.01	Sesquiterpene
$\alpha$ -Cubebene	0.03	0.02	Sesquiterpene
Unknown	0.04*	0.01	Unknown
Cyclosativene I	[0.04]*	[0.11]*	Sesquiterpene
Cyclosativene II	0.02	tr	Sesquiterpene
Isoledene	0.04	0.04	Sesquiterpene
$\alpha$ -Copaene	0.06	0.05	Sesquiterpene
7-Cubebene	0.04	0.04	Sesquiterpene
7-Cubebene epimer?	0.02	[0.03]*	Aliphatic alcohol
$\beta$ -Cubebene	0.04	0.04	Sesquiterpene
$\beta$ -Elemene	0.04	0.20*	Sesquiterpene
$\alpha$ -Gurjunene	0.45*	0.42	Sesquiterpene
Methyleugenol	[0.45]*	0.08*	Phenylpropanoid
$\beta$ -Maaliene	0.02	0.01	Sesquiterpene
$\beta$ -Caryophyllene	0.19	[0.20]*	Sesquiterpene
$\gamma$ -Maaliene	0.06	0.09	Sesquiterpene
$\beta$ -Gurjunene	0.03	0.04	Sesquiterpene
$\alpha$ -Maaliene	0.06	0.07	Sesquiterpene
Aromadendrene	1.62	[42.81]*	Sesquiterpene
Selina-5,11-diene	0.13	0.15	Sesquiterpene
<i>trans</i> -Muuroala-3,5-diene	0.07	0.05	Sesquiterpene
$\alpha$ -Humulene	0.08	0.05	Sesquiterpene
allo-Aromadendrene	0.40	0.43	Sesquiterpene
Valerena-4,7(11)-diene	0.04	[0.18]*	Sesquiterpene
$\gamma$ -Gurjunene	0.05	0.01	Sesquiterpene
<i>trans</i> -Cadina-1(6),4-diene	0.19	0.15	Sesquiterpene
$\gamma$ -Muurolole	0.04	[1.25]*	Sesquiterpene
Germacrene D	0.01	0.24*	Sesquiterpene
(1S,2S,4S)-para-Menthane-1,2,4-triol	0.18*		Monoterpenic alcohol
$\beta$ -Selinene	[0.18]*	[0.24]*	Sesquiterpene
allo-Aromadendr-9-ene	0.22	0.26	Sesquiterpene
<i>trans</i> -Muuroala-4(15),5-diene	0.04	0.02	Sesquiterpene
$\delta$ -Selinene	0.11	0.08*	Sesquiterpene
Viridiflorene	1.88*	[0.08]*	Sesquiterpene

Bicyclogermacrene	[1.88]*	0.66*	Sesquiterpene
Epizonarene	[1.88]*	[0.24]*	Sesquiterpene
$\alpha$ -Selinene	[1.88]*	[0.18]*	Sesquiterpene
$\alpha$ -Muurolene	0.13	[0.66]*	Sesquiterpene
$\gamma$ -Cadinene	0.04	0.23	Sesquiterpene
Zonarene	0.78*	[0.60]*	Sesquiterpene
$\delta$ -Cadinene	[0.78]*	[0.60]*	Sesquiterpene
<i>trans</i> -Calamenene	[0.78]*	0.05	Sesquiterpene
<i>trans</i> -Cadina-1,4-diene	0.12	0.11	Sesquiterpene
$\alpha$ -Calacorene	0.01	0.01	Sesquiterpene
Eudesma-5,7(11)-diene	0.12	0.02	Sesquiterpene
Palustrol	0.12*	0.05	Sesquiterpenic alcohol
Maaliol	[0.12]*	0.04	Sesquiterpenic alcohol
Unknown	[0.12]*	0.07	Oxygenated sesquiterpene
Unknown	0.01	0.12	Oxygenated sesquiterpene
Spathulenol	0.13	0.13	Sesquiterpenic alcohol
Globulol	0.61	0.59	Sesquiterpenic alcohol
Gleenol	0.02	0.03	Sesquiterpenic alcohol
Viridiflorol	0.20	0.22	Sesquiterpenic alcohol
Cubeban-11-ol	0.16	0.22*	Sesquiterpenic alcohol
Ledol	0.16*	[0.08]*	Sesquiterpenic alcohol
Eudesm-5-en-11-ol analog	[0.16]*	0.14*	Sesquiterpenic alcohol
Eudesm-5-en-11-ol	0.01	0.01	Sesquiterpenic alcohol
10-epi-Cubenol	0.04		Sesquiterpenic alcohol
Rosifoliol	0.14	[0.14]*	Sesquiterpenic alcohol
1-epi-Cubenol	0.15	0.14	Sesquiterpenic alcohol
Isospathulenol	0.04	[0.04]*	Sesquiterpenic alcohol
Cubenol	0.08	[0.22]*	Sesquiterpenic alcohol
$\alpha$ -Muurolol	0.04	[0.05]*	Sesquiterpenic alcohol
<b>Total identified</b>	<b>98.54%</b>	<b>98.01%</b>	

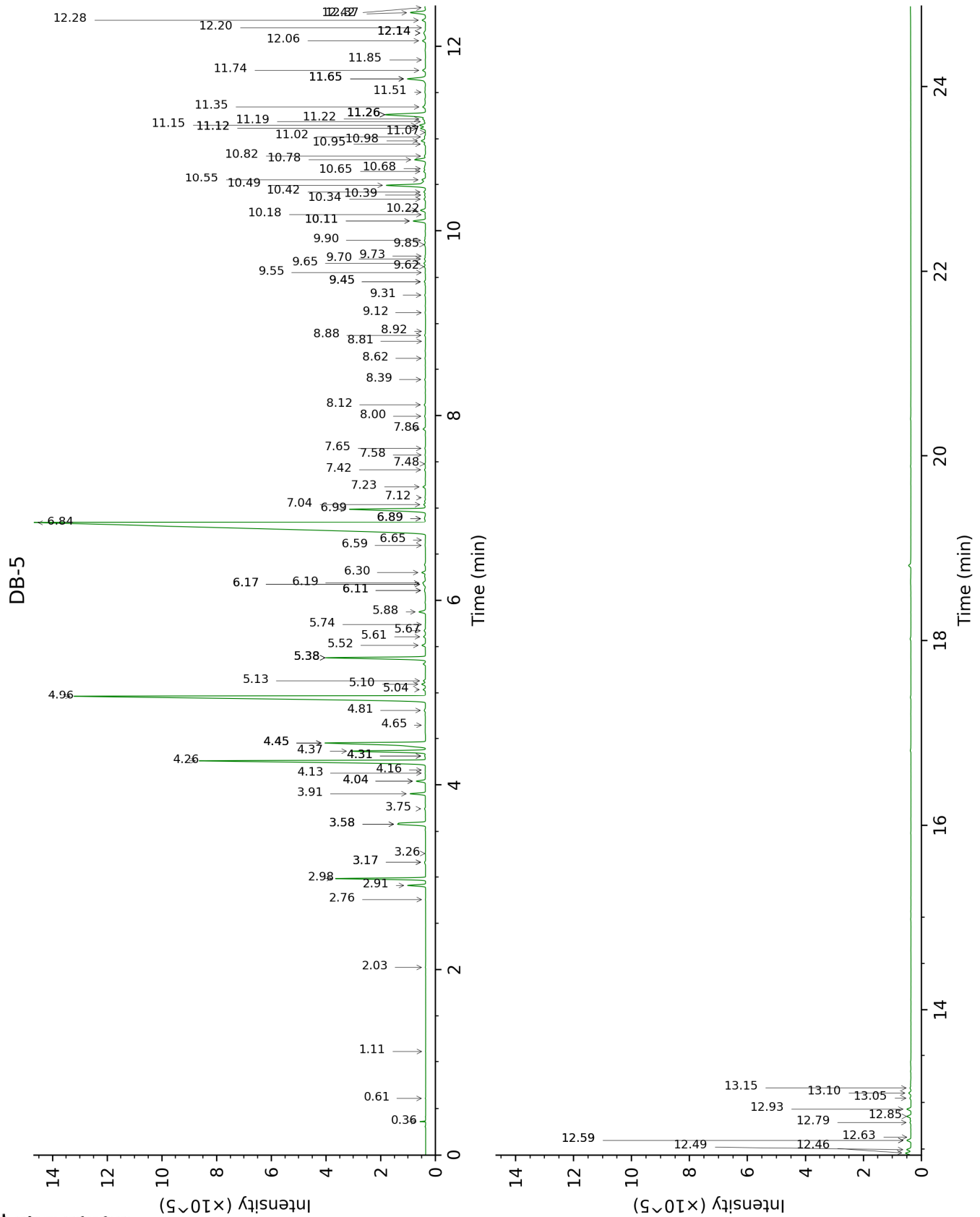
\*: Two or more compounds are coeluting on this column

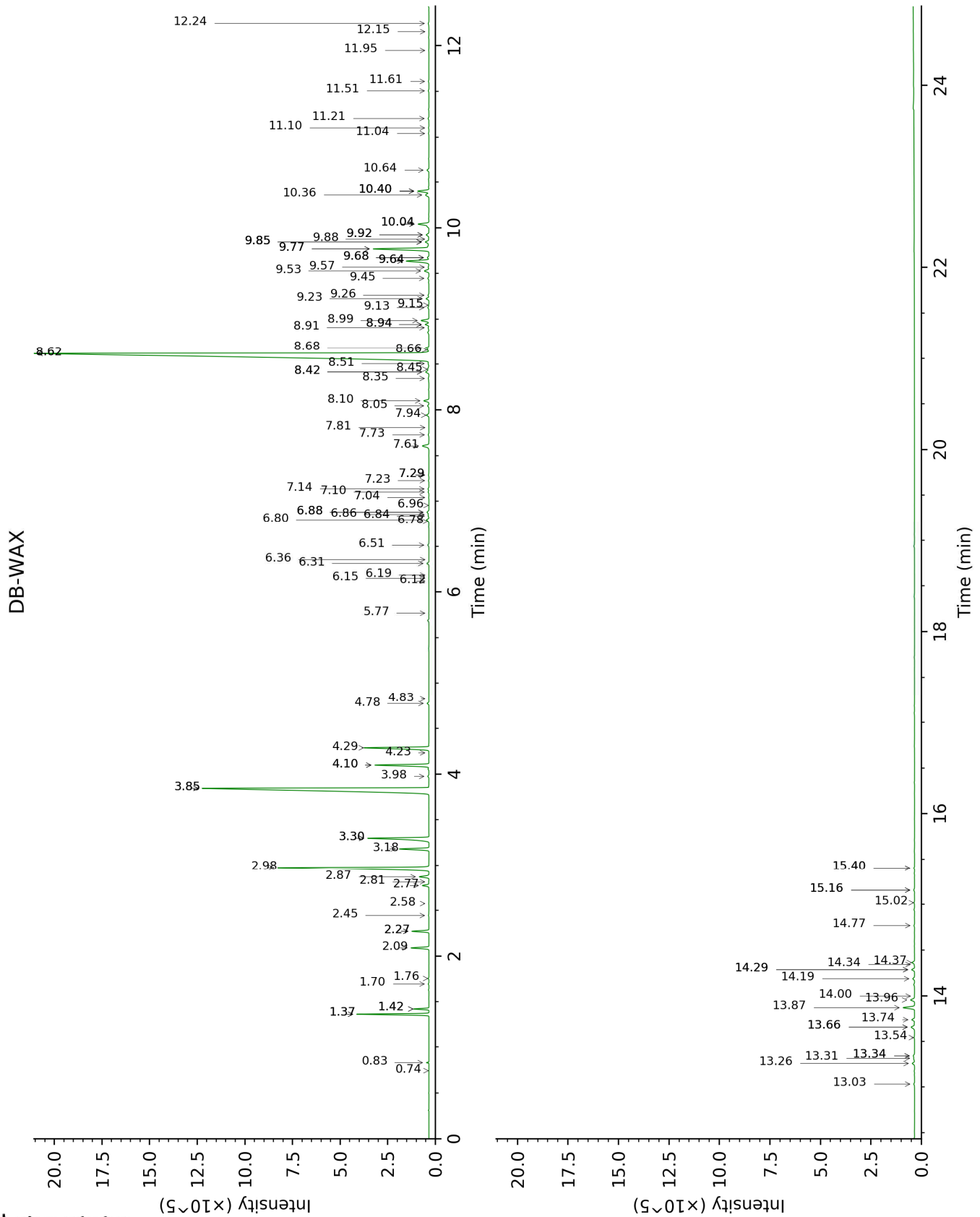
[xx]: Duplicate percentage due to coelutions, not taken account in the identified total

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	496	0.06	0.83	903	0.06
2-Methylbutyral	0.61	647	0.01	0.74	877	tr
Toluene	1.11	753	tr	1.42*	1001	0.49
(3Z)-Hexenol	2.03	852	0.01	5.77	1346	0.01
Hashishene	2.76	911	tr	1.37*	992	2.48
$\alpha$ -Thujene	2.91	922	0.49	1.42*	1001	[0.49]
$\alpha$ -Pinene	2.98	927	2.47	1.37*	992	[2.48]
Camphene	3.17*	939	0.04	1.76	1034	0.02
$\alpha$ -Fenchene	3.17*	939	[0.04]	1.70	1028	0.02
Thuja-2,4(10)-diene	3.26	946	tr	2.27*	1085	0.67
Sabinene	3.58*	967	1.39	2.27*	1085	[0.67]
$\beta$ -Pinene	3.58*	967	[1.39]	2.09	1067	0.72
3-Methyl-3-cyclohexenone?	3.74	978	0.03	6.15	1374	0.01
Myrcene	3.91	989	0.45	2.87	1134	0.46
$\alpha$ -Phellandrene	4.04*	998	0.29	2.77	1127	0.28
Pseudolimonene	4.04*	998	[0.29]	2.82	1130	0.01
$\Delta^3$ -Carene	4.13	1004	0.01	2.58	1112	0.01
(3Z)-Hexenyl acetate	4.16	1006	tr	4.83	1278	0.01
$\alpha$ -Terpinene	4.26	1012	8.92	2.98	1142	8.95
Carvomenthene	4.31*	1016	0.03	2.45	1101	0.02
ortho-Cymene	4.31*	1016	[0.03]	4.10*	1226	2.44
para-Cymene	4.37	1019	2.45	4.10*	1226	[2.44]
$\beta$ -Phellandrene	4.45*	1024	4.63	3.30*	1167	3.31
Limonene	4.45*	1024	[4.63]	3.18	1158	1.29
1,8-Cineole	4.45*	1024	[4.63]	3.30*	1167	[3.31]
(Z)- $\beta$ -Ocimene	4.65	1036	tr	3.84*	1208	18.93
(E)- $\beta$ -Ocimene	4.81	1047	0.05	3.98	1218	0.05
$\gamma$ -Terpinene	4.96	1056	18.87	3.84*	1208	[18.93]
cis-Sabinene hydrate	5.04	1061	0.07	6.88*	1427	0.11
Unknown [m/z 79, 93 (60), 43 (40), 94 (35), 137 (33), 77 (26), 91 (20), 152 (18)]	5.10	1065	0.12	4.78	1274	0.08
cis-Linalool oxide (fur.)	5.13	1067	0.06	6.51	1400	0.06
Terpinolene	5.38*	1083	3.37	4.29	1240	3.24
Isoterpinolene	5.38*	1083	[3.37]	4.23	1236	tr
para-Cymenene	5.38*	1083	[3.37]	6.31	1385	0.10
trans-Sabinene hydrate	5.52	1092	0.12	7.94	1506	0.13
Linalool	5.61	1097	0.06	8.05	1514	0.07
Unknown [m/z 119, 109 (94), 43	5.67	1102	0.05	8.51	1550	0.05

(61), 95 (56), 91 (48), 77 (32), 152 (32), 137 (31), 134 (24)]						
para-Mentha-1,3,8- triene	5.74	1106	tr	6.19	1376	tr
cis-para-Menth-2- en-1-ol	5.88	1115	0.24	8.10	1518	0.25
trans-Pinocarveol	6.11*	1130	0.07	9.13	1598	0.06
Cosmene isomer I	6.11*	1130	[0.07]	6.36	1388	tr
Camphor	6.17*†	1134	0.17	7.23	1453	0.02
Cosmene isomer II	6.17*†	1134	[0.17]	6.12	1372	0.01
trans-para-Menth- 2-en-1-ol	6.19†	1135	[0.17]	8.94*	1584	0.18
Unknown [m/z 109, 124 (45), 119 (41), 43 (35), 91 (28), 95 (25)...]	6.30	1142	0.13	6.80	1421	0.14
Borneol	6.59	1161	0.02	9.77*	1650	2.98
δ-Terpineol	6.65	1164	0.01	9.45	1624	0.06
Terpinen-4-ol	6.84	1177	41.40	8.62*	1559	42.81
Dill ether	6.89*	1180	0.05	7.29*	1457	0.03
para-Cymen-8-ol	6.89*	1180	[0.05]	11.51	1795	0.04
α-Terpineol	6.99	1186	2.90	9.77*	1650	[2.98]
cis-Piperitol	7.04	1190	0.06	9.57	1634	0.05
Unknown [m/z 121, 43 (99), 91 (85), 77 (73), 93 (41), 136 (33)... 166 (3)]	7.12	1194	0.02			
trans-Piperitol	7.23	1202	0.08	10.40*	1702	0.60
endo-Fenchyl acetate	7.42	1214	0.03	6.84	1424	0.03
exo-2- Hydroxycineole	7.48	1219	0.01	11.61	1804	0.03
cis-para-Mentha- 1(7),8-dien-2-ol	7.58	1225	0.02	11.95	1834	0.02
Nerol	7.65	1230	0.02	11.04	1756	0.02
Piperitone	7.86	1244	0.09	9.92*	1663	0.18
cis-Carvenone oxide?	8.00	1253	0.05			
trans-Ascaridole glycol	8.12	1262	0.05	14.19	2041	0.09
cis-Ascaridole glycol?	8.39	1280	0.03	14.77	2097	0.03
Thymol	8.62	1295	0.02	15.16*	2136	0.05
Carvacrol	8.81	1308	0.01	15.40*	2160	0.04
Unknown [m/z 97, 112 (92), 83 (62), 43 (44), 41 (25)... 170? (4)]	8.88	1313	0.03	15.02	2122	0.03
Myrtenyl acetate	8.92	1316	0.01	9.64*	1639	1.25

Bicycloelemene	9.12	1330	0.02	7.04	1439	0.01
α-Cubebene	9.31	1344	0.03	6.78	1419	0.02
Unknown [m/z 43, 95 (62), 107 (45), 110 (41), 55 (28), 67 (25)...]	9.45*	1354	0.04	14.00	2022	0.01
Cyclosativene I	9.45*	1354	[0.04]	6.88*	1427	[0.11]
Cyclosativene II	9.55	1361	0.02	6.96	1433	tr
Isoledene	9.62	1365	0.04	6.86	1425	0.04
α-Copaene	9.65	1368	0.06	7.14	1446	0.05
7-Cubebene	9.70	1371	0.04	7.10	1444	0.04
7-Cubebene epimer?	9.73	1374	0.02	7.29*	1457	[0.03]
β-Cubebene	9.85	1382	0.04	7.73	1490	0.04
β-Elemene	9.90	1386	0.04	8.42*	1543	0.20
α-Gurjunene	10.11*	1400	0.45	7.61	1481	0.42
Methyleugenol	10.11*	1400	[0.45]	13.34*	1960	0.08
β-Maaliene	10.18	1405	0.02	7.81	1496	0.01
β-Caryophyllene	10.22	1409	0.19	8.42*	1543	[0.20]
γ-Maaliene	10.34	1418	0.06	8.45	1545	0.09
β-Gurjunene	10.39	1421	0.03	8.34	1537	0.04
α-Maaliene	10.42	1424	0.06	8.66	1562	0.07
Aromadendrene	10.49	1429	1.62	8.62*	1559	[42.81]
Selina-5,11-diene	10.55	1434	0.13	8.68	1564	0.15
<i>trans</i> -Muuroala-3,5-diene	10.65	1441	0.07	8.91	1581	0.05
α-Humulene	10.68	1443	0.08	9.26	1609	0.05
allo-Aromadendrene	10.78	1450	0.40	8.99	1587	0.43
Valerena-4,7(11)-diene	10.82	1453	0.04	8.94*	1584	[0.18]
γ-Gurjunene	10.95	1463	0.05	9.16	1600	0.01
<i>trans</i> -Cadina-1(6),4-diene	10.98	1466	0.19	9.23	1606	0.15
γ-Murolene	11.02	1469	0.04	9.64*	1639	[1.25]
Germacrene D	11.07	1472	0.01	9.85*	1656	0.24
(1S,2S,4S)-para-Menthane-1,2,4-triol	11.12*	1476	0.18			
β-Selinene	11.12*	1476	[0.18]	9.85*	1656	[0.24]
allo-Aromadendrene	11.15	1478	0.22	9.53	1631	0.26
<i>trans</i> -Muuroala-4(15),5-diene	11.19	1481	0.04	9.88	1659	0.02
δ-Selinene	11.22	1483	0.11	9.68*	1642	0.08
Viridiflorene	11.26*	1487	1.88	9.68*	1642	[0.08]
Bicyclogermacrene	11.26*	1487	[1.88]	10.04*	1672	0.66
Epizonarene	11.26*	1487	[1.88]	9.85*	1656	[0.24]
α-Selinene	11.26*	1487	[1.88]	9.92*	1663	[0.18]
α-Murolene	11.35	1493	0.13	10.04*	1672	[0.66]
γ-Cadinene	11.50	1505	0.04	10.36	1698	0.23
Zonarene	11.65*	1516	0.78	10.40*	1702	[0.60]

$\delta$ -Cadinene	11.65*	1516	[0.78]	10.40*	1702	[0.60]
<i>trans</i> -Calamenene	11.65*	1516	[0.78]	11.20	1770	0.05
<i>trans</i> -Cadina-1,4-diene	11.74	1524	0.12	10.64	1722	0.11
$\alpha$ -Calacorene	11.85	1532	0.01	12.16	1853	0.01
Eudesma-5,7(11)-diene	12.06	1549	0.12	11.10	1761	0.02
Palustrol	12.14*	1555	0.12	12.24	1861	0.05
Maaliol	12.14*	1555	[0.12]	13.03	1932	0.04
Unknown [m/z 161, 109 (98), 82 (93), 43 (72), 105 (68), 93 (59), 69 (56), 119 (55)... 222 (7)]	12.14*	1555	[0.12]	13.31	1958	0.07
Unknown [m/z 107, 163 (88), 59 (60), 93 (49), 43 (47), 81 (46... 204 (5)...]	12.20	1560	0.01	13.26	1953	0.12
Spathulenol	12.28	1566	0.13	14.36	2058	0.13
Globulol	12.36	1573	0.61	13.87	2010	0.59
Gleenol	12.42	1577	0.02	13.54	1979	0.03
Viridiflorol	12.46	1580	0.20	13.96	2018	0.22
Cubeban-11-ol	12.49	1583	0.16	13.66*	1990	0.22
Ledol	12.59*	1591	0.16	13.34*	1960	[0.08]
Eudesm-5-en-11-ol analog	12.59*	1591	[0.16]	14.29*	2050	0.14
Eudesm-5-en-11-ol	12.63	1593	0.01	14.34	2056	0.01
10-epi-Cubenol	12.78	1606	0.04			
Rosifoliol	12.85	1611	0.14	14.29*	2050	[0.14]
1-epi-Cubenol	12.93	1618	0.15	13.74	1998	0.14
Isospathulenol	13.05	1628	0.04	15.40*	2160	[0.04]
Cubenol	13.10	1632	0.08	13.66*	1990	[0.22]
$\alpha$ -Muurolol	13.16	1637	0.04	15.16*	2136	[0.05]
<b>Total identified</b>		<b>98.54%</b>			<b>98.01%</b>	
<b>Total reported</b>		<b>98.90%</b>			<b>98.52%</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