Date : February 25, 2022

Certificate of Analysis – GC Profiling

Sample identification

Internal code : 22B11-ZAA01
Customer identification : Pine White - Canada - EAB746787CA63721B
Type : Essential oil
Source : *Pinus strobus*
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 14, 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Notes: This report may not be published, including online, without the written consent from Laboratoire PhytoChemia.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.

Méthode certifiée ISO 17025:2017 Certified method

Laboratoire PhytoChemia

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PHYSICOCHEMICAL DATA

Physical aspect: Clear liquid
Refractive index: 1.4737 ± 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
Ethanol	0.01	Aliphatic alcohol
Isovaleral	0.01	Aliphatic aldehyde
2-Methylbutyral	tr	Aliphatic aldehyde
Toluene	0.01	Simple phenolic
Hexanal	0.01	Aliphatic aldehyde
(3*Z*)-Hexenol	0.02	Aliphatic alcohol
Hexanol	0.01	Aliphatic alcohol
Santene	0.12	Normonoterpene
Bornylene	0.01	Monoterpene
Tricyclene	0.34	Monoterpene
α-Thujene	0.06	Monoterpene
α-Pinene	36.31	Monoterpene
α-Fenchene	0.06	Monoterpene
Camphene	3.43	Monoterpene
Thuja-2,4(10)-diene	0.03	Monoterpene
Benzaldehyde	0.01	Simple phenolic
β-Pinene	34.65	Monoterpene
Sabinene	0.23	Monoterpene
6-Methyl-5-hepten-2-one	0.01	Aliphatic ketone
Myrcene	5.74	Monoterpene
Methyl 4-methylhexanoate	tr	Aliphatic ester
α-Phellandrene	0.32	Monoterpene
Pseudolimonene	0.01	Monoterpene
Δ3-Carene	2.54	Monoterpene
(3*Z*)-Hexenyl acetate	0.01	Aliphatic ester
α-Terpinene	0.14	Monoterpene
para-Cymene	0.12	Monoterpene
Limonene	4.02	Monoterpene
β-Phellandrene	4.28	Monoterpene
(*Z*)-β-Ocimene	0.02	Monoterpene
(*E*)-β-Ocimene	0.01	Monoterpene
γ-Terpinene	0.20	Monoterpene
Unknown	0.01	Oxygenated monoterpene
Octanol	tr	Aliphatic alcohol
Fenchone	0.04	Monoterpenic ketone
para-Cymenene	0.04	Monoterpene
Terpinolene	0.97	Monoterpene
α-Pinene oxide	0.01	Monoterpenic ether
α-Thujone	tr	Monoterpenic ketone
Linalool	0.02	Monoterpenic alcohol
endo-Fenchol	0.08	Monoterpenic alcohol
cis-para-Menth-2-en-1-ol	0.01	Monoterpenic alcohol
α-Campholenal	0.02	Monoterpenic aldehyde
trans-Pinocarveol	0.08	Monoterpenic alcohol
Camphor	0.11	Monoterpenic ketone

Camphene hydrate	0.06	Monoterpenic alcohol
β-Pinene oxide	0.01	Monoterpenic ether
Pinocamphone	0.06	Monoterpenic ketone
Isoborneol	0.02	Monoterpenic alcohol
Pinocarvone	0.02	Monoterpenic ketone
Borneol	0.25	Monoterpenic alcohol
Isopinocamphone	0.07	Monoterpenic ketone
Unknown	0.02	Oxygenated monoterpene
Terpinen-4-ol	0.26	Monoterpenic alcohol
Cryptone	0.01	Normonoterpenic ketone
Dill ether	0.02	Monoterpenic ether
para-Cymen-8-ol	0.02	Monoterpenic alcohol
α-Terpineol	0.58	Monoterpenic alcohol
Myrtenal	0.01	Monoterpenic aldehyde
Myrtenol	0.05	Monoterpenic alcohol
Methylchavicol	0.04	Phenylpropanoid
cis-α-Phellandrene epoxide (iPr vs Me)	0.02	Monoterpenic ether
Unknown	0.01	Unknown
Verbenone	0.02	Monoterpenic ketone
trans-Piperitol	0.01	Monoterpenic alcohol
endo-Fenchyl acetate	0.02	Monoterpenic ester
Thymol methyl ether	0.07	Monoterpenic ether
Unknown	0.01	Oxygenated monoterpene
Piperitone	0.01	Monoterpenic ketone
Unknown	0.02	Unknown
Phellandral	0.02	Monoterpenic aldehyde
α-Terpinen-7-al	0.01	Monoterpenic aldehyde
Bornyl acetate	1.02	Monoterpenic ester
2-Undecanone	0.01	Aliphatic ketone
Methyl myrtenate	0.02	Monoterpenic ester
Pin-2-en-8-yl acetate	0.02	Monoterpenic ester
δ-Elemene isomer	0.01	Sesquiterpene
Terpinyl acetate analog	0.01	Monoterpenic ester
Unknown	0.01	Unknown
α-Longipinene	0.01	Sesquiterpene
α-Cubebene	0.02	Sesquiterpene
α-Terpinyl acetate	0.02	Monoterpenic ester
Dodecanone analog?	0.02	Aliphatic ketone
α-Ylangene	0.02	Sesquiterpene
α-Copaene	0.06	Sesquiterpene
β-Bourbonene	0.01	Sesquiterpene
trans-Myrtanyl acetate	0.01	Monoterpenic ester
β-Cubebene	0.01	Sesquiterpene
β-Elemene	0.03	Sesquiterpene
Longifolene	0.01	Sesquiterpene
β-Caryophyllene	0.59	Sesquiterpene
β-Copaene	0.01	Sesquiterpene
Aromadendrene	0.02	Sesquiterpene
Cadina-3,5-diene isomer I?	0.01	Sesquiterpene
Cadina-3,5-diene?	0.02	Sesquiterpene
α-Humulene	0.18	Sesquiterpene
cis-Muurola-4(15),5-diene	0.02	Sesquiterpene

trans-Cadina-1(6),4-diene	0.03	Sesquiterpene
γ-Muurolene	0.08	Sesquiterpene
Germacrene D	0.31	Sesquiterpene
β-Selinene	0.02	Sesquiterpene
γ-Amorphene	0.03	Sesquiterpene
Bicyclogermacrene	0.06	Sesquiterpene
Viridiflorene	0.01	Sesquiterpene
α-Muurolene	0.10	Sesquiterpene
(*Z*)-α-Bisabolene	0.04	Sesquiterpene
γ-Cadinene	0.18	Sesquiterpene
trans-Calamenene	0.01	Sesquiterpene
δ-Cadinene	0.43	Sesquiterpene
trans-Cadina-1,4-diene	0.02	Sesquiterpene
α-Cadinene	0.03	Sesquiterpene
α-Calacorene	0.01	Sesquiterpene
(*E*)-Nerolidol	0.03	Sesquiterpenic alcohol
Spathulenol	0.02	Sesquiterpenic alcohol
Caryophyllene oxide	0.02	Sesquiterpenic ether
Humulene epoxide II	0.01	Sesquiterpenic ether
1-epi-Cubenol	0.01	Sesquiterpenic alcohol
τ-Cadinol	0.01	Sesquiterpenic alcohol
τ-Muurolol	0.01	Sesquiterpenic alcohol
α-Muurolol	0.01	Sesquiterpenic alcohol
α-Cadinol	0.02	Sesquiterpenic alcohol
meta-Camphorene	0.01	Diterpene
Manoyl oxide	0.03	Diterpenic ether
(*Z*)-Abienol	0.01	Diterpenic alcohol
Sandaracopimarinal?	0.01	Diterpenic aldehyde
Palustral	0.01	Diterpenic aldehyde
Consolidated total	**99.54%**	

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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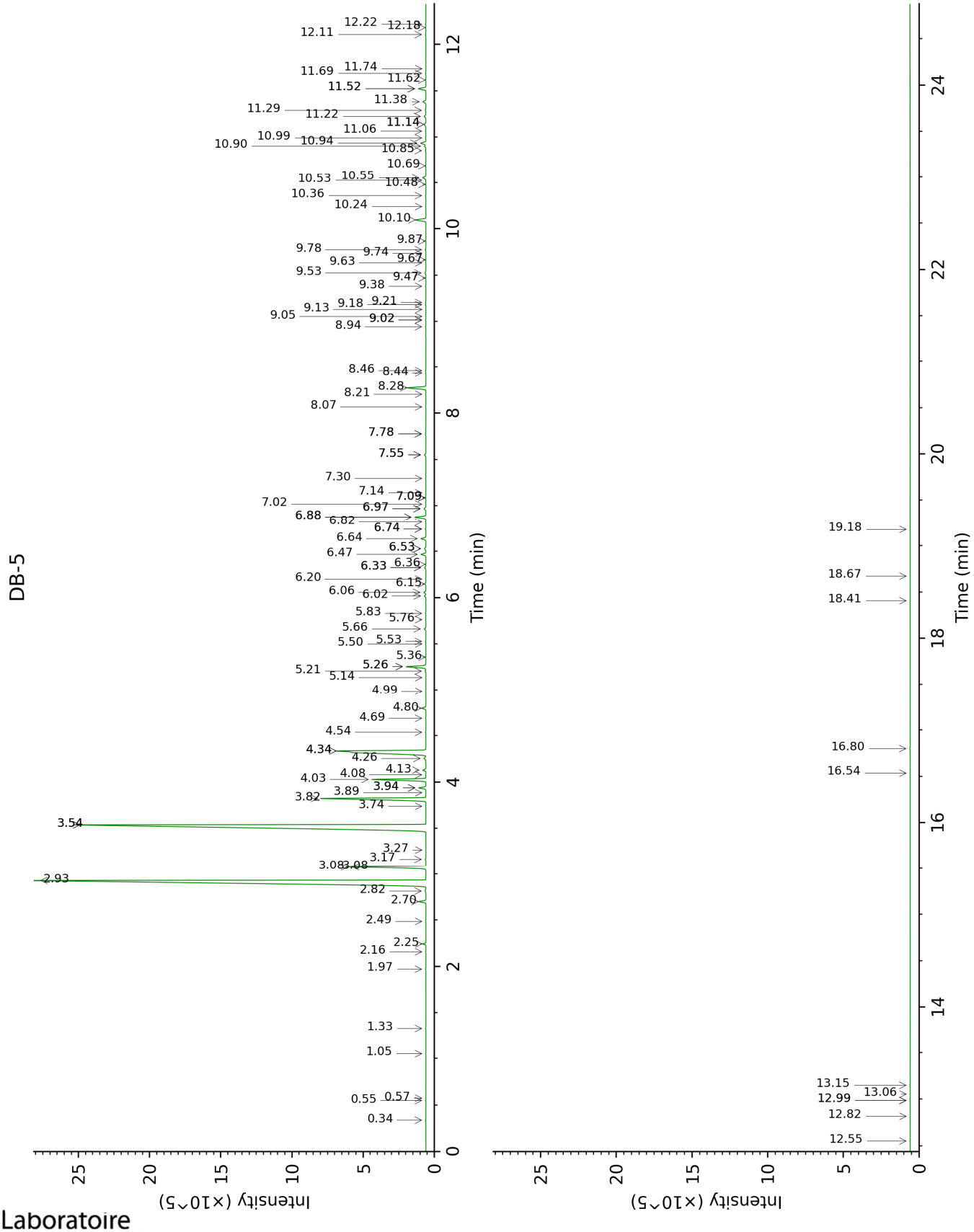
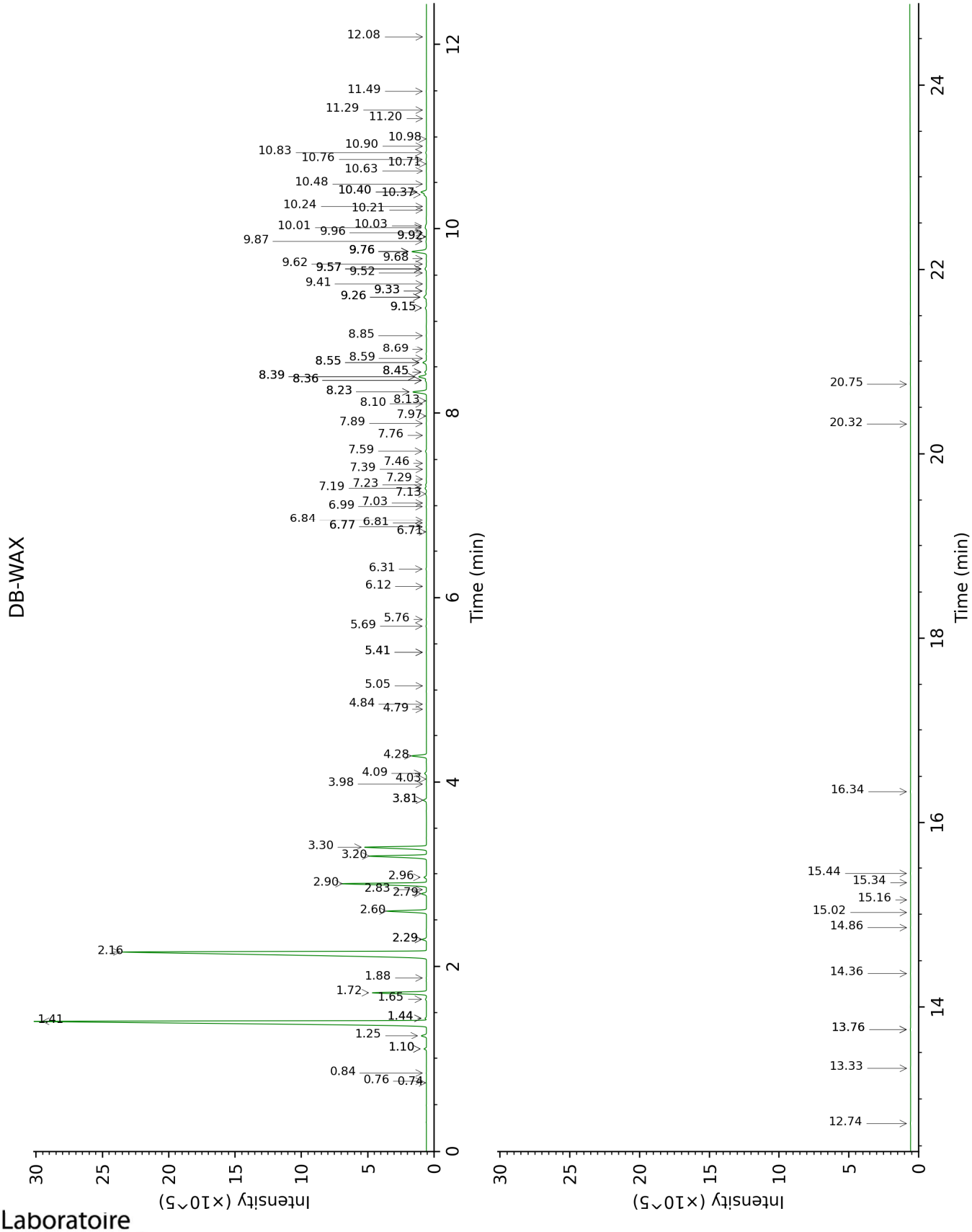

DB-5
Time (min)
Intensity (×10^5)
12.22
12.18
12.11
11.74
11.69
11.62
11.52
11.38
11.29
11.22
11.14
11.06
10.99
10.94
10.90
10.85
10.69
10.55
10.53
10.48
10.36
10.24
10.10
9.87
9.78
9.74
9.67
9.63
9.53
9.47
9.38
9.21
9.18
9.13
9.05
9.02
8.94
8.46
8.44
8.28
8.21
8.07
7.78
7.55
7.30
7.14
7.09
7.02
6.97
6.88
6.82
6.74
6.64
6.53
6.47
6.36
6.33
6.20
6.15
6.06
6.02
5.83
5.76
5.66
5.53
5.50
5.36
5.26
5.21
5.14
4.99
4.80
4.69
4.54
4.34
4.26
4.13
4.08
4.03
3.94
3.89
3.82
3.74
3.54
3.27
3.17
3.08
3.08
2.93
2.82
2.70
2.49
2.25
2.16
1.97
1.33
1.05
0.57
0.55
0.34
19.18
18.67
18.41
16.80
16.54
13.15
13.06
12.99
12.82
12.55


DB-WAX
Time (min)
Intensity (×10^5)
12.08
11.49
11.29
11.20
10.98
10.90
10.83
10.76
10.71
10.63
10.48
10.40
10.37
10.24
10.21
10.03
10.01
9.96
9.92
9.87
9.76
9.68
9.62
9.57
9.52
9.41
9.33
9.26
9.15
8.85
8.69
8.59
8.55
8.45
8.39
8.36
8.23
8.13
8.10
7.97
7.89
7.76
7.59
7.46
7.39
7.29
7.23
7.19
7.13
7.03
6.99
6.84
6.81
6.77
6.71
6.31
6.12
5.76
5.69
5.41
5.05
4.84
4.79
4.28
4.09
4.03
3.98
3.81
3.30
3.20
2.96
2.90
2.83
2.79
2.60
2.29
2.16
1.88
1.72
1.65
1.44
1.41
1.25
1.10
0.84
0.76
0.74
20.75
20.32
16.34
15.44
15.34
15.16
15.02
14.86
14.36
13.76
13.33
12.74

FULL ANALYSIS DATA

Identification	Column DB-5			Column DB-WAX		
	R.T	R.I	%	R.T	R.I	%
Ethanol	0.34	499	0.01	0.84	905	0.01
Isovaleral	0.55	641	0.01	0.76	884	0.01
2-Methylbutyral	0.57	651	tr	0.74	878	tr
Toluene	1.05	758	0.01	1.44*	999	0.08
Hexanal	1.33	801	0.01	1.88	1042	0.01
(3*Z*)-Hexenol	1.97	858	0.02	5.76	1345	0.02
Hexanol	2.16	875	0.01	5.41*	1319	0.02
Santene	2.24	882	0.12	1.10*	947	0.12
Bornylene	2.49	904	0.01	1.10*	947	[0.12]
Tricyclene	2.70	918	0.34	1.25	971	0.33
α-Thujene	2.82	926	0.06	1.44*	999	[0.08]
α-Pinene	2.93	934	36.31	1.41	996	36.20
α-Fenchene	3.08*	944	3.49	1.65	1019	0.06
Camphene	3.08*	944	[3.49]	1.72	1026	3.43
Thuja-2,4(10)-diene	3.16	950	0.03	2.29*	1083	0.26
Benzaldehyde	3.27	957	0.01	7.40	1464	0.01
β-Pinene	3.54*	975	34.92	2.16	1070	34.65
Sabinene	3.54*	975	[34.92]	2.29*	1083	[0.26]
6-Methyl-5-hepten-2-one	3.74	989	0.01	5.05	1298	0.01
Myrcene	3.82	994	5.74	2.90	1133	5.72
Methyl 4-methylhexanoate	3.89	999	tr	4.03	1222	0.01
α-Phellandrene	3.94*	1002	0.34	2.79	1125	0.32
Pseudolimonene	3.94*	1002	[0.34]	2.83	1128	0.01
Δ3-Carene	4.03	1008	2.54	2.60	1110	2.53
(3*Z*)-Hexenyl acetate	4.08	1011	0.01	4.84	1282	0.01
α-Terpinene	4.13	1014	0.14	2.96	1139	0.15
para-Cymene	4.26	1022	0.12	4.09	1226	0.12
Limonene	4.34*	1028	8.29	3.20	1158	4.02
β-Phellandrene	4.34*	1028	[8.29]	3.30	1165	4.28
(*Z*)-β-Ocimene	4.54	1040	0.02	3.80*	1205	0.22
(*E*)-β-Ocimene	4.69	1050	0.01	3.98	1218	0.01
γ-Terpinene	4.80	1057	0.20	3.80*	1205	[0.22]
Unknown [m/z 79, 93 (60), 43 (40), 94 (35), 137 (33), 77 (26), 91 (20), 152 (18)]	4.99	1069	0.01	4.79	1278	0.01
Octanol	5.14	1078	tr	8.23*	1528	1.03
Fenchone	5.21	1083	0.04	5.69	1339	0.04
para-Cymenene	5.26*	1086	1.02	6.31	1384	0.04
Terpinolene	5.26*	1086	[1.02]	4.28	1241	0.97
α-Pinene oxide	5.36	1092	0.01	5.41*	1319	[0.02]
α-Thujone	5.50	1101	tr	6.12	1370	0.01
Linalool	5.53	1103	0.02	8.10	1518	0.02
endo-Fenchol	5.66	1112	0.08	8.36*	1537	0.09

cis-para-Menth-2-en-1-ol	5.76	1118	0.01	8.14	1520	0.01
α-Campholenal	5.83	1123	0.02	6.99	1434	0.02
trans-Pinocarveol	6.02	1135	0.08	9.15*	1599	0.10
Camphor	6.06	1137	0.11	7.19	1449	0.11
Camphene hydrate	6.15	1143	0.06	8.45*	1544	0.12
β-Pinene oxide	6.20	1146	0.01	6.71	1413	0.01
Pinocamphone	6.33*	1154	0.07	7.23	1452	0.06
Isoborneol	6.33*	1154	[0.07]	9.41	1620	0.02
Pinocarvone	6.36	1157	0.02	7.89	1501	0.03
Borneol	6.47	1164	0.25	9.76*	1648	1.16
Isopinocamphone	6.53*	1168	0.09	7.59	1479	0.07
Unknown [m/z 109, 79 (18), 81 (15), 91 (12), 77 (10)... 152 (3)]	6.53*	1168	[0.09]			
Terpinen-4-ol	6.64	1175	0.26	8.55*	1552	0.28
Cryptone	6.74*	1181	0.03	9.15*	1599	[0.10]
Dill ether	6.74*	1181	[0.03]	7.29	1456	0.02
para-Cymen-8-ol	6.82	1186	0.02	11.50	1793	0.02
α-Terpineol	6.88*	1190	0.59	9.76*	1648	[1.16]
Myrtenal	6.88*	1190	[0.59]	8.69	1563	0.01
Myrtenol	6.97*	1196	0.12	10.83	1737	0.05
Methylchavicol	6.97*	1196	[0.12]	9.33*	1614	0.06
cis-α-Phellandrene epoxide (iPr vs Me)	7.02	1199	0.02	10.98	1750	0.02
Unknown [m/z 95, 93 (32), 121 (24), 79 (22), 91 (21), 105 (16)... 154 (2)]	7.09*	1203	0.03	10.90	1743	0.01
Verbenone	7.09*	1203	[0.03]	9.62	1637	0.02
trans-Piperitol	7.14	1207	0.01	10.40*	1700	0.45
endo-Fenchyl acetate	7.30	1217	0.02	6.81	1420	0.02
Thymol methyl ether	7.55*	1234	0.09	8.45*	1544	[0.12]
Unknown [m/z 137, 152 (28), 43 (25), 91 (24), 109 (23), 119 (19)]	7.55*	1234	[0.09]	11.29	1776	0.01
Piperitone	7.78*	1250	0.03	9.92*	1661	0.03
Unknown [m/z 43, 97 (55), 107 (44), 41 (38), 109 (32), 55 (27)...]	7.78*	1250	[0.03]			
Phellandral	8.07	1269	0.02	9.96	1664	0.01
α-Terpinen-7-al	8.21	1278	0.01	10.71	1727	0.01
Bornyl acetate	8.28	1283	1.02	8.23*	1528	[1.03]
2-Undecanone	8.44	1294	0.01	8.59	1556	0.02
Methyl myrtenate	8.46	1296	0.02	9.52	1629	0.03
Pin-2-en-8-yl acetate	8.94	1329	0.02	9.57*	1633	0.13
δ-Elemene isomer	9.02*	1334	0.02	6.84	1423	0.01

Terpinyl acetate analog	9.02*	1334	[0.02]	9.57*	1633	[0.13]
Unknown [m/z 93, 121 (67), 91 (62), 105 (56), 120 (56), 79 (47), 41 (47)...]	9.06	1337	0.01	10.48	1708	0.01
α-Longipinene	9.13	1342	0.01	6.77*	1417	0.03
α-Cubebene	9.18	1346	0.02	6.77*	1417	[0.03]
α-Terpinyl acetate	9.21	1348	0.02	9.68	1642	0.02
Dodecanone analog?	9.38	1360	0.02			
α-Ylangene	9.47	1366	0.02	7.03	1437	0.01
α-Copaene	9.52	1370	0.06	7.13	1444	0.05
β-Bourbonene	9.63	1378	0.01	7.46	1469	0.01
trans-Myrtanyl acetate	9.67	1380	0.01	10.24	1688	0.01
β-Cubebene	9.74	1386	0.01	7.76	1491	0.01
β-Elemene	9.78	1388	0.03	8.40*	1540	0.62
Longifolene	9.87	1395	0.01	7.97	1507	0.02
β-Caryophyllene	10.10	1411	0.59	8.40*	1540	[0.62]
β-Copaene	10.24	1422	0.01	8.36*	1537	[0.09]
Aromadendrene	10.36	1431	0.02	8.55*	1552	[0.28]
Cadina-3,5-diene isomer I?	10.48	1440	0.01			
Cadina-3,5-diene?	10.53	1444	0.02	8.85	1575	0.03
α-Humulene	10.56	1446	0.18	9.26*	1608	0.26
cis-Muurola-4(15),5-diene	10.69	1456	0.02	9.33*	1614	[0.06]
trans-Cadina-1(6),4-diene	10.85	1468	0.03	9.26*	1608	[0.26]
γ-Muurolene	10.90	1472	0.08	9.57*	1633	[0.13]
Germacrene D	10.94	1474	0.31	9.76*	1648	[1.16]
β-Selinene	10.99	1478	0.02	9.92*	1661	[0.03]
γ-Amorphene	11.06	1484	0.03	9.87	1657	0.06
Bicyclogermacrene	11.14*	1489	0.12	10.01†	1669	0.17
Viridiflorene	11.14*	1489	[0.12]	9.76*	1648	[1.16]
α-Muurolene	11.22	1496	0.10	10.03†	1671	[0.17]
(*Z*)-α-Bisabolene	11.29	1500	0.04	10.20	1684	0.01
γ-Cadinene	11.38	1508	0.18	10.37	1698	0.16
trans-Calamenene	11.52*	1519	0.44	11.20	1768	0.01
δ-Cadinene	11.52*	1519	[0.44]	10.40*	1700	[0.45]
trans-Cadina-1,4-diene	11.62	1526	0.02	10.64	1720	0.02
α-Cadinene	11.69	1532	0.03	10.76	1731	0.03
α-Calacorene	11.74	1536	0.01	12.08	1846	0.01
(*E*)-Nerolidol	12.11	1565	0.03	13.76*	1998	0.03
Spathulenol	12.18	1571	0.02	14.36	2056	0.02
Caryophyllene oxide	12.22	1574	0.02	12.74	1904	0.03
Humulene epoxide II	12.55	1600	0.01	13.33	1959	0.01
1-epi-Cubenol	12.82	1621	0.01	13.76*	1998	[0.03]
τ-Cadinol	12.99*	1635	0.03	14.86	2105	0.01
τ-Muurolol	12.99*	1635	[0.03]	15.02	2121	0.01

α-Muurolol	13.06	1641	0.01	15.16	2134	0.01
α-Cadinol	13.15	1649	0.02	15.44	2163	0.02
meta-Camphorene	16.54	1949	0.01	15.34	2153	0.01
Manoyl oxide	16.80	1974	0.03	16.34	2255	0.02
(*Z*)-Abienol	18.41	2134	0.01	20.32	2705	0.01
Sandaracopimarinal?	18.67	2162	0.01			
Palustral	19.18	2214	0.01	20.75	2758	0.01
Total identified		**99.66%**			**99.43%**	
Total reported		**99.67%**			**99.48%**	

*: 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