Date : August 08, 2022

Certificate of Analysis – GC Profiling

Sample identification

Internal code : 22G26-ZAA02
Customer identification : Hemlock spruce - EAB878226CA93222B
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 : August 02, 2022

Checked and approved by :

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

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PHYSICOCHEMICAL DATA

Physical aspect: Faintly yellow liquid
Refractive index: 1.4692 ± 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
Toluene	0.03	Simple phenolic
Hexanal	0.01	Aliphatic aldehyde
(2*E*)-Hexenal	0.01	Aliphatic aldehyde
(3*Z*)-Hexenol	0.07	Aliphatic alcohol
Hexanol	0.03	Aliphatic alcohol
Santene	0.40	Normonoterpene
Unknown	0.01	Normonoterpene
Hashishene	0.01	Monoterpene
Tricyclene	6.26	Monoterpene
α-Thujene	0.22	Monoterpene
α-Pinene	21.80	Monoterpene
Camphene	15.47	Monoterpene
α-Fenchene	0.04	Monoterpene
Benzaldehyde	0.01	Simple phenolic
β-Pinene	2.55	Monoterpene
Sabinene	0.14	Monoterpene
Dehydro-1,8-cineole	0.03	Monoterpenic ether
Myrcene	2.55	Monoterpene
α-Phellandrene	1.14	Monoterpene
Δ3-Carene	0.09	Monoterpene
(3*Z*)-Hexenyl acetate	0.01	Aliphatic ester
α-Terpinene	0.29	Monoterpene
1,4-Cineole	0.02	Monoterpenic ether
para-Cymene	0.65	Monoterpene
β-Phellandrene	1.89	Monoterpene
1,8-Cineole	0.21	Monoterpenic ether
Limonene	3.76	Monoterpene
(*Z*)-β-Ocimene	0.01	Monoterpene
γ-Terpinene	0.38	Monoterpene
Unknown	0.04	Oxygenated monoterpene
Fenchone	0.01	Monoterpenic ketone
γ-Campholenal	0.12	Aliphatic alcohol
para-Cymenene	0.14	Monoterpene
Terpinolene	0.64	Monoterpene
Linalool	0.08	Monoterpenic alcohol
α-Thujone	0.01	Monoterpenic ketone
Nonanal	0.01	Aliphatic aldehyde
endo-Fenchol	0.04	Monoterpenic alcohol
cis-para-Menth-2-en-1-ol	0.01	Monoterpenic alcohol
α-Campholenal	0.06	Monoterpenic aldehyde
Nopinone	0.01	Normonoterpenic ketone
1-Terpineol	0.01	Monoterpenic alcohol
trans-Pinocarveol	0.10	Monoterpenic alcohol
Camphor	0.28	Monoterpenic ketone
Camphene hydrate	0.07	Monoterpenic alcohol

Isoborneol	0.03	Monoterpenic alcohol
Pinocamphone	0.02	Monoterpenic ketone
Pinocarvone	0.03	Monoterpenic ketone
Borneol	0.87	Monoterpenic alcohol
α-Phellandren-8-ol	0.06	Monoterpenic alcohol
Isopinocamphone	0.05	Monoterpenic ketone
Terpinen-4-ol	0.46	Monoterpenic alcohol
Cryptone	0.03	Normonoterpenic ketone
para-Cymen-8-ol	0.03	Monoterpenic alcohol
α-Terpineol	0.49	Monoterpenic alcohol
Myrtenal	0.07	Monoterpenic aldehyde
Methyl salicylate	0.04	Phenolic ester
Myrtenol	0.06	Monoterpenic alcohol
Verbenone	0.09	Monoterpenic ketone
Citronellol	0.05	Monoterpenic alcohol
Carvotanacetone	0.01	Monoterpenic ketone
Piperitone	1.58	Monoterpenic ketone
Isobornyl acetate	30.04	Monoterpenic ester
Unknown	0.13	Unknown
Unknown	0.21	Monoterpenic ester
trans-Pinocarvyl acetate	0.07	Monoterpenic ester
Thymol	0.05	Monoterpenic alcohol
Myrtenyl acetate	0.11	Monoterpenic ester
Terpinyl acetate analog	0.02	Monoterpenic ester
Pin-2-en-8-yl acetate	1.06	Monoterpenic ester
Citronellyl acetate	0.05	Monoterpenic ester
Unknown	0.03	Oxygenated monoterpene
α-Ylangene	0.01	Sesquiterpene
α-Copaene	0.04	Sesquiterpene
β-Bourbonene	0.04	Sesquiterpene
trans-Myrtanyl acetate	0.04	Monoterpenic ester
Geranyl acetate	0.05	Monoterpenic ester
β-Elemene	0.01	Sesquiterpene
β-Caryophyllene	1.10	Sesquiterpene
trans-α-Bergamotene	0.02	Sesquiterpene
α-Humulene	1.33	Sesquiterpene
trans-Cadina-1(6),4-diene	0.03	Sesquiterpene
α-Amorphene	0.13	Sesquiterpene
Germacrene D	0.04	Sesquiterpene
β-Selinene	0.07	Sesquiterpene
α-Selinene	0.08	Sesquiterpene
α-Muurolene	0.07	Sesquiterpene
γ-Cadinene	0.15	Sesquiterpene
(*Z*)-γ-Bisabolene	0.02	Sesquiterpene
δ-Cadinene	0.27	Sesquiterpene
Zonarene	0.01	Sesquiterpene
trans-Cadina-1,4-diene	0.02	Sesquiterpene
α-Cadinene	0.02	Sesquiterpene
α-Calacorene	0.01	Sesquiterpene
(*E*)-Nerolidol	0.04	Sesquiterpenic alcohol
Caryophyllene oxide	0.03	Sesquiterpenic ether
Humulene epoxide I	0.02	Sesquiterpenic ether

Humulene epoxide II	0.02	Sesquiterpenic ether
10-epi-Cubenol	0.01	Sesquiterpenic alcohol
τ-Muurolol	0.01	Sesquiterpenic alcohol
τ-Cadinol	0.01	Sesquiterpenic alcohol
Manool	0.06	Diterpenic alcohol
7,13-Abietadiene	0.01	Diterpene
Consolidated total	**99.25%**	

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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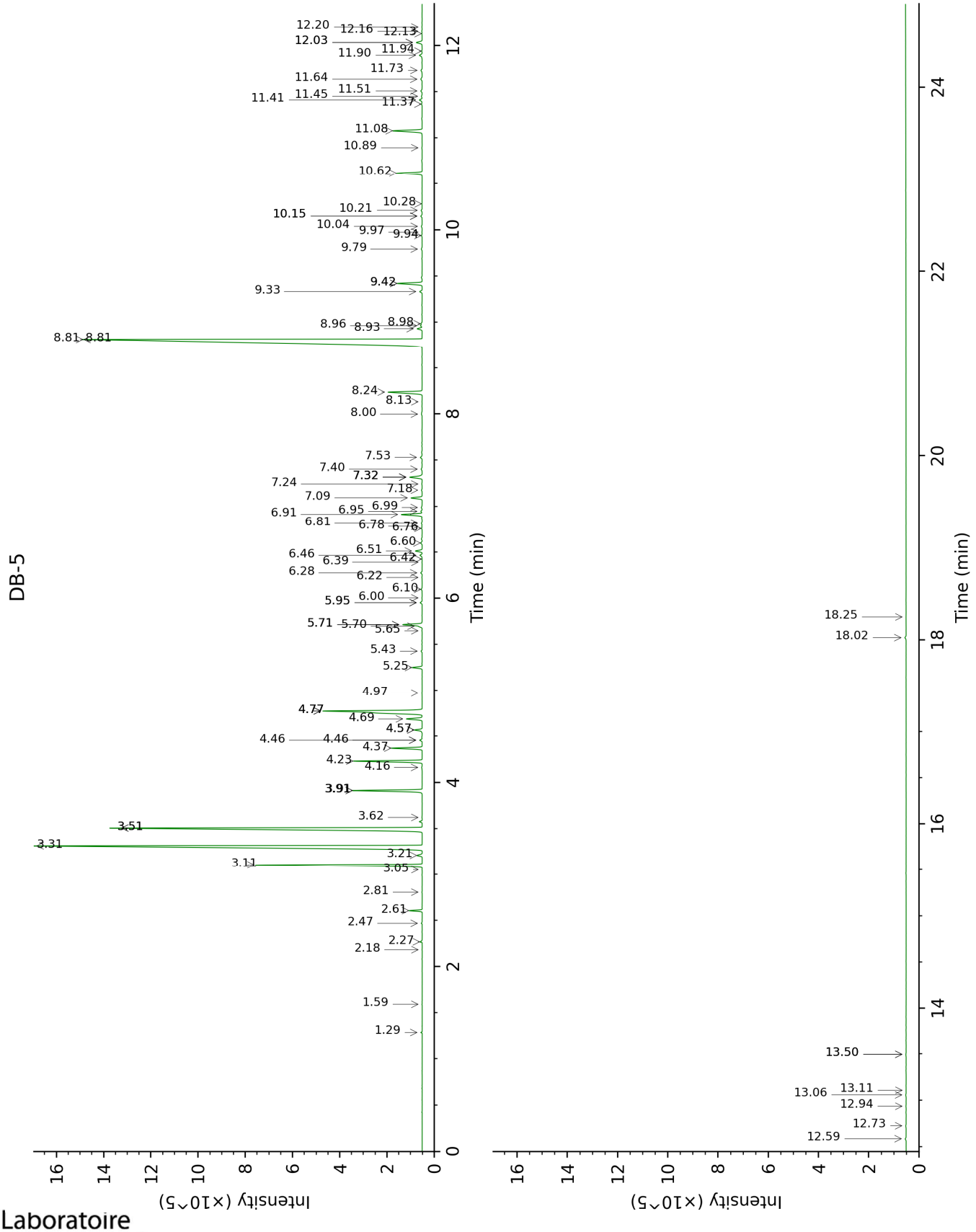
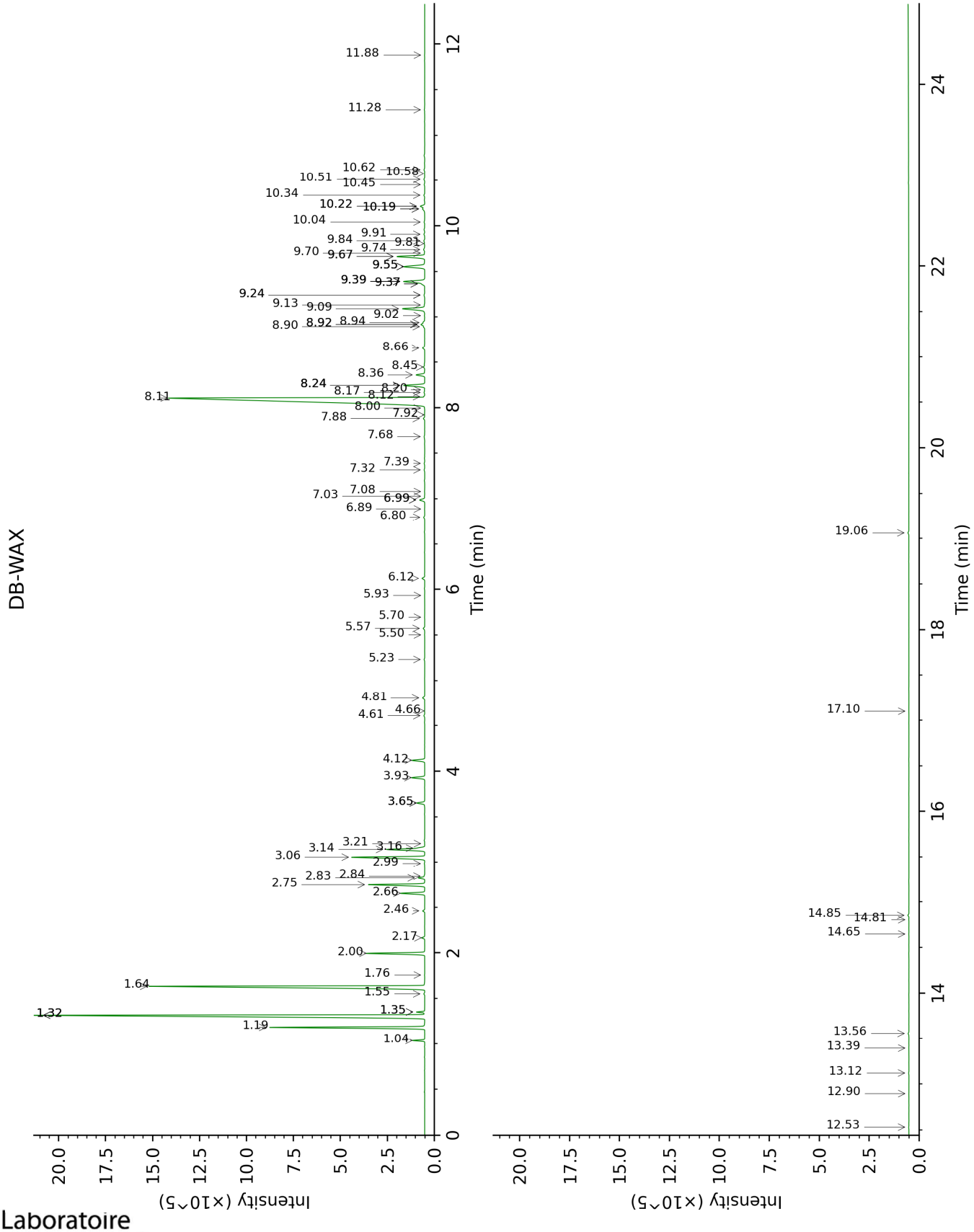

DB-5
Time (min)
Intensity (×10^5)
12.20
12.16
12.13
12.03
11.90
11.94
11.73
11.64
11.41
11.45
11.51
11.37
11.08
10.89
10.62
10.15
10.21
10.28
10.04
9.97
9.94
9.79
9.42
9.33
8.96
8.93
8.98
8.81
8.81
8.24
8.13
8.00
7.53
7.40
7.32
7.24
7.18
7.09
6.91
6.95
6.99
6.81
6.78
6.76
6.60
6.46
6.51
6.42
6.39
6.28
6.22
6.10
5.95
6.00
5.71
5.70
5.65
5.43
5.25
4.97
4.77
4.69
4.57
4.46
4.46
4.37
4.23
4.16
3.91
3.62
3.51
3.31
3.21
3.11
3.05
2.81
2.61
2.47
2.27
2.18
1.59
1.29
18.25
18.02
13.50
13.06
13.11
12.94
12.73
12.59


DB-WAX
Time (min)
Intensity (×10^5)
11.88
11.28
10.62
10.58
10.51
10.45
10.34
10.22
10.19
10.04
9.91
9.84
9.81
9.74
9.70
9.67
9.55
9.39
9.37
9.24
9.13
9.09
9.02
8.90
8.92
8.94
8.66
8.45
8.36
8.24
8.17
8.20
8.12
8.11
8.00
7.92
7.88
7.68
7.39
7.32
7.08
7.03
6.99
6.89
6.80
6.12
5.93
5.70
5.57
5.50
5.23
4.81
4.66
4.61
4.12
3.93
3.65
3.21
3.16
3.14
3.06
2.99
2.84
2.83
2.75
2.66
2.46
2.17
2.00
1.76
1.64
1.55
1.35
1.32
1.19
1.04
19.06
17.10
14.85
14.81
14.65
13.56
13.39
13.12
12.90
12.53

FULL ANALYSIS DATA

Identification	Column DB-5			Column DB-WAX		
	R.T	R.I	%	R.T	R.I	%
Toluene	1.29	762	0.03	1.35*	1003	0.27
Hexanal	1.59	802	0.01	1.76	1044	0.01
(2*E*)-Hexenal	2.18	851	0.01	3.21	1171	0.01
(3*Z*)-Hexenol	2.27	858	0.07	5.57	1344	0.09
Hexanol	2.47	874	0.03	5.23	1319	0.04
Santene	2.61	885	0.40	1.04	950	0.40
Unknown [m/z 79, 93 (66), 94 (52), 91 (39), 77 (37), 122 (31)]	2.81	901	0.01	1.32*	997	21.76
Hashishene	3.05	918	0.01	1.32*	997	[21.76]
Tricyclene	3.11	921	6.26	1.18	975	6.23
α-Thujene	3.21	928	0.22	1.35*	1003	[0.27]
α-Pinene	3.31	935	21.80	1.32*	997	[21.76]
Camphene	3.51*	947	15.53	1.64	1032	15.47
α-Fenchene	3.51*	947	[15.53]	1.55	1023	0.04
Benzaldehyde	3.62	955	0.01	7.08	1456	0.01
β-Pinene	3.91*	974	2.59	2.00	1068	2.55
Sabinene	3.91*	974	[2.59]	2.17	1085	0.14
Dehydro-1,8-cineole	4.16	990	0.03	2.99	1154	0.02
Myrcene	4.23	995	2.55	2.75	1135	2.54
α-Phellandrene	4.37	1004	1.14	2.66	1127	1.12
Δ3-Carene	4.46*	1009	0.10	2.46	1112	0.09
(3*Z*)-Hexenyl acetate	4.46*	1009	[0.10]	4.66	1281	0.01
α-Terpinene	4.57*	1016	0.31	2.82	1141	0.29
1,4-Cineole	4.57*	1016	[0.31]	2.84	1142	0.02
para-Cymene	4.69	1024	0.65	3.93	1227	0.65
β-Phellandrene	4.77*	1029	5.85	3.14	1166	1.89
1,8-Cineole	4.77*	1029	[5.85]	3.16	1167	0.21
Limonene	4.77*	1029	[5.85]	3.06	1159	3.76
(*Z*)-β-Ocimene	4.97	1041	0.01	3.65*	1206	0.41
γ-Terpinene	5.25	1059	0.38	3.65*	1206	[0.41]
Unknown [m/z 79, 93 (60), 43 (40), 94 (35), 137 (33), 77 (26), 91 (20), 152 (18)]	5.43	1070	0.04	4.61	1278	0.05
Fenchone	5.65	1083	0.01	5.50	1338	0.01
γ-Campholenal	5.70†	1086	0.90	4.81	1292	0.12
para-Cymenene	5.72*†	1088	[0.90]	6.12	1384	0.14
Terpinolene	5.72*†	1088	[0.90]	4.12	1241	0.64
Linalool	5.95*	1102	0.09	7.88	1517	0.08
α-Thujone	5.95*	1102	[0.09]	5.94	1370	0.01
Nonanal	6.00	1106	0.01	5.70	1353	0.01
endo-Fenchol	6.10	1112	0.04	8.17	1540	0.04

cis-para-Menth-2-en-1-ol	6.22	1120	0.01	7.92	1520	0.01
α-Campholenal	6.28	1123	0.06	6.80	1434	0.06
Nopinone	6.39	1130	0.01	8.00	1526	0.01
1-Terpineol	6.42	1132	0.01	8.12	1536	0.02
trans-Pinocarveol	6.46	1135	0.10	8.94	1601	0.07
Camphor	6.51	1138	0.28	6.99*	1449	0.30
Camphene hydrate	6.60	1143	0.07	8.24*	1546	1.18
Isoborneol	6.76	1154	0.03	9.13	1616	0.02
Pinocamphone	6.78	1155	0.02	7.03	1452	0.01
Pinocarvone	6.81	1157	0.03	7.68	1502	0.04
Borneol	6.91	1164	0.87	9.56*	1651	1.40
α-Phellandren-8-ol	6.95	1166	0.06	9.91	1680	0.05
Isopinocamphone	6.99	1168	0.05	7.39	1479	0.03
Terpinen-4-ol	7.09	1175	0.46	8.36	1555	0.46
Cryptone	7.18	1180	0.03	8.90	1597	0.05
para-Cymen-8-ol	7.24	1184	0.03	11.28	1797	0.02
α-Terpineol	7.32*	1189	0.61	9.56*	1651	[1.40]
Myrtenal	7.32*	1189	[0.61]	8.45	1562	0.07
Methyl salicylate	7.32*	1189	[0.61]	10.22*	1706	0.27
Myrtenol	7.40	1195	0.06	10.62	1740	0.05
Verbenone	7.53	1203	0.09	9.37*	1635	0.11
Citronellol	8.00	1234	0.05	10.51	1731	0.05
Carvotanacetone	8.13	1243	0.01	9.24*	1625	0.05
Piperitone	8.24	1250	1.58	9.67*	1660	1.64
Isobornyl acetate	8.81*	1288	30.17	8.11	1535	30.04
Unknown [m/z 119, 43 (87), 91 (78), 92 (70), 134 (50)...]	8.81*	1288	[30.17]	8.66	1578	0.13
Unknown [m/z 107, 43 (76), 150 (42), 91 (28), 108 (23)]	8.93	1296	0.21	8.92*	1599	0.26
trans-Pinocarvyl acetate	8.96	1298	0.07	8.92*	1599	[0.26]
Thymol	8.98	1300	0.05	14.85	2132	0.06
Myrtenyl acetate	9.33	1324	0.11	9.39*	1638	1.30
Terpinyl acetate analog	9.42*	1330	1.05	9.37*	1635	[0.11]
Pin-2-en-8-yl acetate	9.42*	1330	[1.05]	9.39*	1638	[1.30]
Citronellyl acetate	9.79	1356	0.05	9.24*	1625	[0.05]
Unknown [m/z 93, 121 (68), 43 (67), 67 (44), 136 (36), 107 (34)... 180 (4)]	9.94	1367	0.03	9.81	1672	0.03
α-Ylangene	9.98	1369	0.01	6.89	1441	0.01
α-Copaene	10.04	1374	0.04	6.99*	1449	[0.30]

β-Bourbonene	10.15*	1382	0.06	7.32	1474	0.04
trans-Myrtanyl acetate	10.15*	1382	[0.06]	10.04	1691	0.04
Geranyl acetate	10.21	1386	0.05	10.34	1716	0.05
β-Elemene	10.28	1391	0.01	8.20	1542	0.02
β-Caryophyllene	10.62	1415	1.10	8.24*	1546	[1.18]
trans-α-Bergamotene	10.90	1436	0.02	8.24*	1546	[1.18]
α-Humulene	11.08	1449	1.33	9.09	1613	1.40
trans-Cadina-1(6),4-diene	11.37	1471	0.03	9.02	1607	0.02
α-Amorphene	11.41	1474	0.13	9.39*	1638	[1.30]
Germacrene D	11.45	1477	0.04	9.56*	1651	[1.40]
β-Selinene	11.51	1481	0.07	9.67*	1660	[1.64]
α-Selinene	11.64	1491	0.08	9.74	1666	0.08
α-Muurolene	11.73	1498	0.07	9.84	1674	0.06
γ-Cadinene	11.90	1510	0.15	10.19*	1703	0.15
(*Z*)-γ-Bisabolene	11.94	1514	0.02	9.70	1663	0.02
δ-Cadinene	12.03*	1521	0.28	10.22*	1706	[0.27]
Zonarene	12.03*	1521	[0.28]	10.19*	1703	[0.15]
trans-Cadina-1,4-diene	12.13	1529	0.02	10.45	1726	0.03
α-Cadinene	12.16	1531	0.02	10.58	1737	0.01
α-Calacorene	12.20	1534	0.01	11.88	1851	0.01
(*E*)-Nerolidol	12.59	1565	0.04	13.56	2005	0.05
Caryophyllene oxide	12.73	1576	0.03	12.53	1909	0.02
Humulene epoxide I	12.94	1592	0.02	12.90	1943	0.01
Humulene epoxide II	13.06	1602	0.02	13.12	1964	0.02
10-epi-Cubenol	13.11	1606	0.01	13.39	1990	0.01
τ-Muurolol	13.50*	1638	0.02	14.81	2127	0.01
τ-Cadinol	13.50*	1638	[0.02]	14.65	2111	0.01
Manool	18.02	2045	0.06	19.06	2589	0.06
7,13-Abietadiene	18.25	2067	0.01	17.10	2367	0.01
Total identified		**98.82%**			**98.85%**	
Total reported		**99.11%**			**99.06%**	

*: 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

Note: no correction factor was applied
R.T.: Retention time (minutes)
R.I.: Retention index