Date : February 25, 2022

Certificate of Analysis – GC Profiling

Sample identification

Internal code : 22B11-ZAA02
Customer identification : Hemlock Spruce - Canada - EAB878226CA93221E
Type : Essential oil
Source : *Tsuga canadensis*
Customer : ZAYAT AROMA

Analysis

Method: PC-MAT-014 ISO - 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 2014-005
Analysis date : February 22, 2022

Checked and approved by :

Alexis St-Gelais, Ph. D., Chimiste 2013-174

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PHYSICOCHEMICAL DATA

Physical aspect: Clear liquid
Refractive index: 1.4699 ± 0.0003 (20 °C; method PC-MAT-016)

CONCLUSION

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

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Analysis summary – Consolidated contents

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

Identification	%	Class
Isovaleral	0.01	Aliphatic aldehyde
2-Methylbutyral	tr	Aliphatic aldehyde
Toluene	0.03	Simple phenolic
Hexanal	0.01	Aliphatic aldehyde
Furfural	tr	Furan
(3*Z*)-Hexenol	0.02	Aliphatic alcohol
Hexanol	0.02	Aliphatic alcohol
Santene	0.56	Normonoterpene
Unknown	0.01	Normonoterpene
Bornylene	0.01	Monoterpene
Hashishene	0.01	Monoterpene
Tricyclene	5.80	Monoterpene
α-Thujene	0.18	Monoterpene
α-Pinene	21.86	Monoterpene
Camphene	14.32	Monoterpene
α-Fenchene	0.06	Monoterpene
Thuja-2,4(10)-diene	0.08	Monoterpene
Benzaldehyde	0.01	Simple phenolic
β-Pinene	5.05	Monoterpene
Sabinene	0.03	Monoterpene
Dehydro-1,8-cineole	0.03	Monoterpenic ether
Myrcene	3.04	Monoterpene
α-Phellandrene	1.09	Monoterpene
Menthatriene isomer I	0.04	Monoterpene
Δ3-Carene	1.71	Monoterpene
(3*Z*)-Hexenyl acetate	0.02	Aliphatic ester
1,4-Cineole	0.33*	Monoterpenic ether
α-Terpinene	0.33*	Monoterpene
para-Cymene	0.64	Monoterpene
1,8-Cineole	2.30*	Monoterpenic ether
β-Phellandrene	2.30*	Monoterpene
Limonene	4.26	Monoterpene
(*Z*)-β-Ocimene	0.01	Monoterpene
(*E*)-β-Ocimene	0.01	Monoterpene
γ-Terpinene	0.39	Monoterpene
Unknown	0.05	Oxygenated monoterpene
Fenchone	0.02	Monoterpenic ketone
Terpinolene	0.78	Monoterpene
para-Cymenene	0.15	Monoterpene
γ-Campholenal	0.14	Aliphatic alcohol
α-Thujone	0.02	Monoterpenic ketone
Linalool	0.07	Monoterpenic alcohol
Nonanal	0.01	Aliphatic aldehyde
β-Thujone	0.01	Monoterpenic ketone
endo-Fenchol	0.07	Monoterpenic alcohol

cis-para-Menth-2-en-1-ol	0.01	Monoterpenic alcohol
α-Campholenal	0.05	Monoterpenic aldehyde
Nopinone	0.01	Normonoterpenic ketone
trans-Pinocarveol	0.09	Monoterpenic alcohol
Camphor	0.32	Monoterpenic ketone
Camphene hydrate	0.07	Monoterpenic alcohol
Pinocamphone	0.02	Monoterpenic ketone
Isoborneol	0.01	Monoterpenic alcohol
Pinocarvone	0.03	Monoterpenic ketone
Borneol	1.20	Monoterpenic alcohol
α-Phellandren-8-ol	0.07	Monoterpenic alcohol
Isopinocamphone	0.04	Monoterpenic ketone
Terpinen-4-ol	0.46	Monoterpenic alcohol
Cryptone	0.02	Normonoterpenic ketone
para-Cymen-8-ol	0.02	Monoterpenic alcohol
Myrtenal	0.08	Monoterpenic aldehyde
Methyl salicylate	0.03	Phenolic ester
α-Terpineol	0.70	Monoterpenic alcohol
Myrtenol	0.06	Monoterpenic alcohol
Verbenone	0.08	Monoterpenic ketone
Citronellol	0.06	Monoterpenic alcohol
Carvotanacetone	0.02	Monoterpenic ketone
Piperitone	1.49	Monoterpenic ketone
Isobornyl acetate	26.00	Monoterpenic ester
Unknown	0.13	Unknown
Unknown	0.21	Monoterpenic ester
trans-Pinocarvyl acetate	0.08	Monoterpenic ester
Thymol	0.07	Monoterpenic alcohol
Myrtenyl acetate	0.12	Monoterpenic ester
Pin-2-en-8-yl acetate	0.79	Monoterpenic ester
Terpinyl acetate analog	0.04	Monoterpenic ester
Citronellyl acetate	0.04	Monoterpenic ester
Neryl acetate	0.01	Monoterpenic ester
Unknown	0.03	Oxygenated monoterpene
α-Ylangene	0.01	Sesquiterpene
α-Copaene	0.03	Sesquiterpene
β-Bourbonene	0.03	Sesquiterpene
trans-Myrtanyl acetate	0.04	Monoterpenic ester
Geranyl acetate	0.04	Monoterpenic ester
β-Elemene	0.01	Sesquiterpene
Longifolene	0.03	Sesquiterpene
β-Caryophyllene	0.96	Sesquiterpene
β-Copaene	0.03	Sesquiterpene
trans-α-Bergamotene	0.02	Sesquiterpene
α-Humulene	1.18	Sesquiterpene
trans-Cadina-1(6),4-diene	0.03	Sesquiterpene
γ-Muurolene	0.12*	Sesquiterpene
α-Amorphene	0.12*	Sesquiterpene
Germacrene D	0.05	Sesquiterpene
β-Selinene	0.06	Sesquiterpene
α-Selinene	0.08	Sesquiterpene
α-Muurolene	0.06	Sesquiterpene

γ-Cadinene	0.16	Sesquiterpene
(*Z*)-γ-Bisabolene	0.02	Sesquiterpene
δ-Cadinene	0.27	Sesquiterpene
trans-Cadina-1,4-diene	0.01	Sesquiterpene
α-Cadinene	0.01	Sesquiterpene
α-Calacorene	0.01	Sesquiterpene
(*E*)-α-Bisabolene	0.01	Sesquiterpene
(*E*)-Nerolidol	0.06	Sesquiterpenic alcohol
Caryophyllene oxide	0.02	Sesquiterpenic ether
Salvial-4(14)-en-1-one	0.01	Aliphatic alcohol
Humulene epoxide I	0.01	Sesquiterpenic ether
Humulene epoxide II	0.02	Sesquiterpenic ether
1-epi-Cubenol	0.01	Sesquiterpenic alcohol
τ-Cadinol	0.02	Sesquiterpenic alcohol
τ-Muurolol	0.01	Sesquiterpenic alcohol
Unknown	0.01	Diterpene
ar-Abietatriene	0.01	Diterpene
Manool	0.06	Diterpenic alcohol
7,13-Abietadiene	0.02	Diterpene
Consolidated total	**99.21%**	

*: 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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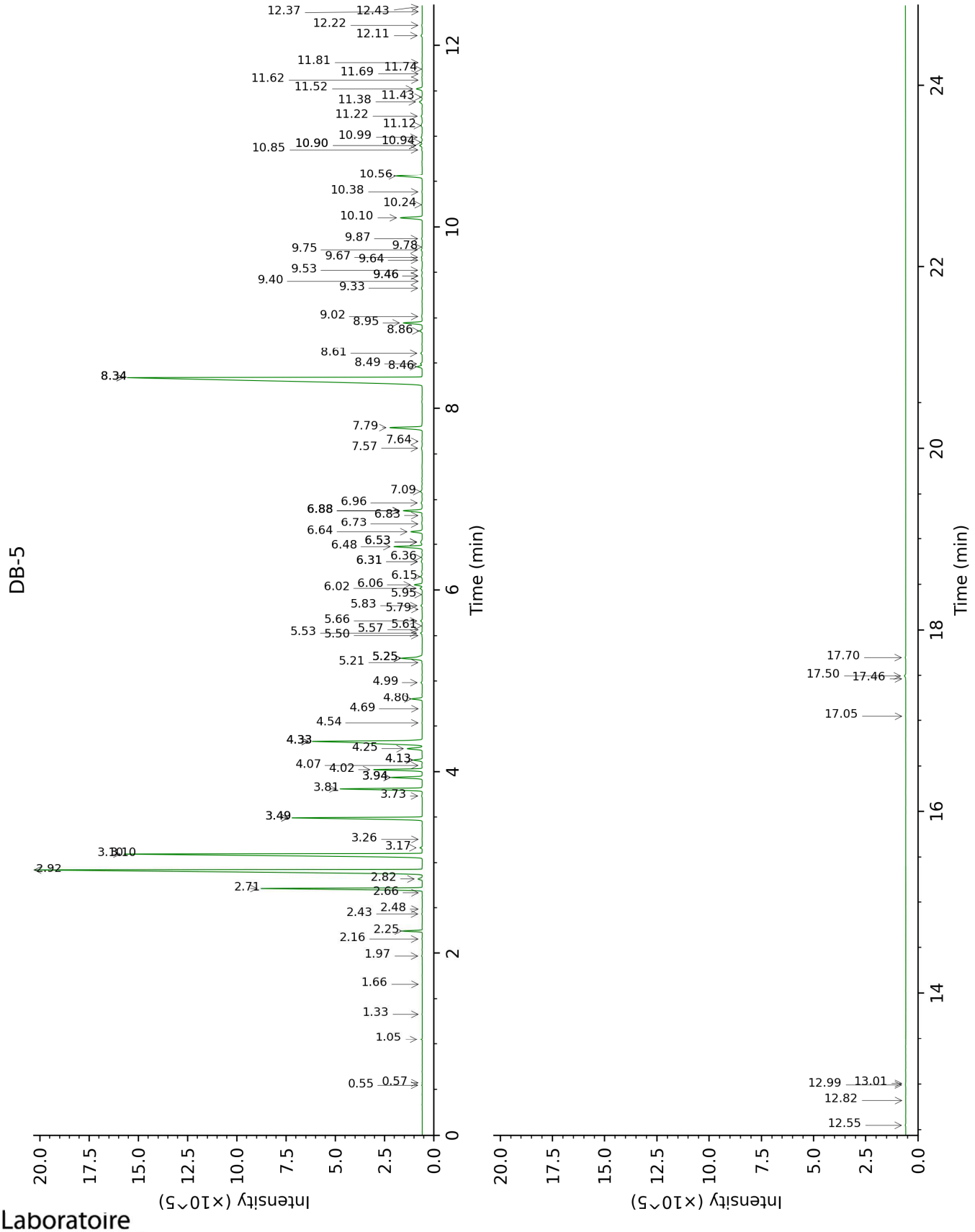
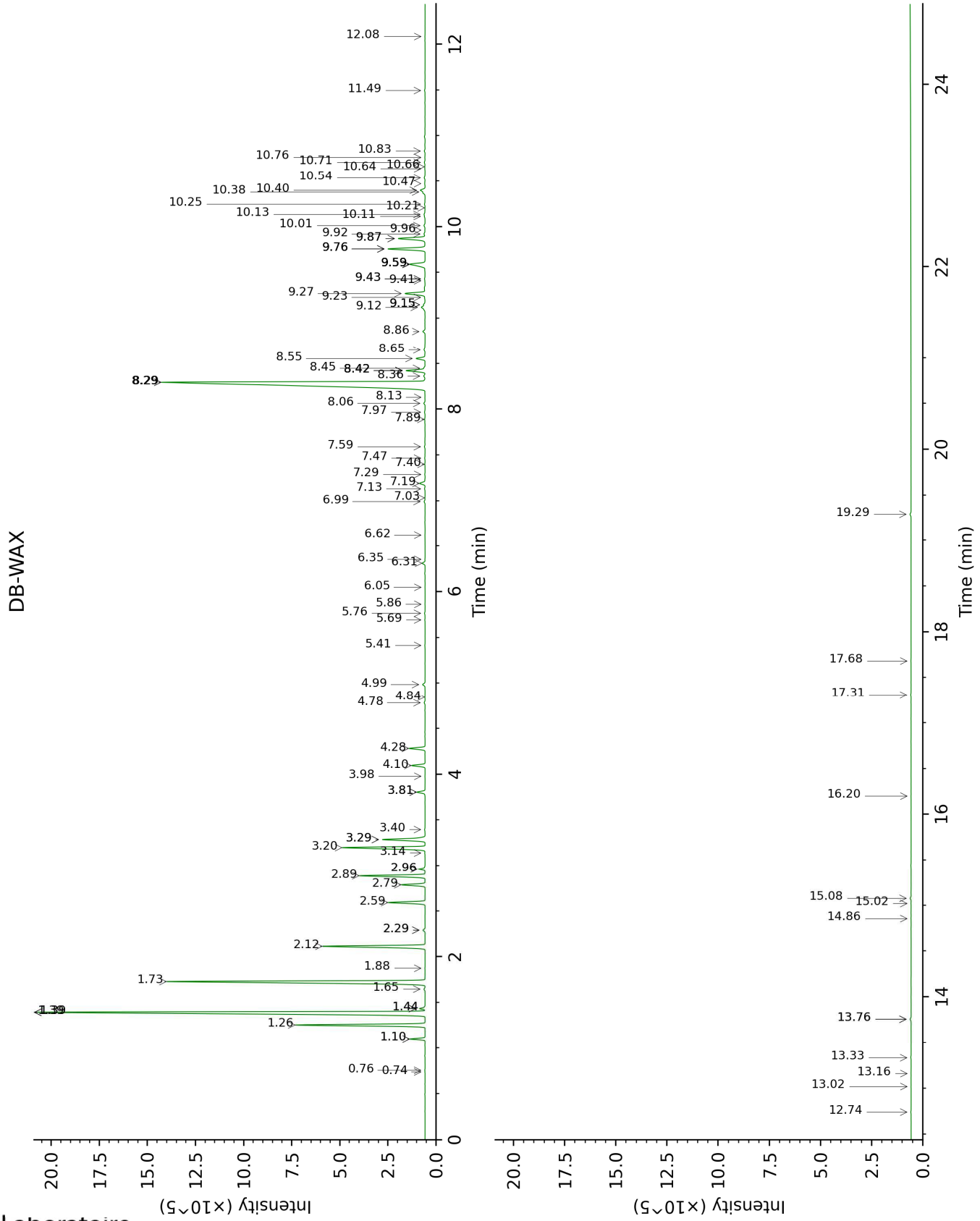

DB-5
Time (min)
Intensity (×10^5)
12.37
12.43
12.22
12.11
11.81
11.69
11.74
11.62
11.52
11.38
11.43
11.22
11.12
10.99
10.94
10.85
10.90
10.56
10.38
10.24
10.10
9.87
9.75
9.78
9.67
9.64
9.53
9.46
9.40
9.33
9.02
8.95
8.86
8.61
8.49
8.46
8.34
7.79
7.57
7.64
7.09
6.96
6.88
6.83
6.64
6.73
6.48
6.53
6.31
6.36
6.02
6.06
6.15
5.95
5.83
5.79
5.66
5.61
5.53
5.50
5.57
5.21
5.25
4.99
4.80
4.69
4.54
4.33
4.25
4.07
4.02
4.13
3.94
3.81
3.73
3.49
3.26
3.17
3.10
2.92
2.82
2.71
2.66
2.43
2.48
2.25
2.16
1.97
1.66
1.33
1.05
0.55
0.57
17.70
17.50
17.46
17.05
12.99
13.01
12.82
12.55


DB-WAX
Time (min)
Intensity (×10^5)
12.08
11.49
10.83
10.76
10.71
10.64
10.66
10.54
10.47
10.38
10.40
10.25
10.21
10.13
10.11
10.01
9.96
9.92
9.87
9.76
9.59
9.43
9.41
9.27
9.23
9.12
9.15
8.86
8.65
8.55
8.45
8.42
8.36
8.29
8.13
8.06
7.97
7.89
7.59
7.47
7.40
7.29
7.19
7.13
7.03
6.99
6.62
6.35
6.31
6.05
5.86
5.76
5.69
5.41
4.99
4.84
4.78
4.28
4.10
3.98
3.81
3.40
3.29
3.20
3.14
2.96
2.89
2.79
2.59
2.29
2.12
1.88
1.73
1.65
1.44
1.39
1.26
1.10
0.76
0.74
19.29
17.68
17.31
16.20
15.08
15.02
14.86
13.76
13.33
13.16
13.02
12.74

FULL ANALYSIS DATA

Identification	Column DB-5			Column DB-WAX		
	R.T	R.I	%	R.T	R.I	%
Isovaleral	0.55	641	0.01	0.76	884	0.01
2-Methylbutyral	0.58	651	tr	0.74	878	tr
Toluene	1.05	758	0.03	1.39*	994	21.72
Hexanal	1.33	801	0.01	1.88	1042	0.01
Furfural	1.66	831	tr	6.62	1406	0.01
(3*Z*)-Hexenol	1.97	858	0.02	5.76	1345	0.03
Hexanol	2.16	875	0.02	5.41	1319	0.02
Santene	2.24	882	0.56	1.10*	947	0.57
Unknown [m/z 79, 93 (66), 94 (52), 91 (39), 77 (37), 122 (31)]	2.43	899	0.01	1.44*	999	0.23
Bornylene	2.48	903	0.01	1.10*	947	[0.57]
Hashishene	2.66	916	0.01	1.39*	994	[21.72]
Tricyclene	2.71	919	5.80	1.26	971	5.76
α-Thujene	2.82	926	0.18	1.44*	999	[0.23]
α-Pinene	2.92	933	21.86	1.39*	994	[21.72]
Camphene	3.10*	945	14.44	1.73	1028	14.32
α-Fenchene	3.10*	945	[14.44]	1.65	1020	0.06
Thuja-2,4(10)-diene	3.17	950	0.08	2.29*	1083	0.11
Benzaldehyde	3.26	956	0.01	7.40	1464	0.02
β-Pinene	3.49*	972	5.10	2.12	1066	5.05
Sabinene	3.49*	972	[5.10]	2.29*	1083	[0.11]
Dehydro-1,8-cineole	3.73	988	0.03	3.14	1153	0.02
Myrcene	3.81	994	3.04	2.89	1133	3.03
α-Phellandrene	3.94*	1002	1.11	2.79	1125	1.09
Menthatriene isomer I	3.94*	1002	[1.11]	3.40	1173	0.04
Δ3-Carene	4.02	1008	1.71	2.59	1110	1.71
(3*Z*)-Hexenyl acetate	4.07	1011	0.02	4.84	1282	0.01
1,4-Cineole	4.13*	1014	0.33	2.96*	1139	0.34
α-Terpinene	4.13*	1014	[0.33]	2.96*	1139	[0.34]
para-Cymene	4.25	1022	0.64	4.10	1227	0.65
1,8-Cineole	4.33*	1027	6.56	3.29*	1164	2.32
β-Phellandrene	4.33*	1027	[6.56]	3.29*	1164	[2.32]
Limonene	4.33*	1027	[6.56]	3.20	1158	4.26
(*Z*)-β-Ocimene	4.54	1040	0.01	3.80*	1205	0.41
(*E*)-β-Ocimene	4.69	1050	0.01	3.98	1218	0.01
γ-Terpinene	4.80	1057	0.39	3.80*	1205	[0.41]
Unknown [m/z 79, 93 (60), 43 (40), 94 (35), 137 (33), 77 (26), 91 (20), 152 (18)]	4.99	1069	0.05	4.78	1278	0.05
Fenchone	5.20	1083	0.02	5.69	1339	0.02

Terpinolene	5.25*	1086	1.05	4.28	1240	0.78
para-Cymenene	5.25*	1086	[1.05]	6.31	1384	0.15
γ-Campholenal	5.25*	1086	[1.05]	4.99	1293	0.14
α-Thujone	5.50	1102	0.02	6.05	1365	0.01
Linalool	5.53	1103	0.07	8.06	1515	0.07
Nonanal	5.57	1106	0.01	5.86	1352	0.01
β-Thujone	5.61	1108	0.01	6.35	1387	0.01
endo-Fenchol	5.66	1112	0.07	8.36	1538	0.08
cis-para-Menth-2-en-1-ol	5.79	1120	0.01	8.13	1520	0.01
α-Campholenal	5.83	1123	0.05	6.99	1434	0.06
Nopinone	5.95	1130	0.01	8.29*	1532	26.22
trans-Pinocarveol	6.02	1135	0.09	9.15*†	1599	[0.37]
Camphor	6.06	1137	0.32	7.19	1449	0.31
Camphene hydrate	6.15	1143	0.07	8.45	1544	0.05
Pinocamphone	6.31*	1154	0.05	7.29	1456	0.02
Isoborneol	6.31*	1154	[0.05]	9.41	1620	0.01
Pinocarvone	6.36	1157	0.03	7.89	1501	0.03
Borneol	6.48	1164	1.20	9.76*	1648	1.98
α-Phellandren-8-ol	6.53*	1167	0.10	10.13	1679	0.07
Isopinocamphone	6.53*	1167	[0.10]	7.59	1479	0.04
Terpinen-4-ol	6.64	1175	0.46	8.55	1553	0.47
Cryptone	6.73	1180	0.02	9.15*†	1599	[0.37]
para-Cymen-8-ol	6.83	1187	0.02	11.49	1793	0.03
Myrtenal	6.88*	1190	0.81	8.65	1560	0.08
Methyl salicylate	6.88*	1190	[0.81]	10.47	1706	0.03
α-Terpineol	6.88*	1190	[0.81]	9.76*	1648	[1.98]
Myrtenol	6.96	1196	0.06	10.83	1737	0.04
Verbenone	7.09	1204	0.08	9.59*	1635	1.11
Citronellol	7.56	1235	0.06	10.71	1727	0.05
Carvotanacetone	7.64	1240	0.02	9.43*	1622	0.04
Piperitone	7.79	1251	1.49	9.87*	1657	1.56
Isobornyl acetate	8.34*	1287	26.13	8.29*	1532	[26.22]
Unknown [m/z 119, 43 (87), 91 (78), 92 (70), 134 (50)...]	8.34*	1287	[26.13]	8.86	1576	0.13
Unknown [m/z 107, 43 (76), 150 (42), 91 (28), 108 (23)]	8.46	1295	0.21	9.12†	1596	0.37
trans-Pinocarvyl acetate	8.49	1298	0.08	9.15*†	1599	[0.37]
Thymol	8.61	1305	0.07	15.08	2126	0.05
Myrtenyl acetate	8.86	1323	0.12	9.59*	1635	[1.11]
Pin-2-en-8-yl acetate	8.95	1330	0.79	9.59*	1635	[1.11]
Terpinyl acetate analog	9.02	1334	0.04	9.59*	1635	[1.11]
Citronellyl acetate	9.33	1356	0.04	9.43*	1622	[0.04]

Neryl acetate	9.40	1362	0.01	10.21	1684	0.01
Unknown [m/z 93, 121 (68), 43 (67), 67 (44), 136 (36), 107 (34)... 180 (4)]	9.46*	1366	0.04	10.11	1677	0.03
α-Ylangene	9.46*	1366	[0.04]	7.03	1437	0.01
α-Copaene	9.53	1370	0.03	7.13	1444	0.03
β-Bourbonene	9.64	1378	0.03	7.47	1469	0.02
trans-Myrtanyl acetate	9.67	1380	0.04	10.25	1688	0.03
Geranyl acetate	9.75	1386	0.04	10.54	1712	0.05
β-Elemene	9.78	1388	0.01	8.42*	1542	1.01
Longifolene	9.87	1395	0.03	7.97	1507	0.04
β-Caryophyllene	10.10	1412	0.96	8.42*	1542	[1.01]
β-Copaene	10.24	1422	0.03	8.42*	1542	[1.01]
trans-α-Bergamotene	10.38	1433	0.02	8.42*	1542	[1.01]
α-Humulene	10.56	1446	1.18	9.27	1609	1.19
trans-Cadina-1(6),4-diene	10.85	1468	0.03	9.23	1605	0.02
γ-Muurolene	10.90*	1471	0.12	9.59*	1635	[1.11]
α-Amorphene	10.90*	1471	[0.12]	9.59*	1635	[1.11]
Germacrene D	10.94	1474	0.05	9.76*	1648	[1.98]
β-Selinene	10.99	1478	0.06	9.87*	1657	[1.56]
α-Selinene	11.12	1488	0.08	9.92	1661	0.07
α-Muurolene	11.22	1496	0.06	10.01	1669	0.07
γ-Cadinene	11.38	1507	0.16	10.38	1699	0.12
(*Z*)-γ-Bisabolene	11.43	1512	0.02	9.96	1665	0.01
δ-Cadinene	11.52	1519	0.27	10.40	1700	0.29
trans-Cadina-1,4-diene	11.62	1526	0.01	10.64	1721	0.02
α-Cadinene	11.69	1532	0.01	10.76	1731	0.02
α-Calacorene	11.74	1536	0.01	12.08	1846	0.01
(*E*)-α-Bisabolene	11.81	1541	0.01	10.66	1723	0.02
(*E*)-Nerolidol	12.11	1565	0.06	13.76*	1998	0.06
Caryophyllene oxide	12.22	1574	0.02	12.74	1904	0.02
Salvial-4(14)-en-1-one	12.37	1585	0.01	13.02	1930	0.01
Humulene epoxide I	12.43	1590	0.01	13.16	1943	0.01
Humulene epoxide II	12.55	1599	0.02	13.33	1959	0.02
1-epi-Cubenol	12.82	1622	0.01	13.76*	1998	[0.06]
τ-Cadinol	12.99	1636	0.02	14.86	2104	0.01
τ-Muurolol	13.01	1637	0.01	15.02	2121	0.01
Unknown [m/z 257, 258 (20), 91 (19), 272 (18)]	17.05	1998	0.01	16.20	2240	0.01
ar-Abietatriene	17.46	2039	0.01	17.68	2399	0.01
Manool	17.50	2042	0.06	19.29	2582	0.06

7,13-Abietadiene	17.70	2062	0.02	17.31	2358	0.03
Total identified		**99.01%**			**98.60%**	
Total reported		**99.29%**			**99.18%**	

*: 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

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