Date : June 18, 2019

Certificate of Analysis – GC Profiling

Sample identification

Internal code : 19F05-PTH06-1-SCC
Customer identification : Peppermint Western - USA - PF0103810R
Type : Essential oil
Source : *Mentha x piperita*
Customer : Plant Therapy

Analysis

Method: PC-PA-014 - 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 : June 12, 2019

Checked and approved by :

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

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PHYSICOCHEMICAL DATA

Physical aspect: Clear liquid
Refractive index: 1.4608 ± 0.0003 (20 °C)

NF T 75-210:2007 & ISO 856:2006 - OIL OF PEPPERMINT - USA

Compound	Min. %	Max. %	Observed %	Complies?
β-Caryophyllene	1.0	2.5	2.5	Yes
Menthyl acetate	3.0	6.5	5.0	Yes
Pulegone	0.5	2.5	1.3	Yes
Menthol	36.0	46.0	40.3	Yes
neo-Menthol	2.5	4.5	3.6	Yes
Menthofuran	1.5	6.0	3.2	Yes
Isomenthone	2.0	4.5	3.5	Yes
Menthone	15.0	25.0	22.6	Yes
cis-Sabinene hydrate	0.5	2.3	0.8	Yes
Limonene	1.0	2.5	1.3	Yes
1,8-Cineole	4.0	6.0	4.4	Yes
Octan-3-ol	0.1	0.4	0.2	Yes
Refractive index	1.459	1.465	1.461	Yes

EUROPEAN PHARMACOPOEIA 9.0 - 07/2012:0405 - PEPPERMINT OIL

Compound	Min. %	Max. %	Observed %	Complies?
Carvone		1.0	0.1	Yes
Pulegone		3.0	1.3	Yes
Menthol	30.0	55.0	40.3	Yes
Menthyl acetate	2.8	10.0	5.0	Yes
Isomenthone	1.5	10.0	3.5	Yes
Menthofuran	1.0	8.0	3.2	Yes
Menthone	14.0	32.0	22.6	Yes
1,8-Cineole	3.5	8.0	4.4	Yes
Limonene	1.0	3.5	1.3	Yes
Total isopulegol		0.20	0.15	Yes
Refractive index	1.457	1.467	1.461	Yes

CONCLUSION

No adulterant, contaminant or diluent has been detected using this method. The oil complies with the AFNOR/ISO standard for USA peppermint oil, and with the European pharmacopoeial requirements for peppermint oil.

Analysis summary – Consolidated contents

New readers of similar reports are encouraged to read table footnotes at least once.

Identification	%	Classe
Isovaleral	tr	Aliphatic aldehyde
2-Methylbutyral	tr	Aliphatic aldehyde
Isoamyl alcohol	0.01	Aliphatic alcohol
2-Methylbutanol	0.01	Aliphatic alcohol
Hexanal	tr	Aliphatic aldehyde
(2*E*)-Hexenal	0.02	Aliphatic aldehyde
(3*Z*)-Hexenol	0.02	Aliphatic alcohol
(2*E*)-Hexenol	0.01	Aliphatic alcohol
Hexanol	0.02	Aliphatic alcohol
trans-2,5-Diethyltetrahydrofuran	0.01	Furan
α-Thujene	0.03	Monoterpene
α-Pinene	0.44	Monoterpene
3-Methylcyclohexanone	0.04	Aliphatic ketone
Camphene	0.02	Monoterpene
α-Fenchene	tr	Monoterpene
Thuja-2,4(10)-diene	0.01	Monoterpene
Benzaldehyde	0.01	Simple phenolic
β-Pinene	0.70	Monoterpene
Sabinene	0.31	Monoterpene
Octen-3-ol	0.10	Aliphatic alcohol
Octan-3-one	0.04	Aliphatic ketone
Myrcene	0.15	Monoterpene
Octan-3-ol	0.23	Aliphatic alcohol
α-Phellandrene	0.01	Monoterpene
Pseudolimonene	0.01	Monoterpene
Δ3-Carene	0.01	Monoterpene
α-Terpinene	0.16	Monoterpene
para-Cymene	0.12	Monoterpene
Limonene	1.33	Monoterpene
1,8-Cineole	4.44	Monoterpenic ether
2-Ethylhexanol	0.02	Aliphatic alcohol
(*Z*)-β-Ocimene	0.19	Monoterpene
(*E*)-β-Ocimene	0.06	Monoterpene
γ-Terpinene	0.27	Monoterpene
cis-Sabinene hydrate	0.78	Monoterpenic alcohol
cis-Linalool oxide (fur.)	0.02	Monoterpenic alcohol
Octanol	0.04	Aliphatic alcohol
Terpinolene	0.10	Monoterpene
trans-Linalool oxide (fur.)	0.01	Monoterpenic alcohol
para-Cymenene	0.02	Monoterpene
trans-Sabinene hydrate	0.09	Monoterpenic alcohol
Linalool	0.25	Monoterpenic alcohol
2-Methylbutyl 2-methylbutyrate	0.04	Aliphatic ester
Amyl isovalerate	0.07	Aliphatic ester
Octen-3-yl acetate	0.02	Aliphatic ester
cis-para-Menth-2-en-1-ol	0.05	Monoterpenic alcohol
Octan-3-yl acetate	0.02	Aliphatic ester

trans-para-Menth-2-en-1-ol	0.05	Monoterpenic alcohol
neo-Isopulegol	0.15*	Monoterpenic alcohol
Isopulegol	[0.15]*	Monoterpenic alcohol
Menthone	22.57	Monoterpenic ketone
Isomenthone	3.49	Monoterpenic ketone
Menthofuran	3.23	Monoterpenic ether
Borneol	tr	Monoterpenic alcohol
neo-Menthol	3.64	Monoterpenic alcohol
δ-Terpineol	0.18	Monoterpenic alcohol
Terpinen-4-ol	0.37	Monoterpenic alcohol
Menthol	40.28	Monoterpenic alcohol
Isomenthol	0.72	Monoterpenic alcohol
α-Terpineol	0.27	Monoterpenic alcohol
Myrtenal	0.04	Monoterpenic aldehyde
neoiso-Menthol	0.20	Monoterpenic alcohol
Methylchavicol	0.07	Phenylpropanoid
trans-Isopiperitenol	0.02	Monoterpenic alcohol
Unknown	0.02	Unknown
trans-Piperitol	0.02	Monoterpenic alcohol
Unknown	0.03	Unknown
(3*Z*)-Hexenyl 2-methylbutyrate	0.03	Aliphatic ester
Pulegone	1.28	Monoterpenic ketone
(2*E*)-Hexenyl isovalerate	0.05	Aliphatic ester
Carvone	0.07	Monoterpenic ketone
Piperitone	0.40	Monoterpenic ketone
neo-Menthyl acetate	0.19	Monoterpenic ester
2-Ethylmenthone?	0.02	Aliphatic ketone
Dihydroedulan I	0.04	Terpenic ether
Menthyl acetate	5.00	Monoterpenic ester
Dihydroedulan II	0.03	Terpenic ether
Isomenthyl acetate	0.16	Monoterpenic alcohol
Bicycloelemene	0.02	Sesquiterpene
Piperitenone	0.02	Monoterpenic ketone
α-Cubebene	0.02	Sesquiterpene
Evodone	0.01	Monoterpenic ketone
Menthofurolactone	0.02	Aliphatic alcohol
α-Copaene	0.04	Sesquiterpene
β-Bourbonene	0.22	Sesquiterpene
1,5-diepi-β-Bourbonene	0.02	Sesquiterpene
β-Elemene	0.07	Sesquiterpene
Unknown	0.03	Unknown
Unknown	0.03	Sesquiterpene
β-Caryophyllene	2.51	Sesquiterpene
β-Copaene	0.07	Sesquiterpene
trans-α-Bergamotene	0.04	Sesquiterpene
Isogermacrene D	0.04	Sesquiterpene
α-Humulene	0.16	Sesquiterpene
Muurola-4,11-diene	0.05	Sesquiterpene
(*E*)-β-Farnesene	0.15	Sesquiterpene
Germacrene D	0.98	Sesquiterpene
Bicyclogermacrene	0.20	Sesquiterpene
Viridiflorene	0.04	Sesquiterpene

5-Methyl-2,4-diisopropylphenol	0.04	Terpene derivative
α-Muurolene	0.05	Sesquiterpene
γ-Cadinene	0.07	Sesquiterpene
δ-Cadinene	0.14	Sesquiterpene
trans-Cadina-1,4-diene	0.01	Sesquiterpene
(*E*)-Nerolidol	0.03	Sesquiterpenic alcohol
Spathulenol	0.04	Sesquiterpenic alcohol
Caryophyllene oxide	0.04	Sesquiterpenic ether
Viridiflorol	0.03	Sesquiterpenic alcohol
Isospathulenol	0.01	Sesquiterpenic alcohol
τ-Cadinol	0.02	Sesquiterpenic alcohol
α-Cadinol	0.01	Sesquiterpenic alcohol
Unknown	0.01	Oxygenated sesquiterpene
Consolidated total	**98.12%**	

*: Individual compounds concentration could not be found due to overlapping coelutions on columns considered
[xx]: Duplicate percentage due to coelutions, not taken into account in the consolidated total
tr: The compound has been detected below 0.005% of total signal.

Note: no correction factor was applied

About "consolidated" data: The table above presents the breakdown of the sample volatile constituents after applying an algorithm to collapse data acquired from the multi-columns system of PhytoChemia into a single set of consolidated contents. In case of discrepancies between columns, the algorithm is set to prioritize data from the most standard DB-5 column, and smallest values so as to avoid overestimating individual content. This process is semi-automatic. Advanced users are invited to consult the "Full analysis data" table after the chromatograms in this report to access the full untreated data and perform their own calculations if needed.

Unknowns: Unknown compounds' mass spectral data is presented in the "Full analysis data" table. The occurrence of unknown compounds is to be expected in many samples, and does not denote particular problems unless noted otherwise in the conclusion.

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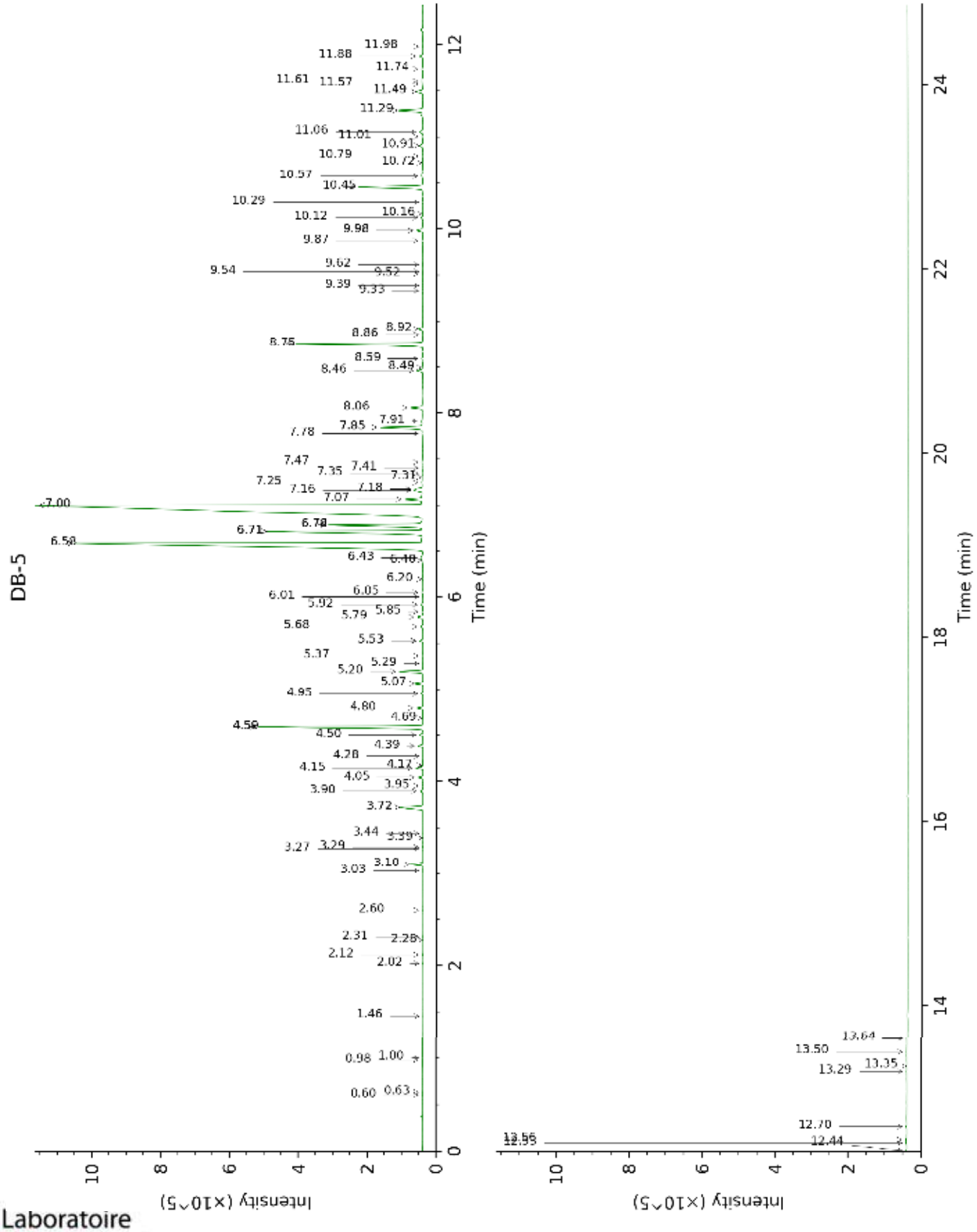
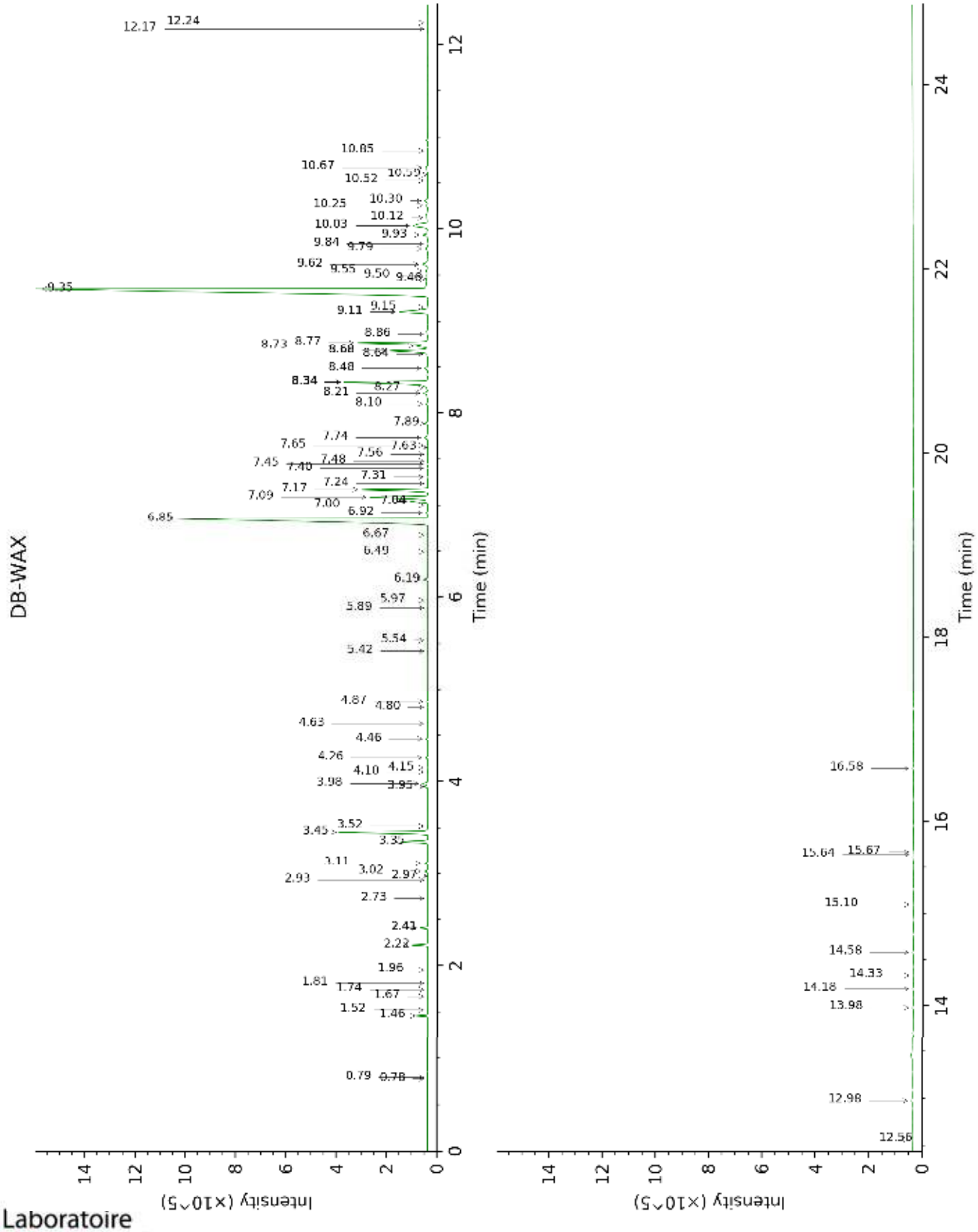

DB-5
Time (min)
Intensity (x10^5)
11.98
11.88
11.74
11.61
11.57
11.49
11.29
11.06
11.01
10.91
10.79
10.72
10.57
10.45
10.29
10.12
10.16
9.98
9.87
9.62
9.54
9.52
9.39
9.33
8.92
8.86
8.75
8.59
8.49
8.46
8.06
7.91
7.85
7.78
7.47
7.41
7.35
7.31
7.25
7.18
7.16
7.07
7.00
6.78
6.71
6.58
6.43
6.40
6.20
6.05
6.01
5.92
5.85
5.79
5.68
5.53
5.37
5.29
5.20
5.07
4.95
4.80
4.69
4.58
4.50
4.39
4.28
4.17
4.15
4.05
3.95
3.90
3.72
3.44
3.39
3.29
3.27
3.10
3.03
2.60
2.31
2.28
2.12
2.02
1.46
1.00
0.98
0.63
0.60
13.64
13.50
13.35
13.29
12.70
12.55
12.44


DB-WAX
Time (min)
Intensity (x10^5)
12.17
12.24
10.85
10.67
10.52
10.25
10.30
10.12
10.03
9.93
9.84
9.62
9.55
9.50
9.35
9.11
9.15
8.86
8.73
8.77
8.68
8.64
8.48
8.34
8.21
8.27
8.10
7.89
7.74
7.65
7.56
7.63
7.45
7.48
7.31
7.24
7.17
7.09
7.00
7.04
6.92
6.85
6.67
6.49
6.19
5.89
5.97
5.54
5.42
4.87
4.80
4.63
4.46
4.26
4.10
4.15
3.98
3.95
3.52
3.45
3.11
3.02
2.97
2.93
2.73
2.41
2.22
1.96
1.81
1.74
1.67
1.52
1.46
0.79
0.78
16.58
15.64
15.67
15.10
14.58
14.33
14.18
13.98
12.98
12.56

FULL ANALYSIS DATA

Identification	Column DB-5			Column DB-WAX		
	R.T	R.I	%	R.T	R.I	%
Isovaleral	0.60	639	tr	0.79	888	tr
2-Methylbutyral	0.63	650	tr	0.78	882	tr
Isoamyl alcohol	0.98	734	0.01	3.52*	1176	0.03
2-Methylbutanol	1.00	737	0.01	3.52*	1176	[0.03]
Hexanal	1.46	800	tr	1.96	1043	tr
(2*E*)-Hexenal	2.02	848	0.02	3.45*	1171	4.45
(3*Z*)-Hexenol	2.12	856	0.02	5.89	1342	0.03
(2*E*)-Hexenol	2.28	868	0.01	6.19*	1364	0.23
Hexanol	2.31	871	0.02	5.54	1316	0.02
trans-2,5-Diethyltetrahydrofuran	2.60	895	0.01	1.67	1016	0.01
α-Thujene	3.03	924	0.03	1.52	1002	0.02
α-Pinene	3.10	929	0.44	1.46	996	0.42
3-Methylcyclohexanone	3.27	940	0.04	4.80	1273	0.03
Camphene	3.29*	942	0.01	1.81	1030	0.02
α-Fenchene	3.29*	942	[0.01]	1.74	1023	tr
Thuja-2,4(10)-diene	3.39	948	0.01	2.41*	1087	0.32
Benzaldehyde	3.44	951	0.01	7.56	1465	0.02
β-Pinene	3.72*	970	1.03	2.22	1069	0.70
Sabinene	3.72*	970	[1.03]	2.41*	1087	[0.32]
Octen-3-ol	3.90	981	0.10	6.92	1418	0.17
Octan-3-one	3.95	985	0.04	4.10	1220	0.02
Myrcene	4.05	991	0.15	3.02	1137	0.14
Octan-3-ol	4.15	998	0.23	6.19*	1364	[0.23]
α-Phellandrene	4.17*	1000	0.02	2.93	1129	0.01
Pseudolimonene	4.17*	1000	[0.02]	2.97	1133	0.01
Δ3-Carene	4.28	1006	0.01	2.73	1114	0.01
α-Terpinene	4.39	1013	0.16	3.11	1144	0.16
para-Cymene	4.50	1020	0.12	4.26	1232	0.11
Limonene	4.59*	1026	5.82	3.35	1162	1.33
1,8-Cineole	4.59*	1026	[5.82]	3.45*	1171	[4.45]
2-Ethylhexanol	4.69	1032	0.02	7.48	1460	0.02
(*Z*)-β-Ocimene	4.80	1038	0.19	3.95	1209	0.17
(*E*)-β-Ocimene	4.95	1048	0.06	4.15	1224	0.05
γ-Terpinene	5.07	1056	0.27	3.98	1211	0.28
cis-Sabinene hydrate	5.20	1064	0.78	7.04*	1427	0.79
cis-Linalool oxide (fur.)	5.28	1069	0.02	6.67	1399	0.02
Octanol	5.37	1074	0.04	8.34*	1525	5.20
Terpinolene	5.53*	1085	0.11	4.46	1247	0.10
trans-Linalool oxide (fur.)	5.53*	1085	[0.11]	7.04*	1427	[0.79]
para-Cymenene	5.53*	1085	[0.11]	6.49	1386	0.02
trans-Sabinene hydrate	5.68	1094	0.09	8.10	1506	0.11
Linalool	5.79	1101	0.25	8.22	1516	0.24
2-Methylbutyl 2-methylbutyrate	5.85	1105	0.04	4.63	1259	0.04

Amyl isovalerate	5.92	1109	0.07	4.87	1277	0.06
Octen-3-yl acetate	6.01	1115	0.02	5.97	1348	0.01
cis-para-Menth-2-en-1-ol	6.05	1118	0.05	8.27	1520	0.06
Octan-3-yl acetate	6.20	1127	0.02	5.42	1308	0.02
trans-para-Menth-2-en-1-ol	6.40	1140	0.05	9.10*	1585	2.05
neo-Isopulegol	6.43*	1142	0.15	8.34*	1525	[5.20]
Isopulegol	6.43*	1142	[0.15]	8.34*	1525	[5.20]
Menthone	6.58	1152	22.57	6.85	1413	22.48
Isomenthone	6.71*	1160	6.72	7.17	1437	3.49
Menthofuran	6.71*	1160	[6.72]	7.09	1430	3.23
Borneol	6.71*	1160	[6.72]	9.93*	1652	0.26
neo-Menthol	6.78*	1165	3.82	8.77	1559	3.64
δ-Terpineol	6.78*	1165	[3.82]	9.62*	1626	0.37
Terpinen-4-ol	7.00*	1179	40.98	8.73†	1556	[2.99]
Menthol	7.00*	1179	[40.98]	9.35	1604	40.28
Isomenthol	7.07	1183	0.72	9.10*	1585	[2.05]
α-Terpineol	7.16†	1190	0.50	9.93*	1652	[0.26]
Myrtenal	7.18*†	1190	[0.50]	8.86	1566	0.04
neoiso-Menthol	7.18*†	1190	[0.50]	9.62*	1626	[0.37]
Methylchavicol	7.25	1195	0.07	9.50	1616	0.08
trans-Isopiperitenol	7.31	1199	0.02	10.52	1700	0.02
Unknown [m/z 43, 99 (84), 81 (46), 986 (43), 126 (36), 71 (28)... 170 (12)]	7.35	1202	0.02			
trans-Piperitol	7.41	1206	0.02	10.59	1705	0.03
Unknown [m/z 146, 145 (94), 43 (72), 99 (41), 81 (29), 115 (25), 86 (24)...]	7.47	1210	0.03			
(3*Z*)-Hexenyl 2-methylbutyrate	7.78	1231	0.03	7.24	1442	0.03
Pulegone	7.85*	1235	1.52	9.10*	1585	[2.05]
(2*E*)-Hexenyl isovalerate	7.85*	1235	[1.52]	7.45	1457	0.05
Carvone	7.91	1240	0.07	10.12	1667	0.07
Piperitone	8.06	1250	0.40	10.03*	1660	1.40
neo-Menthyl acetate	8.46	1277	0.19	7.89	1490	0.18
2-Ethylmenthone?	8.49	1280	0.02			
Dihydroedulan I	8.59	1286	0.04	7.31*	1447	0.08
Menthyl acetate	8.75	1298	5.00	8.34*	1525	[5.20]
Dihydroedulan II	8.86	1300	0.03	7.65	1472	0.04
Isomenthyl acetate	8.92	1304	0.16	8.48	1536	0.19
Bicycloelemene	9.33	1333	0.02	7.31*	1447	[0.08]
Piperitenone	9.39	1337	0.02	12.24	1848	0.01
α-Cubebene	9.52	1346	0.02	7.00	1424	0.01
Evodone	9.54	1348	0.01	12.56	1877	0.02
Menthofurolactone	9.62	1353	0.02	12.17	1842	0.02
α-Copaene	9.87	1371	0.04	7.40	1454	0.05
β-Bourbonene	9.98*	1379	0.26	7.74	1479	0.22

1,5-diepi-β-Bourbonene	9.98*	1379	[0.26]	7.63	1471	0.02
β-Elemene	10.12	1389	0.07	8.68*†	1551	2.99
Unknown [m/z 107, 121 (79), 119 (66), 91 (58), 136 (55), 105 (49)... 194 (1)]	10.16	1392	0.03			
Unknown [m/z 106, 119 (99), 43 (78), 91 (74), 105 (60), 134 (55)... 204 (19)]	10.29	1400	0.03			
β-Caryophyllene	10.45	1413	2.51	8.68*†	1551	[2.99]
β-Copaene	10.57	1421	0.07	8.64	1548	0.07
trans-α-Bergamotene	10.72	1432	0.04	8.68*†	1551	[2.99]
Isogermacrene D	10.79	1438	0.04	9.15	1589	0.04
α-Humulene	10.91	1446	0.16	9.55	1620	0.14
Muurola-4,11-diene	11.01	1453	0.05	9.46	1613	0.12
(*E*)-β-Farnesene	11.06	1457	0.15	9.79	1640	0.14
Germacrene D	11.29	1474	0.98	10.03*	1660	[1.40]
Bicyclogermacrene	11.49*	1489	0.28	10.30	1682	0.20
Viridiflorene	11.49*	1489	[0.28]	9.84	1644	0.04
5-Methyl-2,4-diisopropylphenol	11.58	1496	0.04	16.58	2265	0.04
α-Muurolene	11.60	1498	0.05	10.25	1678	0.08
γ-Cadinene	11.74	1508	0.07	10.67*	1712	0.24
δ-Cadinene	11.88	1519	0.14	10.67*	1712	[0.24]
trans-Cadina-1,4-diene	11.98	1527	0.01	10.85	1728	0.02
(*E*)-Nerolidol	12.44	1563	0.03	13.98	2007	0.04
Spathulenol	12.53	1570	0.04	14.58	2065	0.04
Caryophyllene oxide	12.56	1572	0.04	12.98	1914	0.04
Viridiflorol	12.70	1583	0.03	14.18	2027	0.03
Isospathulenol	13.29	1630	0.01	15.64	2170	0.02
τ-Cadinol	13.35	1635	0.02	15.10	2115	0.02
α-Cadinol	13.50	1648	0.01	15.67	2172	0.02
Unknown [m/z 82, 81 (92), 95 (76), 67 (69), 93 (68), 107 (68), 79 (63), 91 (61)... 220 (11)]	13.64	1660	0.01	14.33	2041	0.02
Total identified		**98.64%**			**98.09%**	
Total reported		**98.76%**			**98.11%**	

*: Two or more compounds are coeluting on this column
[xx]: Duplicate percentage due to coelutions, not taken into account in the consolidated 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