Date : April 29, 2021

Certificate of Analysis – GC Profiling

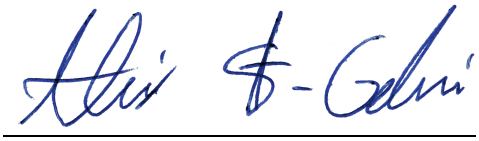
Sample identification

Internal code : 21D15-ZAA03
Customer identification : Pruche - EAB878226 - CA55521B
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 : Sarah-Eve Tremblay, M. Sc. A., Chimiste
Analysis date : April 29, 2021

Checked and approved by :



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

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Méthode certifiée ISO 17025:2017 Certified method

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PHYSICOCHEMICAL DATA

Physical aspect: Faintly yellow liquid
Refractive index: 1.4717 ± 0.0003 (20 °C; method PC-MAT-016)

CONCLUSION

No adulterant, contaminant or diluent has been detected using this method. The presence of significant amounts of diterpenes and the content of isobornyl acetate slightly below typical values (normally around 30%) could indicate that some bark or wood was distilled alongside the foliage.

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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	tr	Aliphatic aldehyde
2-Methylbutyral	tr	Aliphatic aldehyde
Toluene	0.03	Simple phenolic
Hexanal	tr	Aliphatic aldehyde
Furfural	tr	Furan
(3*Z*)-Hexenol	tr	Aliphatic alcohol
Hexanol	tr	Aliphatic alcohol
Santene	0.55	Normonoterpene
Unknown	tr	Normonoterpene
Bornylene	0.01	Monoterpene
Hashishene	tr	Monoterpene
Tricyclene	4.26	Monoterpene
α-Thujene	0.17	Monoterpene
α-Pinene	25.06	Monoterpene
Camphene	11.27	Monoterpene
α-Fenchene	0.08	Monoterpene
Thuja-2,4(10)-diene	0.07	Monoterpene
Benzaldehyde	tr	Simple phenolic
β-Pinene	8.56	Monoterpene
Sabinene	0.04	Monoterpene
Dehydro-1,8-cineole	0.01	Monoterpenic ether
6-Methyl-5-hepten-2-one	tr	Aliphatic ketone
Myrcene	2.37	Monoterpene
Pseudolimonene	tr	Monoterpene
α-Phellandrene	1.28	Monoterpene
Menthatriene isomer I	0.02	Monoterpene
Δ3-Carene	1.87	Monoterpene
(3*Z*)-Hexenyl acetate	0.01	Aliphatic ester
1,4-Cineole	0.29	Monoterpenic ether
α-Terpinene	0.01	Monoterpene
para-Cymene	1.52	Monoterpene
β-Phellandrene	2.60*	Monoterpene
1,8-Cineole	[2.60]*	Monoterpenic ether
Limonene	5.35	Monoterpene
(*Z*)-β-Ocimene	0.01	Monoterpene
(*E*)-β-Ocimene	tr	Monoterpene
γ-Terpinene	0.36	Monoterpene
Unknown	0.02	Oxygenated monoterpene
Fenchone	0.04	Monoterpenic ketone
γ-Campholenal	0.06	Aliphatic alcohol
Terpinolene	0.75	Monoterpene
para-Cymenene	0.12	Monoterpene
Linalool	0.06	Monoterpenic alcohol
Perillene	0.01	Monoterpenic ether
Nonanal	0.02	Aliphatic aldehyde

endo-Fenchol	0.08	Monoterpenic alcohol
β-Thujone	0.01	Monoterpenic ketone
cis-para-Menth-2-en-1-ol	0.01	Monoterpenic alcohol
α-Campholenal	0.05	Monoterpenic aldehyde
Nopinone	tr	Normonoterpenic ketone
trans-Pinocarveol	0.08	Monoterpenic alcohol
Camphor	0.21	Monoterpenic ketone
Camphene hydrate	0.06	Monoterpenic alcohol
Isoborneol	0.03	Monoterpenic alcohol
Pinocamphone	0.02	Monoterpenic ketone
Pinocarvone	0.02	Monoterpenic ketone
Borneol	0.55	Monoterpenic alcohol
α-Phellandren-8-ol	0.04	Monoterpenic alcohol
Isopinocamphone	0.06	Monoterpenic ketone
Terpinen-4-ol	0.31	Monoterpenic alcohol
Cryptone	0.03	Normonoterpenic ketone
para-Cymen-8-ol	0.02	Monoterpenic alcohol
α-Terpineol	0.61	Monoterpenic alcohol
Myrtenal	0.01	Monoterpenic aldehyde
Methyl salicylate	0.05	Phenolic ester
Myrtenol	0.02	Monoterpenic alcohol
Verbenone	0.05	Monoterpenic ketone
Citronellol	0.04	Monoterpenic alcohol
Carvotanacetone	0.01	Monoterpenic ketone
Piperitone	0.77	Monoterpenic ketone
Isobornyl acetate	21.09	Monoterpenic ester
Unknown	0.09	Unknown
Unknown	0.13	Monoterpenic ester
trans-Pinocarvyl acetate	0.06	Monoterpenic ester
Thymol	0.03	Monoterpenic alcohol
Myrtenyl acetate	0.09	Monoterpenic ester
Pin-2-en-8-yl acetate	0.68	Monoterpenic ester
Terpinyl acetate analog	0.03	Monoterpenic ester
Citronellyl acetate	0.04	Monoterpenic ester
Unknown	0.01	Oxygenated monoterpene
Neryl acetate	0.01	Monoterpenic ester
α-Ylangene	0.01	Sesquiterpene
α-Copaene	0.04	Sesquiterpene
β-Bourbonene	0.05	Sesquiterpene
trans-Myrtanyl acetate	0.09	Monoterpenic ester
Geranyl acetate	0.04	Monoterpenic ester
β-Elemene	0.03	Sesquiterpene
Longifolene	0.11	Sesquiterpene
β-Caryophyllene	1.04	Sesquiterpene
β-Copaene	0.02	Sesquiterpene
trans-α-Bergamotene	0.07	Sesquiterpene
α-Humulene	1.29	Sesquiterpene
trans-Cadina-1(6),4-diene	0.02	Sesquiterpene
γ-Muurolene	0.13	Sesquiterpene
Germacrene D	0.05	Sesquiterpene
α-Amorphene	0.01	Sesquiterpene
β-Selinene	0.07	Sesquiterpene

α-Selinene	0.10	Sesquiterpene
α-Muurolene	0.07	Sesquiterpene
γ-Cadinene	0.15	Sesquiterpene
(*Z*)-γ-Bisabolene	0.14	Sesquiterpene
δ-Cadinene	0.30	Sesquiterpene
trans-Cadina-1,4-diene	0.03	Sesquiterpene
α-Cadinene	0.02	Sesquiterpene
α-Calacorene	0.02	Sesquiterpene
(*E*)-α-Bisabolene	0.10	Sesquiterpene
(*E*)-Nerolidol	0.11	Sesquiterpenic alcohol
Caryophyllene oxide	0.03	Sesquiterpenic ether
Caryophyllene oxide isomer	0.01	Sesquiterpenic ether
Salvial-4(14)-en-1-one	0.04	Aliphatic alcohol
Humulene epoxide I	0.04	Sesquiterpenic ether
Humulene epoxide II	0.04	Sesquiterpenic ether
10-epi-Cubenol	0.01	Sesquiterpenic alcohol
1-epi-Cubenol	0.01	Sesquiterpenic alcohol
τ-Cadinol	0.02	Sesquiterpenic alcohol
τ-Muurolol	0.01	Sesquiterpenic alcohol
Unknown	0.02	Sesquiterpenic alcohol
Palustradiene?	0.09	Diterpene
ar-Abietatriene?	0.27	Diterpene
Manool	0.15	Diterpenic alcohol
7,13-Abietadiene	0.69	Diterpene
Consolidated total	**97.85%**	

*: 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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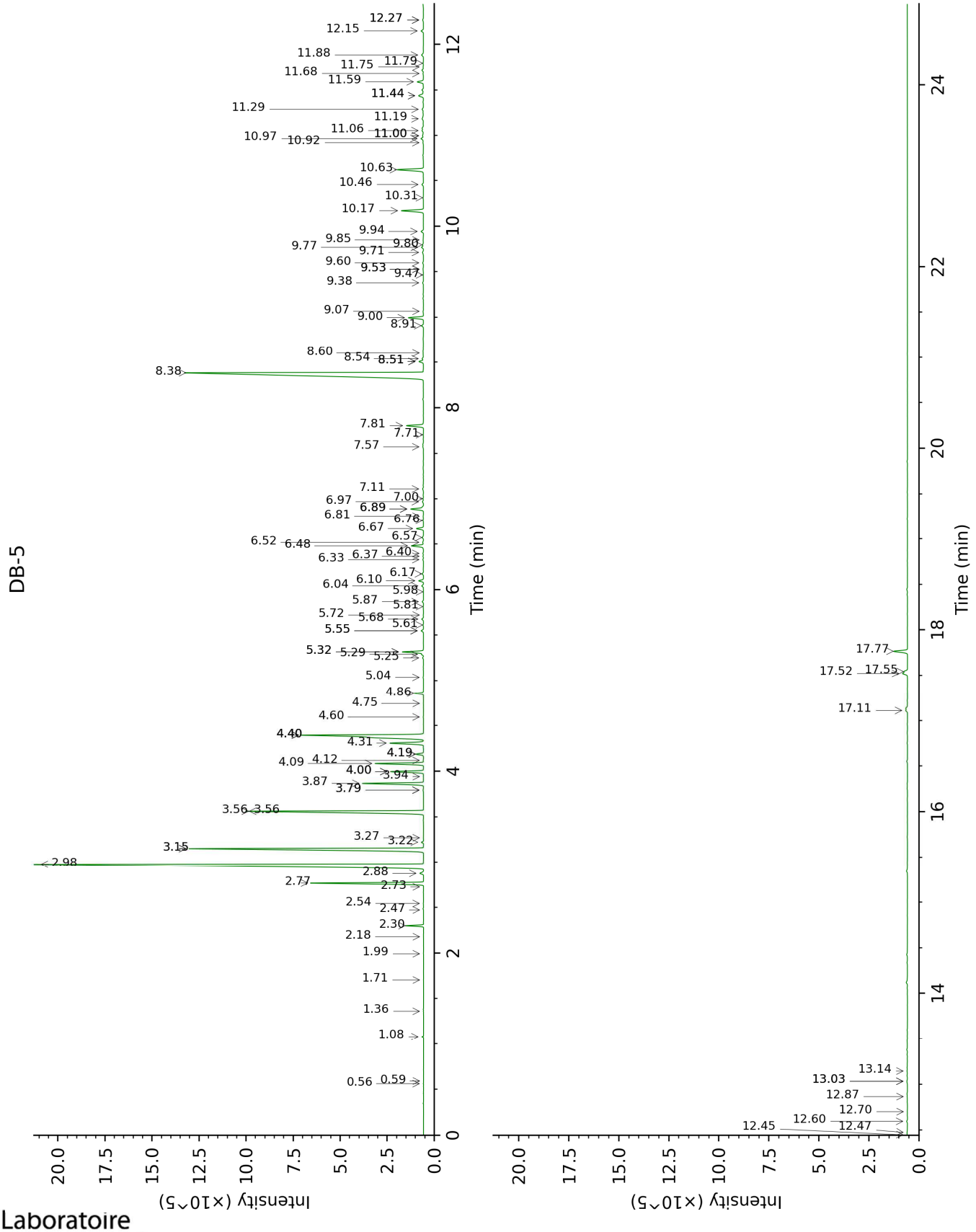

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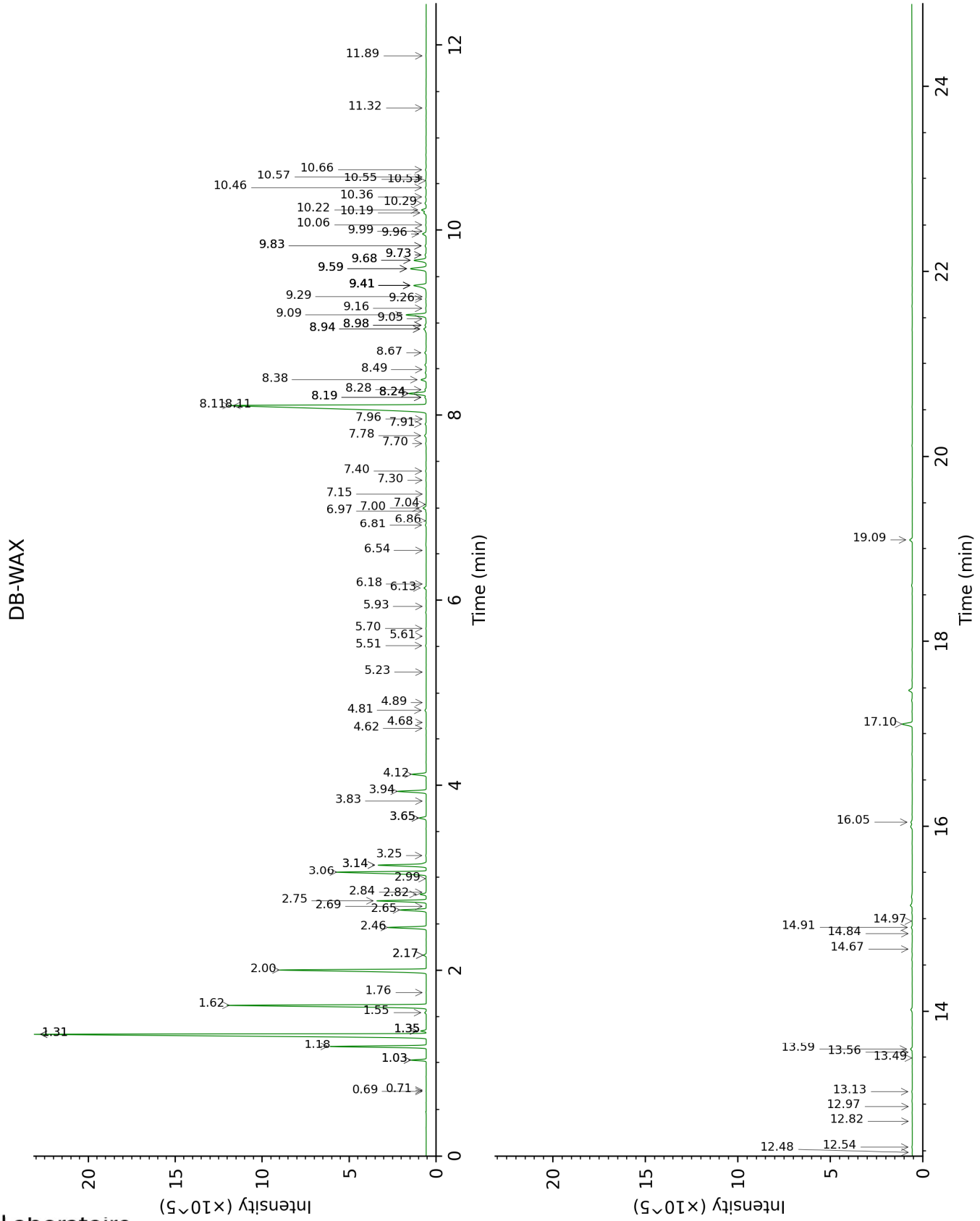
DB-WAX
Time (min)
Intensity (×10^5)
11.89
11.32
10.66
10.57
10.55
10.53
10.46
10.36
10.29
10.22
10.19
10.06
9.99
9.96
9.83
9.73
9.68
9.59
9.41
9.29
9.26
9.16
9.09
9.05
8.94
8.98
8.67
8.49
8.38
8.28
8.24
8.19
8.11
8.11
7.96
7.91
7.78
7.70
7.40
7.30
7.15
6.97
7.00
7.04
6.81
6.86
6.54
6.18
6.13
5.93
5.70
5.61
5.51
5.23
4.89
4.81
4.68
4.62
4.12
3.94
3.83
3.65
3.25
3.14
3.06
2.99
2.84
2.82
2.75
2.69
2.65
2.46
2.17
2.00
1.76
1.62
1.55
1.35
1.31
1.18
1.03
0.71
0.69
19.09
17.10
16.05
14.97
14.91
14.84
14.67
13.59
13.56
13.49
13.13
12.97
12.82
12.54
12.48

FULL ANALYSIS DATA

Identification	Column DB-5			Column DB-WAX		
	R.T	R.I	%	R.T	R.I	%
Isovaleral	0.56	639	tr	0.71	887	tr
2-Methylbutyral	0.59	651	tr	0.69	882	tr
Toluene	1.08	758	0.03	1.35*	1002	0.23
Hexanal	1.36	801	tr	1.76	1043	0.01
Furfural	1.70	832	tr	6.54	1415	tr
(3*Z*)-Hexenol	1.99	857	tr	5.61	1348	0.01
Hexanol	2.18	874	tr	5.23	1320	tr
Santene	2.30	884	0.55	1.03*	949	0.56
Unknown [m/z 79, 93 (66), 94 (52), 91 (39), 77 (37), 122 (31)]	2.47	899	tr	1.35*	1002	[0.23]
Bornylene	2.54	905	0.01	1.03*	949	[0.56]
Hashishene	2.73	917	tr	1.31*	997	25.20
Tricyclene	2.77	920	4.26	1.18	973	4.28
α-Thujene	2.88	927	0.17	1.35*	1002	[0.23]
α-Pinene	2.98	934	25.06	1.31*	997	[25.20]
Camphene	3.15*	946	11.31	1.62	1030	11.27
α-Fenchene	3.15*	946	[11.31]	1.55	1022	0.08
Thuja-2,4(10)-diene	3.22	951	0.07	2.16*	1084	0.14
Benzaldehyde	3.27	954	tr	7.15	1461	tr
β-Pinene	3.56*	974	8.60	2.00	1068	8.56
Sabinene	3.56*	974	[8.60]	2.16*	1084	[0.14]
Dehydro-1,8-cineole	3.79*	990	0.03	2.99	1153	0.01
6-Methyl-5-hepten-2-one	3.79*	990	[0.03]	4.89	1298	tr
Myrcene	3.87	995	2.37	2.75	1134	2.38
Pseudolimonene	3.94	1000	tr	2.69	1129	0.01
α-Phellandrene	4.00*	1003	1.31	2.65	1126	1.28
Menthatriene isomer I	4.00*	1003	[1.31]	3.24	1174	0.02
Δ3-Carene	4.09	1009	1.87	2.46	1111	1.88
(3*Z*)-Hexenyl acetate	4.12	1011	0.01	4.68	1282	0.01
1,4-Cineole	4.19*	1016	0.30	2.82	1140	0.29
α-Terpinene	4.19*	1016	[0.30]	2.84	1142	0.01
para-Cymene	4.31	1023	1.52	3.94	1227	1.52
β-Phellandrene	4.40*	1029	7.95	3.14*	1166	2.62
1,8-Cineole	4.40*	1029	[7.95]	3.14*	1166	[2.62]
Limonene	4.40*	1029	[7.95]	3.06	1159	5.35
(*Z*)-β-Ocimene	4.60	1041	0.01	3.65*	1206	0.37
(*E*)-β-Ocimene	4.75	1051	tr	3.83	1219	0.01
γ-Terpinene	4.86	1058	0.36	3.65*	1206	[0.37]
Unknown [m/z 79, 93 (60), 43 (40), 94 (35), 137	5.04	1069	0.02	4.62	1278	0.02

(33), 77 (26), 91 (20), 152 (18)]						
Fenchone	5.25	1083	0.04	5.51	1340	0.04
γ-Campholenal	5.29	1085	0.06	4.81	1292	0.08
Terpinolene	5.32*	1087	0.89	4.12	1241	0.75
para-Cymenene	5.32*	1087	[0.89]	6.13	1386	0.12
Linalool	5.55*	1102	0.10	7.91	1518	0.06
Perillene	5.55*	1102	[0.10]	5.94	1371	0.01
Nonanal	5.61	1106	0.02	5.70	1354	0.02
endo-Fenchol	5.68	1110	0.08	8.19*	1541	0.08
β-Thujone	5.72	1113	0.01	6.18	1389	tr
cis-para-Menth-2-en-1-ol	5.81	1119	0.01	7.96	1523	0.01
α-Campholenal	5.87	1122	0.05	6.81	1436	0.05
Nopinone	5.98	1129	tr	8.11*	1534	21.03
trans-Pinocarveol	6.04	1133	0.08	8.98*	1602	0.08
Camphor	6.10	1137	0.21	7.00	1450	0.20
Camphene hydrate	6.17	1142	0.06	8.28	1547	0.07
Isoborneol	6.33	1152	0.03	9.16	1617	0.04
Pinocamphone	6.37	1154	0.02	7.04	1453	0.02
Pinocarvone	6.40	1156	0.02	7.70	1502	0.04
Borneol	6.48	1162	0.55	9.59*	1652	1.15
α-Phellandren-8-ol	6.52	1164	0.04	9.96	1683	0.24
Isopinocamphone	6.57	1167	0.06	7.40	1480	0.04
Terpinen-4-ol	6.67	1174	0.31	8.38	1556	0.30
Cryptone	6.76	1180	0.03	8.98*	1602	[0.08]
para-Cymen-8-ol	6.81	1183	0.02	11.32	1798	0.02
α-Terpineol	6.89*	1188	0.62	9.59*	1652	[1.15]
Myrtenal	6.89*	1188	[0.62]	8.49	1564	0.01
Methyl salicylate	6.97	1193	0.05	10.29	1710	0.08
Myrtenol	7.00	1195	0.02	10.66	1742	0.05
Verbenone	7.11	1202	0.05	9.41*	1637	0.99
Citronellol	7.57	1233	0.04	10.55	1732	0.03
Carvotanacetone	7.71	1242	0.01	9.28	1627	0.01
Piperitone	7.81	1249	0.77	9.68*†	1659	0.92
Isobornyl acetate	8.38	1288	21.09	8.11*	1534	[21.03]
Unknown [m/z 119, 43 (87), 91 (78), 92 (70), 134 (50)...]	8.51*	1296	0.21	8.67	1578	0.09
Unknown [m/z 107, 43 (76), 150 (42), 91 (28), 108 (23)]	8.51*	1296	[0.21]	8.94*	1599	0.20
trans-Pinocarvyl acetate	8.54	1298	0.06	8.94*	1599	[0.20]
Thymol	8.60	1302	0.03	14.91	2134	0.06
Myrtenyl acetate	8.91	1324	0.09	9.41*	1637	[0.99]
Pin-2-en-8-yl acetate	9.00	1330	0.68	9.41*	1637	[0.99]

Terpinyl acetate analog	9.07	1335	0.03	9.41*	1637	[0.99]
Citronellyl acetate	9.38	1357	0.04	9.26	1625	0.03
Unknown [m/z 93, 121 (68), 43 (67), 67 (44), 136 (36), 107 (34)... 180 (4)]	9.47	1363	0.01	9.83*	1672	0.07
Neryl acetate	9.53*	1368	0.03	9.99	1685	0.01
α-Ylangene	9.53*	1368	[0.03]	6.86	1440	0.01
α-Copaene	9.60	1372	0.04	6.97	1448	0.02
β-Bourbonene	9.71	1381	0.05	7.30	1472	0.02
trans-Myrtanyl acetate	9.77	1384	0.09	10.06	1691	0.04
Geranyl acetate	9.80	1386	0.04	10.36	1716	0.04
β-Elemene	9.85	1390	0.03	8.24*	1544	1.10
Longifolene	9.94	1397	0.11	7.78	1509	0.11
β-Caryophyllene	10.17	1413	1.04	8.24*	1544	[1.10]
β-Copaene	10.31	1424	0.02	8.19*	1541	[0.08]
trans-α-Bergamotene	10.46	1435	0.07	8.24*	1544	[1.10]
α-Humulene	10.63	1448	1.29	9.09	1611	1.31
trans-Cadina-1(6),4-diene	10.92	1470	0.02	9.05	1608	0.02
γ-Muurolene	10.97	1473	0.13	9.41*	1637	[0.99]
Germacrene D	11.00*	1475	0.06	9.59*	1652	[1.15]
α-Amorphene	11.00*	1475	[0.06]	9.41*	1637	[0.99]
β-Selinene	11.06	1480	0.07	9.68*†	1659	[0.92]
α-Selinene	11.18	1489	0.10	9.73*†	1664	[0.92]
α-Muurolene	11.29	1497	0.07	9.83*	1672	[0.07]
γ-Cadinene	11.44*	1508	0.29	10.19	1701	0.15
(*Z*)-γ-Bisabolene	11.44*	1508	[0.29]	9.73*†	1664	[0.92]
δ-Cadinene	11.59	1520	0.30	10.22	1704	0.28
trans-Cadina-1,4-diene	11.68	1528	0.03	10.46	1724	0.04
α-Cadinene	11.75	1533	0.02	10.57	1734	0.01
α-Calacorene	11.79	1536	0.02	11.89	1848	0.03
(*E*)-α-Bisabolene	11.88	1543	0.10	10.53	1731	0.01
(*E*)-Nerolidol	12.15	1564	0.11	13.59	2005	0.10
Caryophyllene oxide	12.27*	1574	0.04	12.54	1907	0.03
Caryophyllene oxide isomer	12.27*	1574	[0.04]	12.48	1902	0.01
Salvial-4(14)-en-1-one	12.45	1588	0.04	12.82	1933	0.01
Humulene epoxide I	12.47	1590	0.04	12.98	1947	0.01
Humulene epoxide II	12.60	1600	0.04	13.13	1962	0.03
10-epi-Cubenol	12.70	1608	0.01	13.49	1996	tr
1-epi-Cubenol	12.87	1622	0.01	13.56	2001	0.01
τ-Cadinol	13.03*	1635	0.04	14.67	2110	0.02

τ-Muurolol	13.03*	1635	[0.04]	14.84	2127	0.01
Unknown cadinol analog II [m/z 95, 121 (73), 43 (57), 79 (43), 161 (43), 109)40)... 204 (35), 222 (2)]	13.14	1645	0.02	14.98	2140	0.01
Palustradiene?	17.11	1999	0.09	16.05	2250	0.10
ar-Abietatriene?	17.52	2040	0.27			
Manool	17.54	2042	0.15	19.10	2588	0.17
7,13-Abietadiene	17.77	2064	0.69	17.10	2363	0.68
Total identified		**97.85%**			**97.41%**	
Total reported		**97.90%**			**97.53%**	

*: 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