Date : January 23, 2019

Certificate of Analysis – GC Profiling

Sample identification

Internal code : 19A10-ORA10-1-CC
Customer identification : Marjoram
Type : Essential oil
Source : *Origanum majorana*
Customer : Organic Aromas Inc.

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 : Lindsay Girard, B. Sc.
Analysis date : January 17, 2019

Checked and approved by :

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

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PHYSICOCHEMICAL DATA

Physical aspect: Faintly yellow liquid
Refractive index: 1.4710 ± 0.0003 (20 °C)

CONCLUSION

No adulterant, contaminant or diluent has been detected using this method. The sabinene hydrate acetate and linalyl acetate contents are higher than the average in this batch, but this does not question the sample's identity and purity.

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ANALYSIS SUMMARY

Identification	DB-5 (%)	DB-WAX (%)	Classe
2-Methyl-3-buten-2-ol	tr		Aliphatic alcohol
Isovaleral	0.02	0.02	Aliphatic aldehyde
2-Methylbutyral	0.01	0.02	Aliphatic aldehyde
2-Ethylfuran	0.01	0.01	Furan
Isoamyl alcohol	0.01	0.02*	Aliphatic alcohol
2-Methylbutanol	0.01	[0.02]*	Aliphatic alcohol
Methyl 2-methylbutyrate	0.01	0.01	Aliphatic ester
Hexanal	0.01	0.01	Aliphatic aldehyde
Octane	tr	tr	Alkane
(2*E*)-Hexenal	0.03	0.03	Aliphatic aldehyde
(3*Z*)-Hexenol	0.01	0.01	Aliphatic alcohol
Hexanol	0.01	0.01	Aliphatic alcohol
Hashishene	0.01	0.65*	Monoterpene
α-Thujene	0.68	0.67	Monoterpene
α-Pinene	0.66	[0.65]*	Monoterpene
Camphene	0.04	0.03	Monoterpene
β-Pinene	6.47*	0.37	Monoterpene
Sabinene	[6.47]*	5.99	Monoterpene
3-Methylpentyl acetate	0.04	0.01	Aliphatic ester
Octan-3-one	0.07	0.06	Aliphatic ketone
Myrcene	1.60	1.57	Monoterpene
α-Phellandrene	0.48	0.42	Monoterpene
α-Terpinene	8.44	8.30	Monoterpene
Carvomenthene	0.01	0.01	Aliphatic alcohol
para-Cymene	1.47	1.46	Monoterpene
Limonene	3.61	1.56	Monoterpene
1,8-Cineole	[3.61]*	2.00*	Monoterpenic ether
β-Phellandrene	[3.61]*	[2.00]*	Monoterpene
(*Z*)-β-Ocimene	0.03	13.39*	Monoterpene
(*E*)-β-Ocimene	0.04	0.05	Monoterpene
γ-Terpinene	13.58	[13.39]*	Monoterpene
cis-Sabinene hydrate	4.90	4.99	Monoterpenic alcohol
para-Cymenene	3.08*	0.02	Monoterpene
Terpinolene	[3.08]*	3.01	Monoterpene
trans-Sabinene hydrate	10.48	10.58	Monoterpenic alcohol
Unknown	2.11*	0.02	Oxygenated monoterpene
Linalool	[2.11]*	2.12*	Monoterpenic alcohol
Unknown	0.03	3.04*	Monoterpenic alcohol
cis-para-Menth-2-en-1-ol	1.41	[2.12]*	Monoterpenic alcohol
α-Campholenal	0.05	0.04	Monoterpenic aldehyde
4-Hydroxy-4-methylcyclohex-2-enone	0.02	0.02	Aliphatic alcohol
trans-Pinocarveol	0.06	0.06	Monoterpenic alcohol
trans-para-Menth-2-en-1-ol	0.81	0.83	Monoterpenic alcohol
Unknown	0.03*	0.01	Unknown
1,4-Dimethyl-4-acetylcyclohexene	[0.03]*	0.02	Monoterpenic ketone
Pinocarvone	0.01	0.01	Monoterpenic ketone
Borneol	0.06	0.07	Monoterpenic alcohol

δ-Terpineol	0.01	0.03	Monoterpenic alcohol
Terpinen-4-ol	21.23*	21.35*	Monoterpenic alcohol
Cryptone	[21.23]*	0.06	Normonoterpenic ketone
α-Terpineol	2.68	2.76	Monoterpenic alcohol
cis-Piperitol	0.53	0.31*	Monoterpenic alcohol
Methylchavicol	[0.53]	0.21*	Phenylpropanoid
Unknown	0.01	0.01	Unknown
trans-Piperitol	0.46	0.45	Monoterpenic alcohol
trans-Carveol	0.02	0.02	Monoterpenic alcohol
Nerol	0.03	0.04	Monoterpenic alcohol
Citronellol	0.03	0.02	Monoterpenic alcohol
Carvone	0.16*	0.17	Monoterpenic ketone
Neral	[0.16]*	[0.31]*	Monoterpenic aldehyde
trans-Sabinene hydrate acetate	2.34	2.36	Monoterpenic ester
Geraniol	4.34*	0.05	Monoterpenic alcohol
Linalyl acetate	[4.34]*	5.72	Monoterpenic ester
trans-Ascaridole glycol	0.10	0.10	Monoterpenic alcohol
Geranial	0.01	1.74*	Monoterpenic aldehyde
Bornyl acetate	0.02	0.01	Monoterpenic ester
cis-Ascaridole glycol?	0.12	0.07	Monoterpenic alcohol
Terpinen-4-yl acetate	0.55*	0.40	Monoterpenic ester
Thymol	[0.55]*	0.09	Monoterpenic alcohol
Unknown	0.05		Monoterpenic alcohol
Unknown	0.08	0.09	Monoterpenic alcohol
Bicycloelemene	0.04	0.03	Sesquiterpene
α-Cubebene	0.02	0.04	Sesquiterpene
Eugenol	0.03	0.02	Phenylpropanoid
Neryl acetate	0.04	0.03	Monoterpenic ester
α-Copaene	0.01	0.02	Sesquiterpene
Geranyl acetate	0.07	0.07	Monoterpenic ester
β-Elemene	0.01	[3.04]*	Sesquiterpene
β-Caryophyllene	2.89	[3.04]*	Sesquiterpene
Aromadendrene	0.01	[21.35]*	Sesquiterpene
trans-α-Bergamotene	0.05	[3.04]*	Sesquiterpene
α-Humulene	0.12	[0.21]*	Sesquiterpene
allo-Aromadendrene	0.04	0.04	Sesquiterpene
γ-Muurolene	0.02	0.03	Sesquiterpene
Germacrene D	0.01	0.02	Sesquiterpene
Bicyclogermacrene	1.79*	[1.74]*	Sesquiterpene
Viridiflorene	[1.79]*	0.05	Sesquiterpene
γ-Cadinene	0.05	0.03	Sesquiterpene
δ-Cadinene	0.02	0.02	Sesquiterpene
Isocaryophyllene epoxide B	0.01		Sesquiterpenic ether
Spathulenol	0.09	0.10	Sesquiterpenic alcohol
Caryophyllene oxide	0.11*	0.09	Sesquiterpenic ether
Caryophyllene oxide isomer	[0.11]*	0.01	Sesquiterpenic ether
Globulol	0.02	0.02	Sesquiterpenic alcohol
Viridiflorol	0.01	0.03	Sesquiterpenic alcohol
Humulene epoxide II	0.02	0.01	Sesquiterpenic ether
τ-Cadinol	0.09		Sesquiterpenic alcohol
α-Muurolol	0.01	0.02	Sesquiterpenic alcohol
α-Cadinol	0.01	0.02	Sesquiterpenic alcohol

Unknown	0.01	0.04	Diterpene
Total identified	**98.59%**	**98.14%**	

*: 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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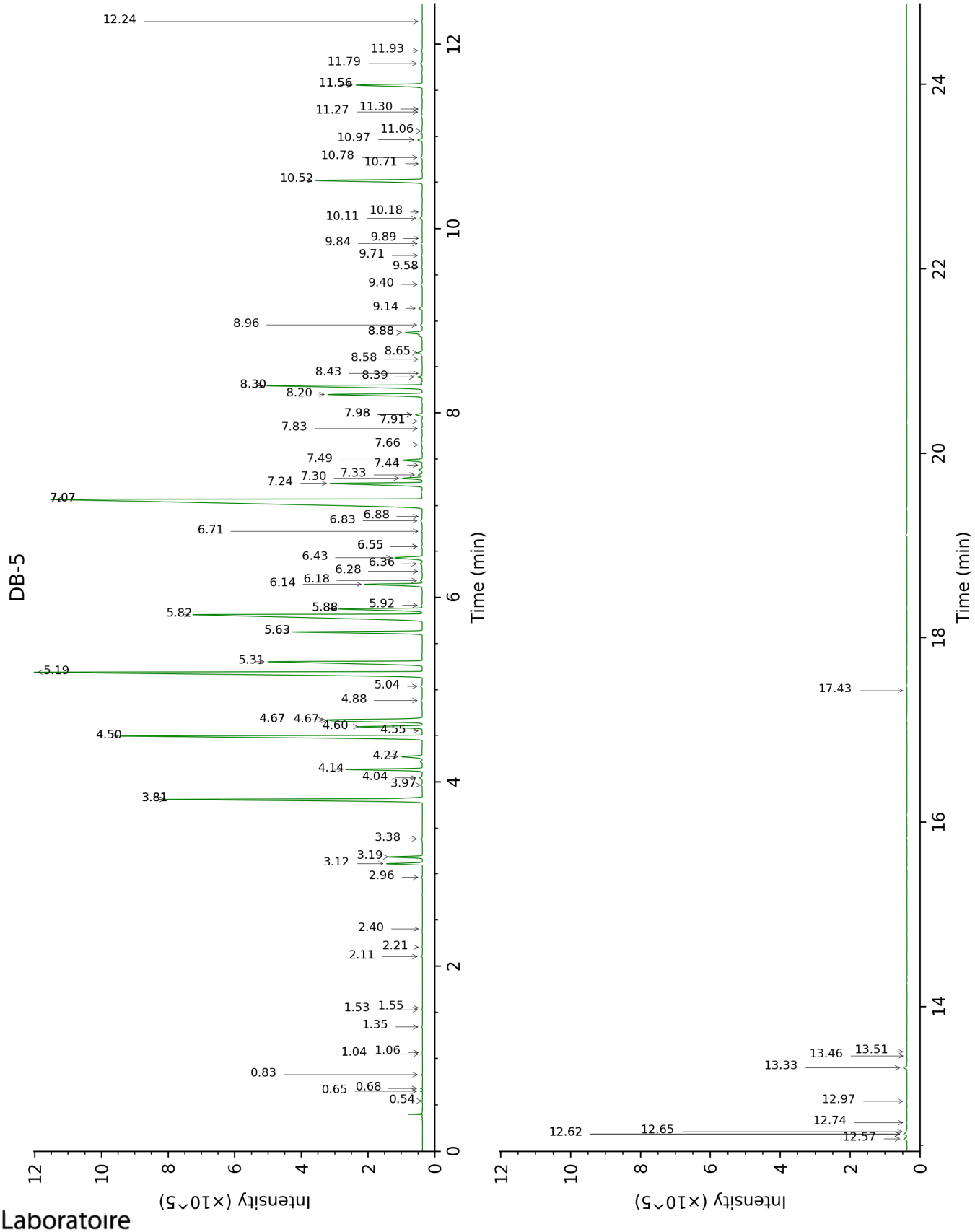
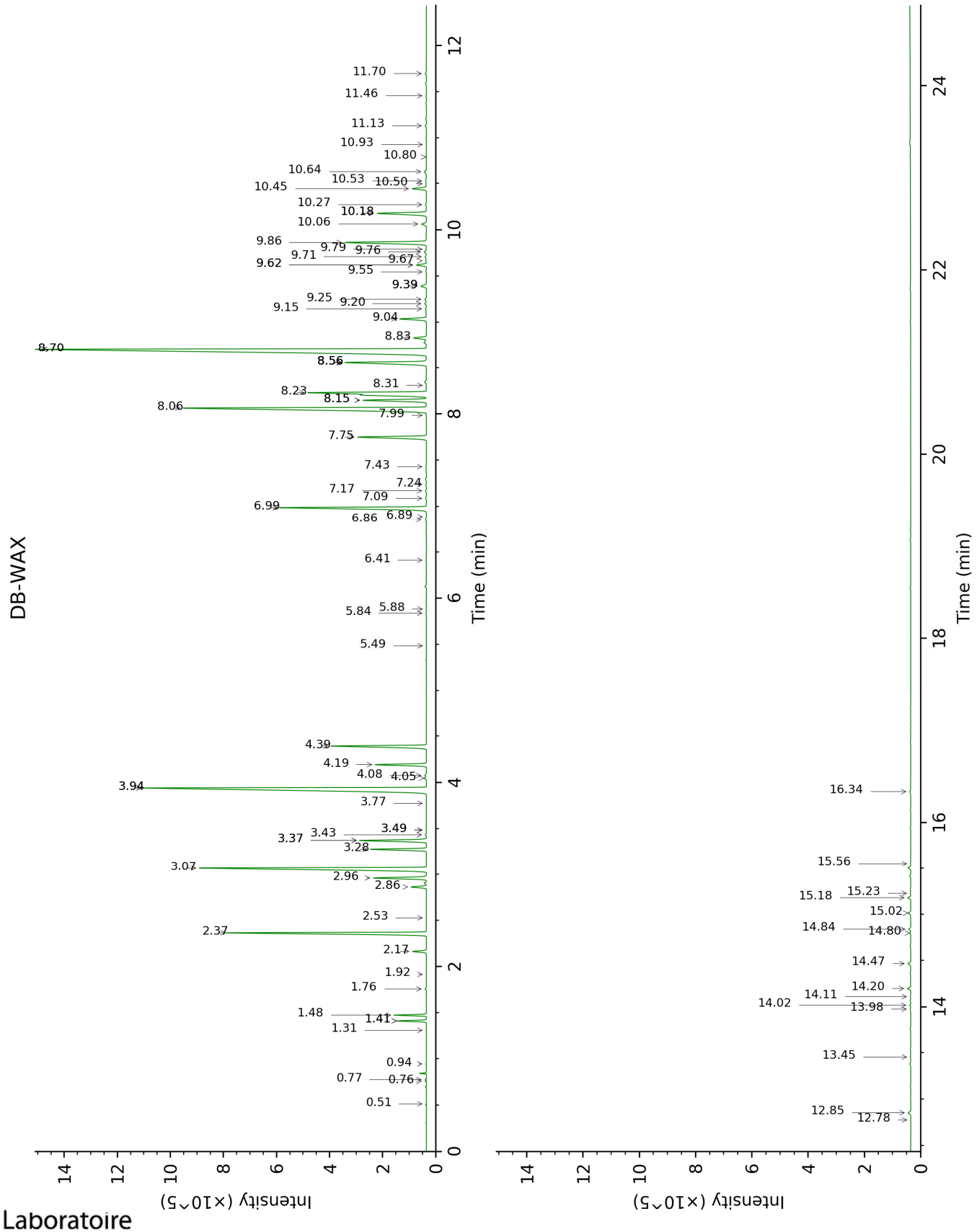

DB-5
Intensity (×10^5)
Time (min)
12.24
11.93
11.79
11.56
11.27
11.30
11.06
10.97
10.78
10.71
10.52
10.18
10.11
9.89
9.84
9.71
9.58
9.40
9.14
8.96
8.88
8.65
8.58
8.43
8.39
8.30
8.20
7.98
7.91
7.83
7.66
7.49
7.44
7.33
7.30
7.24
7.07
6.88
6.83
6.71
6.55
6.43
6.36
6.28
6.18
6.14
5.92
5.88
5.82
5.63
5.31
5.19
5.04
4.88
4.67
4.67
4.60
4.55
4.50
4.27
4.14
4.04
3.97
3.81
3.38
3.19
3.12
2.96
2.40
2.21
2.11
1.55
1.53
1.35
1.06
1.04
0.83
0.68
0.65
0.54
17.43
13.51
13.46
13.33
12.97
12.74
12.65
12.62
12.57


DB-WAX
Intensity (×10^5)
Time (min)
11.70
11.46
11.13
10.93
10.80
10.64
10.53
10.50
10.45
10.27
10.18
10.06
9.86
9.79
9.76
9.71
9.67
9.62
9.55
9.39
9.25
9.20
9.15
9.04
8.83
8.70
8.56
8.31
8.23
8.15
8.06
7.99
7.75
7.43
7.24
7.17
7.09
6.99
6.89
6.86
6.41
5.88
5.84
5.49
4.39
4.19
4.08
4.05
3.94
3.77
3.49
3.43
3.37
3.28
3.07
2.96
2.86
2.53
2.37
2.17
1.92
1.76
1.48
1.41
1.31
0.94
0.77
0.76
0.51
16.34
15.56
15.23
15.18
15.02
14.84
14.80
14.47
14.20
14.11
14.02
13.98
13.45
12.85
12.78

FULL ANALYSIS DATA

Identification	Column DB-5			Column DB-WAX		
	R.T	R.I	%	R.T	R.I	%
2-Methyl-3-buten-2-ol	0.54	604	tr			
Isovaleral	0.65	639	0.02	0.77	888	0.02
2-Methylbutyral	0.68	648	0.01	0.76	883	0.02
2-Ethylfuran	0.83	692	0.01	0.94	925	0.01
Isoamyl alcohol	1.04	731	0.01	3.49*	1177	0.02
2-Methylbutanol	1.06	733	0.01	3.49*	1177	[0.02]
Methyl 2-methylbutyrate	1.35	771	0.01	1.31	978	0.01
Hexanal	1.53	796	0.01	1.92	1044	0.01
Octane	1.55	799	tr	0.51	791	tr
(2*E*)-Hexenal	2.11	847	0.03	3.43	1173	0.03
(3*Z*)-Hexenol	2.21	855	0.01	5.88	1349	0.01
Hexanol	2.40	871	0.01	5.49	1320	0.01
Hashishene	2.96	914	0.01	1.41*	994	0.65
α-Thujene	3.12	924	0.68	1.48	1003	0.67
α-Pinene	3.19	929	0.66	1.41*	994	[0.65]
Camphene	3.38	942	0.04	1.76	1029	0.03
β-Pinene	3.81*	970	6.47	2.16	1067	0.37
Sabinene	3.81*	970	[6.47]	2.37	1087	5.99
3-Methylpentyl acetate	3.97	980	0.04	3.77	1200	0.01
Octan-3-one	4.04	985	0.07	4.05	1221	0.06
Myrcene	4.14	991	1.60	2.96	1136	1.57
α-Phellandrene	4.27	1000	0.48	2.86	1128	0.42
α-Terpinene	4.50	1014	8.44	3.07	1144	8.30
Carvomenthene	4.55	1018	0.01	2.53	1102	0.01
para-Cymene	4.60	1021	1.47	4.19	1232	1.46
Limonene	4.66†	1025	3.61	3.28	1160	1.56
1,8-Cineole	4.67*†	1026	[3.61]	3.37*	1168	2.00
β-Phellandrene	4.67*†	1026	[3.61]	3.37*	1168	[2.00]
(*Z*)-β-Ocimene	4.88	1039	0.03	3.94*	1213	13.39
(*E*)-β-Ocimene	5.04	1049	0.04	4.08	1223	0.05
γ-Terpinene	5.19	1058	13.58	3.94*	1213	[13.39]
cis-Sabinene hydrate	5.31	1066	4.90	6.99	1430	4.99
para-Cymenene	5.63*	1086	3.08	6.41	1387	0.02
Terpinolene	5.63*	1086	[3.08]	4.39	1248	3.01
trans-Sabinene hydrate	5.82	1098	10.48	8.06	1512	10.58
Unknown [m/z 95, 150 (45), 110 (35), 107 (23), 109 (21)]	5.88*	1102	2.11	5.84	1346	0.02
Linalool	5.88*	1102	[2.11]	8.15*	1518	2.12
Unknown [m/z 119, 109 (94), 43 (61), 95 (56), 91 (48), 77 (32), 152	5.92	1104	0.03	8.56*	1550	3.04

(32), 137 (31), 134 (24)]						
cis-para-Menth-2-en-1-ol	6.14	1119	1.41	8.15*	1518	[2.12]
α-Campholenal	6.18	1121	0.05	7.09	1438	0.04
4-Hydroxy-4-methylcyclohex-2-enone	6.28	1128	0.02	14.11	2031	0.02
trans-Pinocarveol	6.36	1133	0.06	9.25	1604	0.06
trans-para-Menth-2-en-1-ol	6.43	1137	0.81	9.04	1587	0.83
Unknown [m/z 109, 124 (45), 119 (41), 43 (35), 91 (28), 95 (25)...]	6.55*	1145	0.03	6.89	1423	0.01
1,4-Dimethyl-4-acetylcyclohexene	6.55*	1145	[0.03]	7.43	1463	0.02
Pinocarvone	6.72	1156	0.01	7.99	1505	0.01
Borneol	6.83	1163	0.06	9.76	1646	0.07
δ-Terpineol	6.88	1166	0.01	9.55	1628	0.03
Terpinen-4-ol	7.07*	1178	21.23	8.70*†	1561	21.35
Cryptone	7.07*	1178	[21.23]	9.20	1600	0.06
α-Terpineol	7.24	1190	2.68	9.86	1654	2.76
cis-Piperitol	7.30†	1193	0.53	9.62*	1634	0.31
Methylchavicol	7.33†	1196	[0.53]	9.39*	1616	0.21
Unknown [m/z 95, 93 (32), 121 (24), 79 (22), 91 (21), 105 (16)... 154 (2)]	7.44	1203	0.01	10.93	1743	0.01
trans-Piperitol	7.49	1206	0.46	10.45	1702	0.45
trans-Carveol	7.66	1217	0.02	11.46	1788	0.02
Nerol	7.83	1229	0.03	11.13	1761	0.04
Citronellol	7.91	1235	0.03	10.80	1732	0.02
Carvone	7.98*	1240	0.16	10.06	1671	0.17
Neral	7.98*	1240	[0.16]	9.62*	1634	[0.31]
trans-Sabinene hydrate acetate	8.20	1255	2.34	7.75	1488	2.36
Geraniol	8.30*	1261	4.34	11.70	1809	0.05
Linalyl acetate	8.30*	1261	[4.34]	8.23	1524	5.72
trans-Ascaridole glycol	8.39	1268	0.10	14.20	2039	0.10
Geranial	8.43	1270	0.01	10.18*	1680	1.74
Bornyl acetate	8.58	1281	0.02	8.31	1531	0.01
cis-Ascaridole glycol?	8.65	1286	0.12	14.84	2102	0.07
Terpinen-4-yl acetate	8.88*†	1301	0.55	8.83	1571	0.40
Thymol	8.88*†	1301	[0.55]	15.18	2136	0.09
Unknown analog	8.96	1307	0.05			
Unknown [m/z 97, 112 (92), 83 (62), 43 (44), 41 (25)...	9.14	1316	0.08	15.02	2119	0.09

170? (4)]						
Bicycloelemene	9.40	1334	0.04	7.17	1444	0.03
α-Cubebene	9.58	1347	0.02	6.86	1420	0.04
Eugenol	9.71	1356	0.03	14.80	2097	0.02
Neryl acetate	9.84	1366	0.04	10.27	1688	0.03
α-Copaene	9.90	1370	0.01	7.24	1449	0.02
Geranyl acetate	10.11	1385	0.07	10.64	1718	0.07
β-Elemene	10.18	1390	0.01	8.56*	1550	[3.04]
β-Caryophyllene	10.52	1414	2.89	8.56*	1550	[3.04]
Aromadendrene	10.71	1429	0.01	8.70*†	1561	[21.35]
trans-α-Bergamotene	10.78	1434	0.05	8.56*	1550	[3.04]
α-Humulene	10.97	1448	0.12	9.39*	1616	[0.21]
allo-Aromadendrene	11.06	1455	0.04	9.15	1596	0.04
γ-Muurolene	11.27	1470	0.02	9.67	1638	0.03
Germacrene D	11.30	1473	0.01	9.79	1648	0.02
Bicyclogermacrene	11.56*	1492	1.79	10.18*	1680	[1.74]
Viridiflorene	11.56*	1492	[1.79]	9.71	1642	0.05
γ-Cadinene	11.79	1510	0.05	10.53	1709	0.03
δ-Cadinene	11.93	1521	0.02	10.50	1706	0.02
Isocaryophyllene epoxide B	12.24	1546	0.01			
Spathulenol	12.57	1571	0.09	14.47	2066	0.10
Caryophyllene oxide	12.62*	1575	0.11	12.85	1913	0.09
Caryophyllene oxide isomer	12.62*	1575	[0.11]	12.78	1906	0.01
Globulol	12.65	1577	0.02	13.98	2018	0.02
Viridiflorol	12.74	1585	0.01	14.02	2022	0.03
Humulene epoxide II	12.97	1603	0.02	13.45	1968	0.01
τ-Cadinol	13.33	1633	0.09			
α-Muurolol	13.46	1643	0.01	15.23	2140	0.02
α-Cadinol	13.51	1647	0.01	15.56	2173	0.02
Unknown [m/z 257, 258 (20), 91 (19), 272 (18)]	17.43	1998	0.01	16.34	2254	0.04
Total identified		**98.59%**			**98.14%**	
Total reported		**98.78%**			**98.31%**	

*: 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