

Date : February 25, 2022

CERTIFICATE OF ANALYSIS – GC PROFILING

SAMPLE IDENTIFICATION

Internal code : 22B11-ZAA03


Customer identification : Hemlock Spruce - Canada - EAB878226CA5522A

Type : Essential oil

Source : *Tsuga canadensis*

Customer : ZAYAT AROMA

ANALYSIS

Method: PC-MAT-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 2014-005

Analysis date : February 22, 2022

Checked and approved by :

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

Notes: This report may not be published, including online, without the written consent from Laboratoire PhytoChemia. This report is digitally signed, it is only considered valid if the digital signature is intact. The results only describe the samples that were submitted to the assays.

PHYSICOCHEMICAL DATA

Physical aspect: Clear liquid

Refractive index: 1.4700 ± 0.0003 (20 °C; method PC-MAT-016)

CONCLUSION

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

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	0.02	Aliphatic aldehyde
Furfural	tr	Furan
(2E)-Hexenal	0.01	Aliphatic aldehyde
(3Z)-Hexenol	0.09	Aliphatic alcohol
Hexanol	0.04	Aliphatic alcohol
Santene	0.41	Normonoterpene
Unknown	0.01	Normonoterpene
Bornylene	0.01	Monoterpene
Hashishene	0.01	Monoterpene
Tricyclene	5.57	Monoterpene
α -Thujene	0.19	Monoterpene
α -Pinene	23.72	Monoterpene
Camphene	13.81	Monoterpene
α -Fenchene	0.05	Monoterpene
Thuja-2,4(10)-diene	0.10	Monoterpene
Benzaldehyde	0.02	Simple phenolic
Sabinene	0.04	Monoterpene
β -Pinene	3.85	Monoterpene
Dehydro-1,8-cineole	0.03	Monoterpenic ether
Myrcene	3.81	Monoterpene
α -Phellandrene	1.14	Monoterpene
Menthatriene isomer I	0.03	Monoterpene
Δ^3 -Carene	0.29	Monoterpene
(3Z)-Hexenyl acetate	0.06	Aliphatic ester
1,4-Cineole	0.29*	Monoterpenic ether
α -Terpinene	0.29*	Monoterpene
para-Cymene	1.00	Monoterpene
β -Phellandrene	1.96*	Monoterpene
1,8-Cineole	1.96*	Monoterpenic ether
Limonene	3.68	Monoterpene
(Z)- β -Ocimene	0.01	Monoterpene
(E)- β -Ocimene	0.01	Monoterpene
γ -Terpinene	0.36	Monoterpene
Unknown	0.03	Oxygenated monoterpene
Fenchone	0.02	Monoterpenic ketone
para-Cymenene	0.14	Monoterpene
Terpinolene	0.63	Monoterpene
γ -Campholenal	0.13	Aliphatic alcohol
α -Thujone	0.01	Monoterpenic ketone
Linalool	0.08	Monoterpenic alcohol
Nonanal	0.02	Aliphatic aldehyde
endo-Fenchol	0.06	Monoterpenic alcohol

<i>cis</i> -para-Menth-2-en-1-ol	0.01	Monoterpenic alcohol
α -Campholenal	0.06	Monoterpenic aldehyde
Nopinone	0.01	Normonoterpenic ketone
<i>trans</i> -Pinocarveol	0.11	Monoterpenic alcohol
Camphor	0.31	Monoterpenic ketone
Camphene hydrate	0.07	Monoterpenic alcohol
Pinocamphone	0.02	Monoterpenic ketone
Isoborneol	0.02	Monoterpenic alcohol
Pinocarvone	0.03	Monoterpenic ketone
Borneol	1.31	Monoterpenic alcohol
α -Phellandren-8-ol	0.11	Monoterpenic alcohol
Terpinen-4-ol	0.43	Monoterpenic alcohol
Cryptone	0.03	Normonoterpenic ketone
Myrtenal	0.09	Monoterpenic aldehyde
Methyl salicylate	0.08	Phenolic ester
α -Terpineol	0.48	Monoterpenic alcohol
Myrtenol	0.07	Monoterpenic alcohol
Verbenone	0.08	Monoterpenic ketone
Citronellol	0.06	Monoterpenic alcohol
Carvotanacetone	0.02	Monoterpenic ketone
Piperitone	1.03	Monoterpenic ketone
Unknown	0.13	Unknown
Isobornyl acetate	26.37	Monoterpenic ester
Unknown	0.19	Monoterpenic ester
<i>trans</i> -Pinocarvyl acetate	0.07	Monoterpenic ester
Thymol	0.06	Monoterpenic alcohol
Myrtenyl acetate	0.11	Monoterpenic ester
Pin-2-en-8-yl acetate	0.88	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	0.04	Sesquiterpene
β -Bourbonene	0.04	Sesquiterpene
<i>trans</i> -Myrtanyl acetate	0.04	Monoterpenic ester
Geranyl acetate	0.04	Monoterpenic ester
β -Elemene	0.03	Sesquiterpene
Longifolene	0.03	Sesquiterpene
β -Caryophyllene	1.19	Sesquiterpene
β -Copaene	0.03	Sesquiterpene
<i>trans</i> - α -Bergamotene	0.04	Sesquiterpene
α -Humulene	1.44	Sesquiterpene
<i>trans</i> -Cadina-1(6),4-diene	0.03	Sesquiterpene
γ -Muurolene	0.16*	Sesquiterpene
α -Amorphene	0.16*	Sesquiterpene
Germacrene D	0.10	Sesquiterpene
β -Selinene	0.07	Sesquiterpene
α -Selinene	0.09	Sesquiterpene
α -Muurolene	0.09	Sesquiterpene
γ -Cadinene	0.23	Sesquiterpene
(<i>Z</i>)- γ -Bisabolene	0.04	Sesquiterpene

δ-Cadinene	0.34	Sesquiterpene
<i>trans</i> -Cadina-1,4-diene	0.04	Sesquiterpene
α-Cadinene	0.01	Sesquiterpene
α-Calacorene	0.01	Sesquiterpene
(<i>E</i>)-α-Bisabolene	0.01	Sesquiterpene
(<i>E</i>)-Nerolidol	0.07	Sesquiterpenic alcohol
Caryophyllene oxide	0.04	Sesquiterpenic ether
Salvia-4(14)-en-1-one	0.01	Aliphatic alcohol
Humulene epoxide I	0.01	Sesquiterpenic ether
Humulene epoxide II	0.04	Sesquiterpenic ether
1- <i>epi</i> -Cubenol	0.01	Sesquiterpenic alcohol
τ-Cadinol	0.02	Sesquiterpenic alcohol
τ-Muurolol	0.01	Sesquiterpenic alcohol
Pimaradiene	0.01	Diterpene
Unknown	0.03	Diterpene
<i>ar</i> -Abietatriene	0.06	Diterpene
Manool	0.11	Diterpenic alcohol
7,13-Abietadiene	0.17	Diterpene
Consolidated total	98.87%	

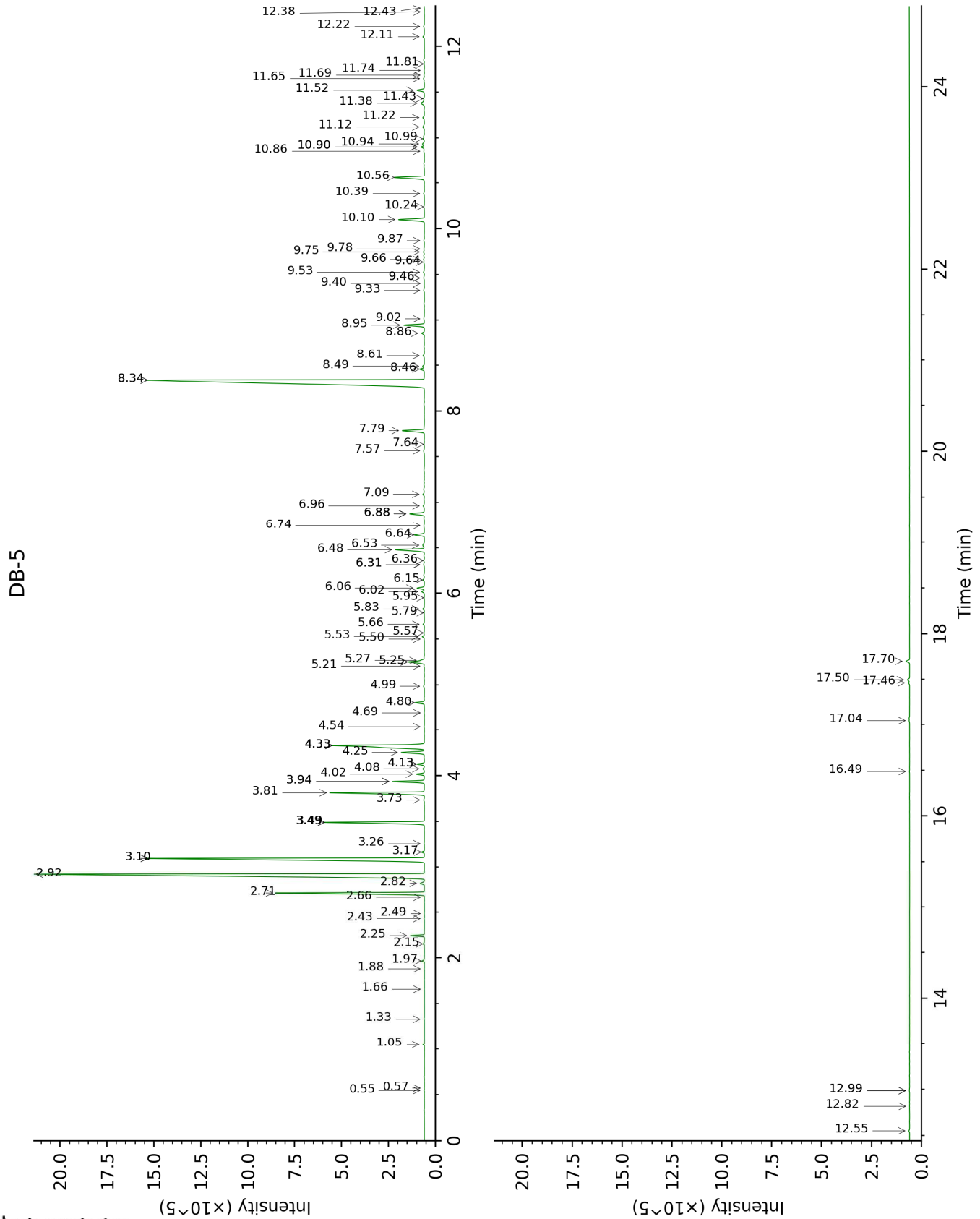
*: Individual compounds concentration could not be found due to overlapping coelutions on columns considered
[xx]: Duplicate percentage due to coelutions, not taken into account in the consolidated total
tr: The compound has been detected below 0.005% of total signal.

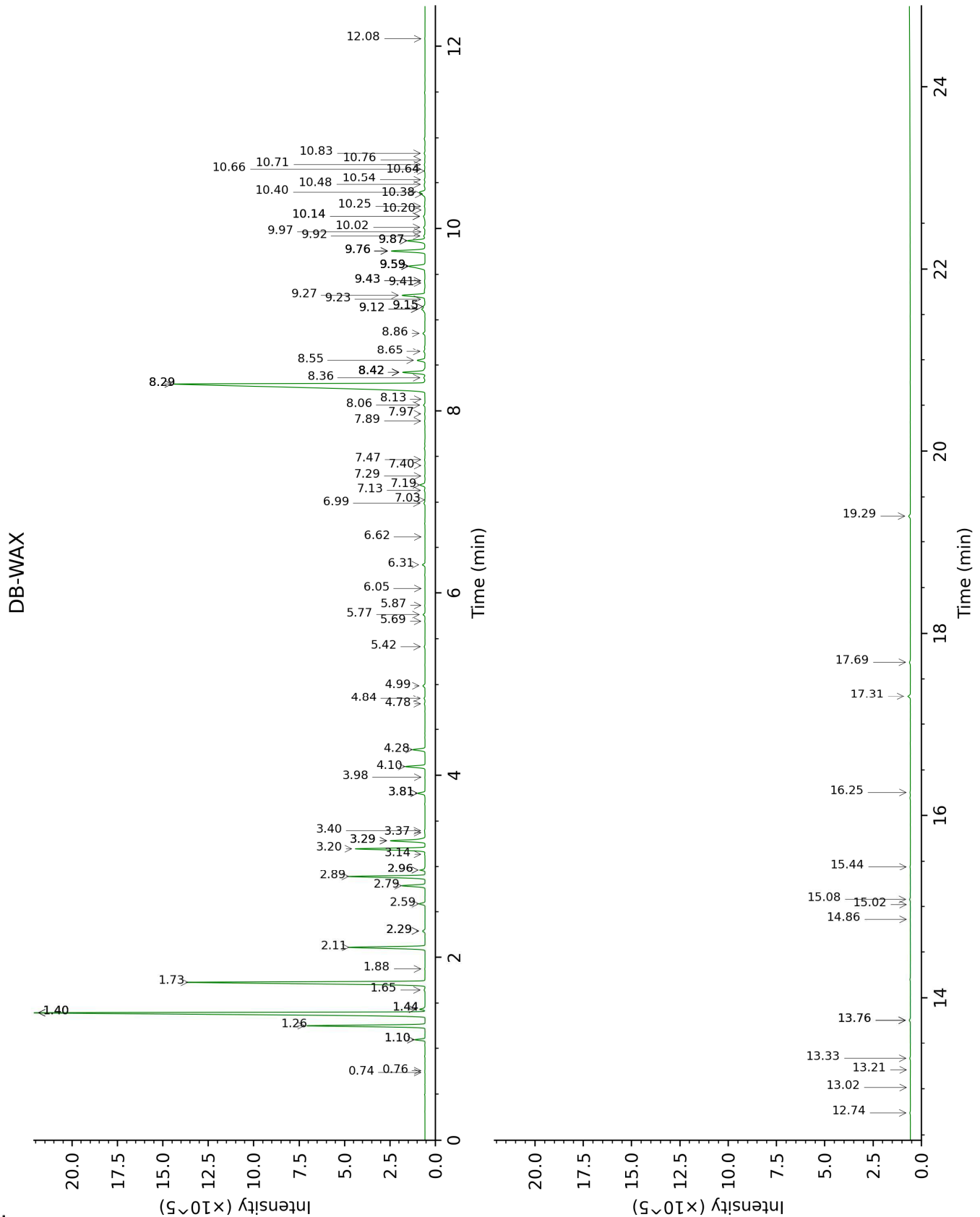
Note: no correction factor was applied

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.

This page was intentionally left blank. The following pages present the complete data of the analysis.





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	885	0.01
2-Methylbutyral	0.57	651	tr	0.74	878	tr
Toluene	1.05	758	0.03	1.40*	994	23.56
Hexanal	1.33	801	0.02	1.88	1042	0.01
Furfural	1.66	831	tr	6.62	1406	0.01
(2E)-Hexenal	1.88	851	0.01	3.37	1171	0.01
(3Z)-Hexenol	1.97	858	0.09	5.77	1345	0.11
Hexanol	2.15	874	0.04	5.42	1319	0.05
Santene	2.24	882	0.41	1.10*	947	0.41
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	2.49	904	0.01	1.10*	947	[0.41]
Hashishene	2.66	916	0.01	1.40*	994	[23.56]
Tricyclene	2.71	919	5.57	1.26	971	5.53
α-Thujene	2.82	926	0.19	1.44*	999	[0.23]
α-Pinene	2.92	933	23.72	1.40*	994	[23.56]
Camphene	3.10*	945	13.94	1.73	1028	13.81
α-Fenchene	3.10*	945	[13.94]	1.65	1019	0.05
Thuja-2,4(10)- diene	3.17	950	0.10	2.29*	1083	0.13
Benzaldehyde	3.26	956	0.02	7.40	1465	0.02
Sabinene	3.49*	972	3.91	2.29*	1083	[0.13]
β-Pinene	3.49*	972	[3.91]	2.11	1065	3.85
Dehydro-1,8- cineole	3.74	988	0.03	3.14	1153	0.02
Myrcene	3.81	994	3.81	2.89	1133	3.77
α-Phellandrene	3.94*	1002	1.17	2.79	1125	1.14
Menthatriene isomer I	3.94*	1002	[1.17]	3.40	1173	0.03
Δ3-Carene	4.02	1007	0.29	2.59	1109	0.29
(3Z)-Hexenyl acetate	4.08	1011	0.06	4.84	1282	0.05
1,4-Cineole	4.13*	1014	0.29	2.96*	1139	0.29
α-Terpinene	4.13*	1014	[0.29]	2.96*	1139	[0.29]
para-Cymene	4.25	1022	1.00	4.10	1227	1.01
β-Phellandrene	4.33*	1027	5.64	3.29*	1164	1.95
1,8-Cineole	4.33*	1027	[5.64]	3.29*	1164	[1.95]
Limonene	4.33*	1027	[5.64]	3.20	1157	3.68
(Z)-β-Ocimene	4.54	1040	0.01	3.80*	1205	0.38
(E)-β-Ocimene	4.69	1050	0.01	3.98	1218	0.01
γ-Terpinene	4.80	1057	0.36	3.80*	1205	[0.38]
Unknown [m/z 79, 93 (60), 43 (40), 94 (35), 137 (33), 77 (26), 91 (20), 152 (18)]	4.99	1069	0.03	4.78	1278	0.04

Fenchone	5.20	1083	0.02	5.69	1339	0.02
para-Cymenene	5.25*†	1086	0.88	6.31	1384	0.14
Terpinolene	5.25*†	1086	[0.88]	4.28	1240	0.63
γ-Campholenal	5.27†	1087	[0.88]	4.99	1293	0.13
α-Thujone	5.50	1101	0.01	6.05	1365	0.01
Linalool	5.53	1103	0.08	8.06	1515	0.08
Nonanal	5.57	1106	0.02	5.87	1352	0.02
endo-Fenchol	5.66	1112	0.06	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	0.06	6.99	1434	0.06
Nopinone	5.95	1130	0.01	8.29*	1532	26.61
trans-Pinocarveol	6.02	1135	0.11	9.15*†	1599	[0.38]
Camphor	6.06	1137	0.31	7.19	1449	0.30
Camphene hydrate	6.15	1143	0.07	8.42*	1542	1.30
Pinocamphone	6.31*	1154	0.04	7.29	1456	0.02
Isoborneol	6.31*	1154	[0.04]	9.41	1620	0.02
Pinocarvone	6.36	1157	0.03	7.89	1501	0.03
Borneol	6.48	1164	1.31	9.76*	1648	1.97
α-Phellandren-8-ol	6.53	1167	0.11	10.14*	1679	0.15
Terpinen-4-ol	6.64	1175	0.43	8.55	1553	0.43
Cryptone	6.74	1181	0.03	9.15*†	1599	[0.38]
Myrtenal	6.88*	1190	0.65	8.65	1560	0.09
Methyl salicylate	6.88*	1190	[0.65]	10.48	1708	0.08
α-Terpineol	6.88*	1190	[0.65]	9.76*	1648	[1.97]
Myrtenol	6.96	1196	0.07	10.83	1737	0.05
Verbenone	7.09	1204	0.08	9.59*	1635	1.26
Citronellol	7.57	1236	0.06	10.71	1727	0.05
Carvotanacetone	7.64	1240	0.02	9.43*	1622	0.04
Piperitone	7.79	1250	1.03	9.87*	1657	1.12
Unknown [m/z 119, 43 (87), 91 (78), 92 (70), 134 (50)...]	8.34*	1287	26.49	8.86	1576	0.13
Isobornyl acetate	8.34*	1287	[26.49]	8.29*	1532	[26.61]
Unknown [m/z 107, 43 (76), 150 (42), 91 (28), 108 (23)]	8.46	1295	0.19	9.12*†	1597	0.38
trans-Pinocarvyl acetate	8.49	1298	0.07	9.12*†	1597	[0.38]
Thymol	8.61	1305	0.06	15.08	2126	0.05
Myrtenyl acetate	8.86	1323	0.11	9.59*	1635	[1.26]
Pin-2-en-8-yl acetate	8.95	1330	0.88	9.59*	1635	[1.26]
Terpinyl acetate analog	9.02	1334	0.04	9.59*	1635	[1.26]

Citronellyl acetate	9.33	1356	0.04	9.43*	1622	[0.04]
Neryl acetate	9.40	1362	0.01	10.20	1684	0.01
Unknown [m/z 93, 121 (68), 43 (67), 67 (44), 136 (36), 107 (34)... 180 (4)]	9.46*	1366	0.04	10.14*	1679	[0.15]
α -Ylangene	9.46*	1366	[0.04]	7.03	1437	0.01
α -Copaene	9.53	1371	0.04	7.13	1444	0.04
β -Bourbonene	9.64	1378	0.04	7.47	1469	0.03
<i>trans</i> -Myrtanyl acetate	9.66	1380	0.04	10.25	1688	0.04
Geranyl acetate	9.75	1386	0.04	10.54	1712	0.05
β -Elemene	9.78	1389	0.03	8.42*	1542	[1.30]
Longifolene	9.87	1395	0.03	7.97	1507	0.03
β -Caryophyllene	10.10	1412	1.19	8.42*	1542	[1.30]
β -Copaene	10.24	1422	0.03	8.42*	1542	[1.30]
<i>trans</i> - α -Bergamotene	10.39	1433	0.04	8.42*	1542	[1.30]
α -Humulene	10.56	1446	1.44	9.27	1609	1.45
<i>trans</i> -Cadina-1(6),4-diene	10.86	1468	0.03	9.23	1605	0.03
γ -Muuroolene	10.90*	1472	0.16	9.59*	1635	[1.26]
α -Amorphene	10.90*	1472	[0.16]	9.59*	1635	[1.26]
Germacrene D	10.94	1474	0.10	9.76*	1648	[1.97]
β -Selinene	10.99	1478	0.07	9.87*	1657	[1.12]
α -Selinene	11.12	1488	0.09	9.92	1662	0.08
α -Muuroolene	11.22	1496	0.09	10.02	1669	0.09
γ -Cadinene	11.38	1507	0.23	10.38	1698	0.13
(<i>Z</i>)- γ -Bisabolene	11.43	1511	0.04	9.97	1665	0.02
δ -Cadinene	11.52	1519	0.34	10.40	1700	0.38
<i>trans</i> -Cadina-1,4-diene	11.65	1528	0.04	10.64	1721	0.04
α -Cadinene	11.69	1532	0.01	10.76	1731	0.03
α -Calacorene	11.74	1536	0.01	12.08	1846	0.02
(<i>E</i>)- α -Bisabolene	11.81	1541	0.01	10.66	1722	0.01
(<i>E</i>)-Nerolidol	12.11	1565	0.07	13.76*	1998	0.07
Caryophyllene oxide	12.22	1573	0.04	12.74	1904	0.04
Salvial-4(14)-en-1-one	12.38	1586	0.01	13.02	1930	0.01
Humulene epoxide I	12.43	1590	0.01	13.21	1947	0.01
Humulene epoxide II	12.55	1600	0.04	13.33	1959	0.04
1-epi-Cubenol	12.82	1621	0.01	13.76*	1998	[0.07]
τ -Cadinol	12.99*	1635	0.03	14.86	2105	0.02
τ -Muurolol	12.99*	1635	[0.03]	15.02	2121	0.01
Pimaradiene	16.49	1944	0.01	15.44	2163	0.03

Unknown [m/z 257, 258 (20), 91 (19), 272 (18)]	17.04	1997	0.03	16.25	2246	0.03
ar-Abietatriene	17.46	2039	0.06	17.69	2399	0.07
Manool	17.50	2042	0.11	19.29	2582	0.11
7,13-Abietadiene	17.70	2062	0.17	17.31	2358	0.18
Total identified	98.69%			98.58%		
Total reported	98.96%			98.77%		

*: 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