

**Date :** May 08, 2020

**CERTIFICATE OF ANALYSIS – GC PROFILING**

**SAMPLE IDENTIFICATION**

**Internal code :** 20D24-PTH01

**Customer identification :** Black Spruce Organic - Canada - SA310197R

**Type :** Essential oil

**Source :** *Picea mariana*

**Customer :** Plant Therapy

**ANALYSIS**

**Method:** PC-MAT-007 - Analysis of the composition of an essential oil or other volatile liquide by FAST GC-FID (in French); identifications validated by GC-MS.

**Analyst :** Fanny Charlier, B. Sc.

**Analysis date :** April 27, 2020

Checked and approved by :

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

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*PHYSICOCHEMICAL DATA*

**Physical aspect:** Faintly yellow liquid

**Refractive index:**  $1.4712 \pm 0.0003$  (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
Ethanol	tr	Aliphatic alcohol
Isovaleral	0.01	Aliphatic aldehyde
2-Methylbutyral	tr	Aliphatic aldehyde
Toluene	0.02	Simple phenolic
Octane	0.01	Alkane
(3Z)-Hexenol	0.03	Aliphatic alcohol
Hexanol	0.02	Aliphatic alcohol
Santene	2.59	Normonoterpene
Unknown	0.07	Normonoterpene
Bornylene	0.01	Monoterpene
Hashishene	0.01	Monoterpene
Tricyclene	1.70	Monoterpene
$\alpha$ -Thujene	0.22	Monoterpene
$\alpha$ -Pinene	19.28	Monoterpene
Camphene	15.52	Monoterpene
$\alpha$ -Fenchene	0.12	Monoterpene
Thuja-2,4(10)-diene	0.06	Monoterpene
meta-Cymene	0.08	Monoterpene
$\beta$ -Pinene	7.28	Monoterpene
Sabinene	0.13	Monoterpene
Unknown	0.02	Unknown
Myrcene	3.21	Monoterpene
2-Carene	0.03	Monoterpene
$\alpha$ -Phellandrene	0.37	Monoterpene
$\Delta^3$ -Carene	9.22	Monoterpene
$\alpha$ -Terpinene	0.30	Monoterpene
para-Cymene	0.36	Monoterpene
Limonene	3.77	Monoterpene
$\beta$ -Phellandrene	1.30	Monoterpene
1,8-Cineole	0.40	Monoterpenic ether
(Z)- $\beta$ -Ocimene	0.04	Monoterpene
(E)- $\beta$ -Ocimene	0.02	Monoterpene
$\gamma$ -Terpinene	0.30	Monoterpene
Unknown	0.06	Oxygenated monoterpene
Unknown	0.01	Unknown
meta-Cymenene	0.02	Monoterpene
Fenchone	0.04	Monoterpenic ketone
$\gamma$ -Campholenal	0.09	Aliphatic alcohol
Terpinolene	1.08	Monoterpene
para-Cymenene	0.18	Monoterpene
$\alpha$ -Pinene oxide	0.01	Monoterpenic ether
Unknown	0.01	Unknown
Linalool	0.23	Monoterpenic alcohol
Nonanal	0.02	Aliphatic aldehyde
para-Mentha-1,3,8-triene	0.02	Monoterpene

endo-Fenchol	0.12	Monoterpenic alcohol
$\alpha$ -Campholenal	0.12	Monoterpenic aldehyde
<i>trans</i> -Pinocarveol	0.13	Monoterpenic alcohol
Camphor	0.20	Monoterpenic ketone
Camphene hydrate	0.26	Monoterpenic alcohol
Isoborneol	0.11	Monoterpenic alcohol
Citronellal	0.06	Monoterpenic aldehyde
Pinocamphone	0.02	Monoterpenic ketone
Borneol	1.10	Monoterpenic alcohol
Unknown	0.04	Unknown
Isopinocamphone	0.05	Monoterpenic ketone
Terpinen-4-ol	0.36	Monoterpenic alcohol
meta-Cymen-8-ol	0.02	Monoterpenic alcohol
para-Cymen-8-ol	0.03	Monoterpenic alcohol
$\alpha$ -Terpineol	0.93	Monoterpenic alcohol
Myrtenal	0.17	Monoterpenic aldehyde
Verbenone	0.10	Monoterpenic ketone
Unknown	0.05	Unknown
<i>trans</i> -Piperitol	0.01	Monoterpenic alcohol
endo-Fenchyl acetate	0.27	Monoterpenic ester
<i>trans</i> -Carveol	0.03	Monoterpenic alcohol
Citronellol	0.06	Monoterpenic alcohol
Thymol methyl ether	0.09	Monoterpenic ether
Carvone	0.02	Monoterpenic ketone
Piperitone	0.04	Monoterpenic ketone
Geraniol	0.03	Monoterpenic alcohol
Unknown	0.02	Unknown
<i>cis</i> -Verbenyl acetate	0.01	Monoterpenic ester
Bornyl acetate	19.56	Monoterpenic ester
Isobornyl acetate	0.61	Monoterpenic ester
Unknown	0.05	Unknown
Unknown	0.12	Monoterpenic ester
<i>trans</i> -Pinocarvyl acetate	0.11	Monoterpenic ester
Myrtenyl acetate	0.02	Monoterpenic ester
Terpinyl acetate analog	0.07	Monoterpenic ester
<i>trans</i> -Carvyl acetate	0.03	Monoterpenic ester
exo-2-Hydroxycineole acetate	0.03	Monoterpenic ester
Unknown	0.03	Unknown
$\alpha$ -Terpinyl acetate	0.07	Monoterpenic ester
Citronellyl acetate	0.08	Monoterpenic ester
Longicyclene	0.03	Sesquiterpene
Unknown	0.04	Oxygenated monoterpene
$\alpha$ -Copaene	0.04	Sesquiterpene
Geranyl acetate	0.19	Monoterpenic ester
$\beta$ -Elemene	0.09	Sesquiterpene
Longifolene	0.19	Sesquiterpene
Unknown	0.01	Unknown
Methyleugenol	0.01	Phenylpropanoid
$\beta$ -Caryophyllene	0.28	Sesquiterpene
$\beta$ -Copaene	0.02	Sesquiterpene
<i>trans</i> -Muurolo-3,5-diene	0.03	Sesquiterpene
$\alpha$ -Humulene	0.08	Sesquiterpene

Unknown	0.08	Unknown
(E)-β-Farnesene	0.01	Sesquiterpene
trans-Cadina-1(6),4-diene	0.08	Sesquiterpene
γ-Murolene	0.12	Sesquiterpene
Germacrene D	0.07	Sesquiterpene
Dodecanol	0.02	Aliphatic alcohol
α-Selinene	0.01	Sesquiterpene
Bicyclogermacrene	0.04	Sesquiterpene
α-Murolene	0.28	Sesquiterpene
γ-Cadinene	0.37	Sesquiterpene
trans-Calamenene	0.11	Sesquiterpene
δ-Cadinene	1.14	Sesquiterpene
trans-Cadina-1,4-diene	0.07	Sesquiterpene
α-Cadinene	0.08	Sesquiterpene
α-Calacorene	0.04	Sesquiterpene
(E)-α-Bisabolene	0.17	Sesquiterpene
Unknown	0.02	Oxygenated sesquiterpene
Germacrene B	0.04	Sesquiterpene
Unknown	0.02	Oxygenated sesquiterpene
(E)-Nerolidol	0.02	Sesquiterpenic alcohol
Caryophyllene oxide	0.01	Sesquiterpenic ether
Unknown	0.01	Unknown
1-epi-Cubenol	0.04	Sesquiterpenic alcohol
τ-Murolol	0.20	Sesquiterpenic alcohol
τ-Cadinol	0.15	Sesquiterpenic alcohol
Cubenol	0.03	Sesquiterpenic alcohol
α-Murolol	0.05	Sesquiterpenic alcohol
α-Cadinol	0.26	Sesquiterpenic alcohol
trans-Calamenen-10-ol	0.02	Sesquiterpenic alcohol
Unknown	0.02	Oxygenated sesquiterpene
Amorpha-4,9-dien-2-ol	0.02	Sesquiterpenic alcohol
(5Z)-Tetradecen-14-olide?	0.05	Aliphatic lactone
Unknown	0.02	Oxygenated sesquiterpene
Unknown	0.04	Oxygenated sesquiterpene
Oplopanone	0.03	Sesquiterpenic alcohol
Unknown	0.02	Oxygenated sesquiterpene
Unknown	0.02	Oxygenated sesquiterpene
(3E)-Cembrene A	0.01	Diterpene
Unknown	0.04	Oxygenated diterpene
(E,E)-Geranylinalool	0.02	Diterpenic alcohol
Manool	0.05	Diterpenic alcohol
7,13-Abietadiene	0.01	Diterpene
(Z)-Abienol	0.04	Diterpenic alcohol
Palustral	0.02	Diterpenic aldehyde
<b>Consolidated total</b>	<b>98.49%</b>	

tr: The compound has been detected below 0.005% of total signal.

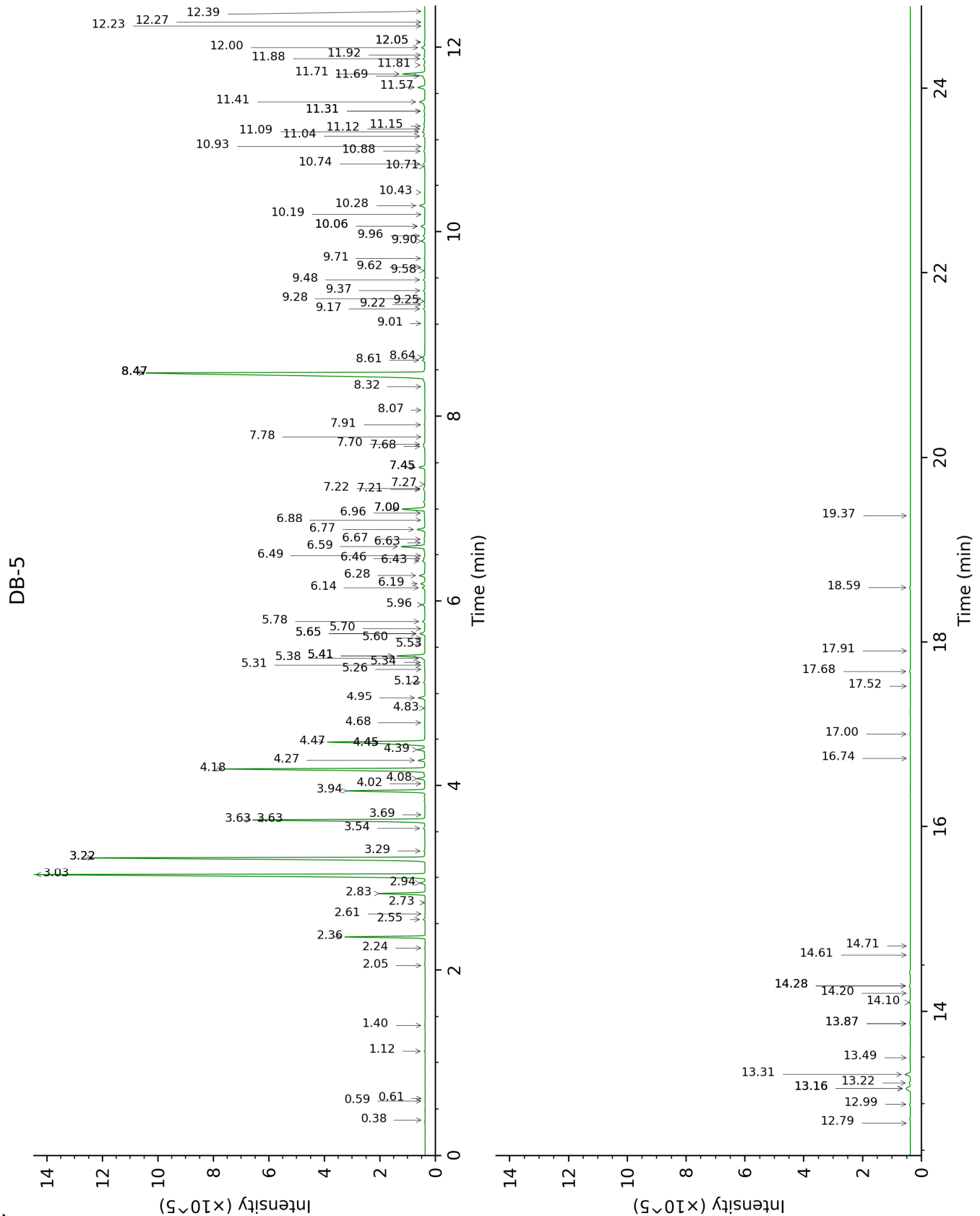
Note: no correction factor was applied

**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

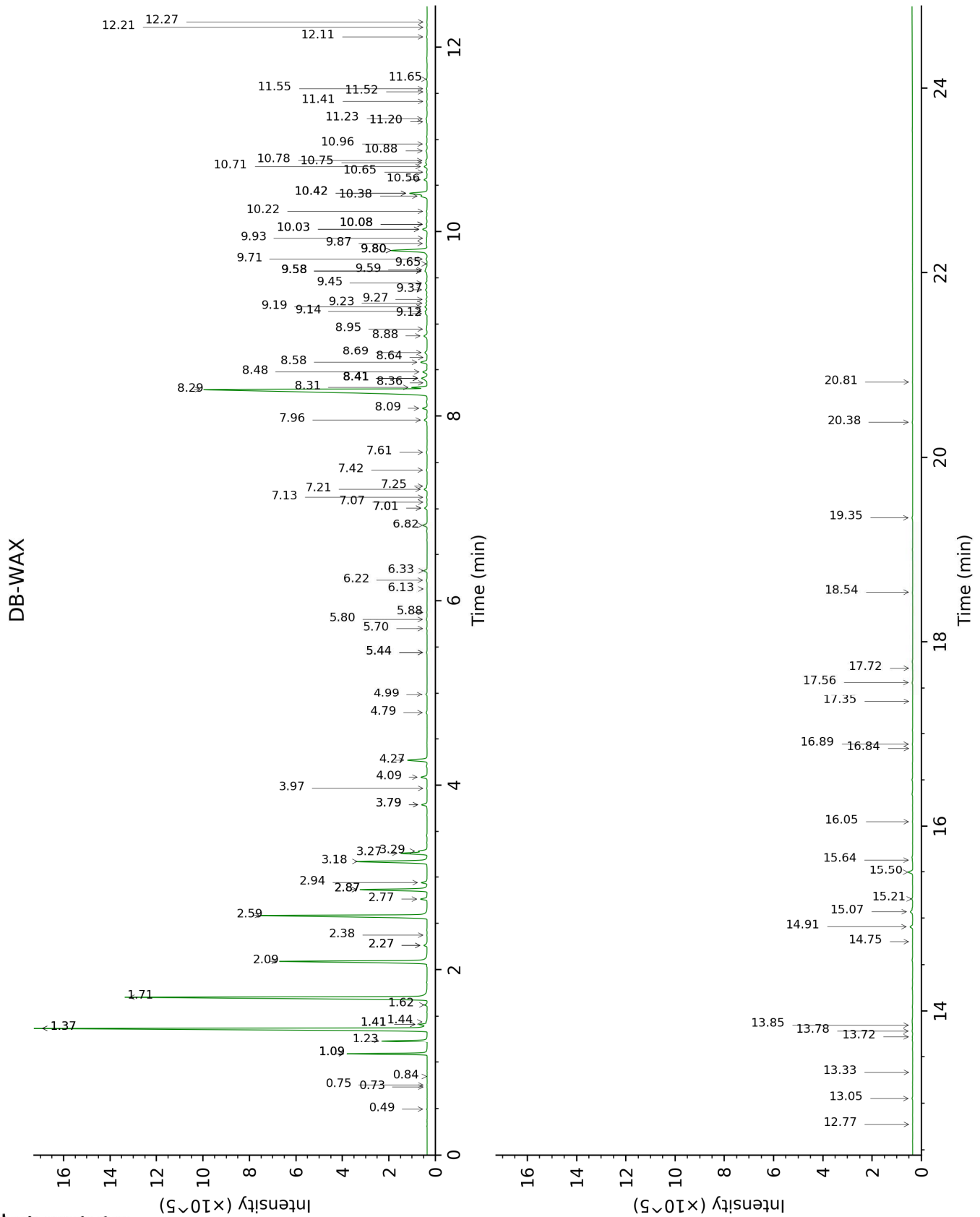
overestimating individual content. This process is semi-automatic. Advanced users are invited to consult the "Full analysis data" table after the chromatograms in this report to access the full untreated data and perform their own calculations if needed.

**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	%
Ethanol	0.38	522	tr	0.84	909	tr
Isovaleral	0.59	640	0.01	0.75	889	0.01
2-Methylbutyral	0.61	651	tr	0.73	881	0.01
Toluene	1.12	762	0.02	1.44	1002	0.08
Octane	1.40	802	0.01	0.50	787	0.01
(3Z)-Hexenol	2.05	857	0.03	5.80	1348	0.05
Hexanol	2.24	873	0.02	5.44*	1323	0.04
Santene	2.36	883	2.59	1.09*	948	2.61
Unknown [m/z 79, 93 (66), 94 (52), 91 (39), 77 (37), 122 (31)]	2.55	898	0.07	1.41*	999	0.38
Bornylene	2.61	903	0.01	1.09*	948	[2.61]
Hashishene	2.73	912	0.01	1.37*	994	19.08
Tricyclene	2.83	918	1.70	1.23	972	1.71
α-Thujene	2.94	926	0.22	1.41*	999	[0.38]
α-Pinene	3.03	932	19.28	1.37*	994	[19.08]
Camphene	3.22*	944	15.68	1.71	1028	15.52
α-Fenchene	3.22*	944	[15.68]	1.62	1020	0.12
Thuja-2,4(10)-diene	3.30	949	0.06	2.26*	1084	0.19
meta-Cymene	3.54	965	0.08	2.87*	1134	3.25
β-Pinene	3.63*	971	7.43	2.09	1067	7.28
Sabinene	3.63*	971	[7.43]	2.26*	1084	[0.19]
Unknown [m/z 83, 43 (83), 55 (72), 71 (27), 41 (25), 58 (19)...]	3.69	974	0.02			
Myrcene	3.94	992	3.21	2.87*	1134	[3.25]
2-Carene	4.02	997	0.03	2.38	1095	0.01
α-Phellandrene	4.08	1000	0.37	2.76	1126	0.33
Δ3-Carene	4.18	1007	9.22	2.59	1112	9.18
α-Terpinene	4.27	1013	0.30	2.94	1140	0.29
para-Cymene	4.39	1020	0.36	4.09	1227	0.34
Limonene	4.45*†	1024	5.52	3.18	1158	3.77
β-Phellandrene	4.45*†	1024	[5.52]	3.27	1165	1.30
1,8-Cineole	4.47†	1025	[5.52]	3.29	1167	0.40
(Z)-β-Ocimene	4.68	1038	0.04	3.79*	1206	0.32
(E)-β-Ocimene	4.84	1048	0.02	3.97	1218	0.02
γ-Terpinene	4.95	1055	0.30	3.79*	1206	[0.32]
Unknown [m/z 79, 93 (60), 43 (40), 94 (35), 137 (33), 77 (26), 91 (20), 152 (18)]	5.12	1066	0.06	4.79	1278	0.07
Unknown [m/z 94, 79 (74), 67 (33), 41 (22), 95 (21)...]	5.26	1075	0.01			

meta-Cymenene	5.31	1078	0.02	6.22	1379	0.06
Fenchone	5.34	1080	0.04	5.70	1341	0.04
γ-Campholenal	5.38	1083	0.09	4.99	1293	0.09
Terpinolene	5.41*	1084	1.29	4.27	1241	1.08
para-Cymenene	5.41*	1084	[1.29]	6.32	1386	0.18
α-Pinene oxide	5.53	1092	0.01	5.44*	1323	[0.04]
Unknown [m/z 79, 94 (87), 77 (25), 91 (21), 93 (16), 95 (12), 138 (8)]	5.60	1097	0.01			
Linalool	5.65*	1100	0.25	8.09	1518	0.23
Nonanal	5.65*	1100	[0.25]	5.88	1354	0.02
para-Mentha-1,3,8-triene	5.70	1103	0.02	6.13	1372	0.01
endo-Fenchol	5.78	1108	0.12	8.41*	1543	0.45
α-Campholenal	5.96	1120	0.12	7.01*	1437	0.15
trans-Pinocarveol	6.14	1132	0.13	9.19	1604	0.13
Camphor	6.19	1135	0.20	7.21	1452	0.19
Camphene hydrate	6.28	1140	0.26	8.41*	1543	[0.45]
Isoborneol	6.43	1150	0.11	9.37	1618	0.10
Citronellal	6.46	1152	0.06	7.01*	1437	[0.15]
Pinocamphone	6.49	1154	0.02	7.25	1454	0.03
Borneol	6.59	1161	1.10	9.80*	1653	2.28
Unknown [m/z 109, 108 (48), 67 (41), 81 (40), 41 (28)...]	6.63	1163	0.04	7.42	1467	0.05
Isopinocamphone	6.67	1166	0.05	7.61	1482	0.05
Terpinen-4-ol	6.77	1173	0.36	8.58	1556	0.39
meta-Cymen-8-ol	6.88	1180	0.02	11.52	1796	0.02
para-Cymen-8-ol	6.96	1185	0.03	11.55	1799	0.04
α-Terpineol	7.00*	1188	1.10	9.80*	1653	[2.28]
Myrtenal	7.00*	1188	[1.10]	8.69	1564	0.17
Verbenone	7.21†	1202	0.11	9.59	1636	0.10
Unknown [m/z 95, 93 (32), 121 (24), 79 (22), 91 (21), 105 (16)... 154 (2)]	7.22†	1202	[0.11]	10.96	1749	0.05
trans-Piperitol	7.27	1205	0.01	10.42*	1703	1.14
endo-Fenchyl acetate	7.45*	1218	0.28	6.82	1422	0.27
trans-Carveol	7.45*	1218	[0.28]	11.42	1787	0.03
Citronellol	7.68	1233	0.06	10.75	1732	0.09
Thymol methyl ether	7.70	1235	0.09	8.41*	1543	[0.45]
Carvone	7.78	1240	0.02	10.03*	1671	0.29
Piperitone	7.91	1249	0.04	9.87	1659	0.04
Geraniol	8.07	1260	0.03	11.66	1808	0.04
Unknown [m/z 43, 119 (72), 81 (66), 54 (48), 41 (47), 58	8.32	1278	0.02			

(44)...						
<i>cis</i> -Verbenyl acetate	8.47*	1288	20.35	8.64	1560	0.01
Bornyl acetate	8.47*	1288	[20.35]	8.29	1533	19.56
Isobornyl acetate	8.47*	1288	[20.35]	8.31	1535	0.61
Unknown [m/z 119, 43 (87), 91 (78), 92 (70), 134 (50)...	8.47*	1288	[20.35]	8.95	1584	0.05
Unknown [m/z 107, 43 (76), 150 (42), 91 (28), 108 (23)]	8.61	1298	0.12	9.12	1598	0.08
<i>trans</i> -Pinocarvyl acetate	8.64	1300	0.11	9.14	1600	0.12
Myrtenyl acetate	9.01	1321	0.02	9.65	1641	0.01
Terpinyl acetate analog	9.17	1332	0.07	9.58*	1635	0.16
<i>trans</i> -Carvyl acetate	9.22	1335	0.03	10.22	1687	0.04
exo-2-Hydroxycineole acetate	9.25	1338	0.03	10.08*	1676	0.05
Unknown [m/z 133, 105 (45), 91 (38), 119 (36)... 150 (3)]	9.28	1340	0.03			
$\alpha$ -Terpinyl acetate	9.37	1346	0.07	9.70	1645	0.06
Citronellyl acetate	9.48	1354	0.08	9.45	1624	0.10
Longicyclene	9.58	1361	0.03	7.07	1442	0.02
Unknown [m/z 93, 121 (68), 43 (67), 67 (44), 136 (36), 107 (34)... 180 (4)]	9.62	1364	0.04	10.08*	1676	[0.05]
$\alpha$ -Copaene	9.71	1370	0.04	7.13	1445	0.03
Geranyl acetate	9.90	1384	0.19	10.56	1715	0.19
$\beta$ -Elemene	9.96	1388	0.09	8.41*	1543	[0.45]
Longifolene	10.06*	1395	0.20	7.96	1508	0.19
Unknown [m/z 119, 43 (57), 91 (50), 134 (36), 93 (29), 79 (28)...	10.06*	1395	[0.20]			
Methyleugenol	10.19	1404	0.01	13.33	1959	0.01
$\beta$ -Caryophyllene	10.28	1411	0.28	8.48	1548	0.28
$\beta$ -Copaene	10.43	1422	0.02	8.36	1539	0.02
<i>trans</i> -Muurola-3,5-diene	10.71	1443	0.03	8.88	1579	0.21
$\alpha$ -Humulene	10.74	1445	0.08	9.23	1607	0.07
Unknown [m/z 95, 43 (94), 79 (93), 91 (71), 93 (65), 177 (54), 41 (52)...	10.88	1456	0.08	10.88	1742	0.09

(E)-β-Farnesene	10.93	1459	0.01	9.58*	1635	[0.16]
<i>trans</i> -Cadina-1(6),4-diene	11.04	1468	0.08	9.27	1610	0.07
γ-Muurolene	11.09	1471	0.12	9.58*	1635	[0.16]
Germacrene D	11.12	1473	0.07	9.80*	1653	[2.28]
Dodecanol	11.15	1476	0.02	13.05	1933	0.04
α-Selinene	11.31*	1488	0.05	9.93	1663	0.01
Bicyclogermacrene	11.31*	1488	[0.05]	10.08*	1676	[0.05]
α-Muurolene	11.41	1495	0.28	10.03*	1671	[0.29]
γ-Cadinene	11.57	1507	0.37	10.38	1700	0.35
<i>trans</i> -Calamenene	11.69	1516	0.11	11.23	1772	0.08
δ-Cadinene	11.71	1518	1.14	10.42*	1703	[1.14]
<i>trans</i> -Cadina-1,4-diene	11.81	1526	0.07	10.65	1723	0.04
α-Cadinene	11.88	1531	0.08	10.78	1734	0.08
α-Calacorene	11.92	1534	0.04	12.11	1849	0.03
(E)-α-Bisabolene	12.00	1541	0.17	10.71	1728	0.18
Unknown [m/z 95, 81 (70), 109 (68), 93 (59), 67 (53), 41 (49), 139 (40)... 220 (3)]	12.06*	1545	0.05	12.22	1858	0.02
Germacrene B	12.06*	1545	[0.05]	11.20	1769	0.04
Unknown [m/z 93, 135 (9), 107 (72), 177 (72), 81 (57), 149 (53)... 220 (25)]	12.23	1559	0.02	12.27	1863	0.02
(E)-Nerolidol	12.27	1562	0.02	13.85	2007	0.03
Caryophyllene oxide	12.39	1572	0.01	12.77	1908	0.01
Unknown0 [m/z 108, 43 (56), 109 (33), 93 (26), 119 (24)... 212 (2)]	12.79	1603	0.01	14.75	2094	0.01
1-epi-Cubenol	12.99	1620	0.04	13.78	2001	0.05
τ-Muurolol	13.16*	1634	0.30	15.07	2126	0.20
τ-Cadinol	13.16*	1634	[0.30]	14.91	2110	0.15
Cubenol	13.16*	1634	[0.30]	13.72	1995	0.03
α-Muurolol	13.22	1639	0.05	15.21	2140	0.05
α-Cadinol	13.31	1646	0.26	15.50	2168	0.27
<i>trans</i> -Calamenen-10-ol	13.49	1661	0.02	16.84	2307	0.01
Unknown [m/z 177, 159 (78), 220 (36), 117 (33), 81 (31)]	13.87*	1692	0.04			
Amorpha-4,9-dien-2-ol	13.87*	1692	[0.04]	16.89	2312	0.02
(5Z)-Tetradecen-14-olide?	14.10	1712	0.05			
Unknown [m/z 159, 220 (92), 93	14.20	1720	0.02	17.72	2401	0.02

(88), 177 (63), 91 (57), 107 (55)]						
Unknown [m/z 159, 132 (79), 135 (37), 91 (35), 177 (33)... 220 (16)]	14.28*	1727	0.07	17.56	2384	0.04
Oplopanone	14.28*	1727	[0.07]			
Unknown [m/z 81, 43 (83), 123 (65), 71 (48), 97 (41), 109 (38)... 236? (t)]	14.61	1756	0.02			
Unknown [m/z 43, 147 (93), 159 (76), 187 (76), 81 (64), 93 (56), 121 (56), 220 (51)]	14.71	1764	0.02			
(3E)-Cembrene A	16.74	1950	0.01	15.64	2182	0.03
Unknown [m/z 105, 91 (100), 81 (89), 79 (86), 109 (86), 257 (83)... 275 (12)...]	17.00	1975	0.04	16.05	2224	0.02
(E,E)-Geranyllinalool	17.52	2026	0.02	18.54	2493	0.02
Manool	17.68	2041	0.05	19.35	2586	0.05
7,13-Abietadiene	17.91	2064	0.01	17.35	2361	0.01
(Z)-Abienol	18.59	2133	0.04	20.38	2709	0.03
Palustral	19.37	2215	0.02	20.81	2762	0.01
<b>Total identified</b>		<b>97.99%</b>			<b>97.65%</b>	
<b>Total reported</b>		<b>98.61%</b>			<b>98.16%</b>	

\*: 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