CERTIFICATE OF ANALYSIS – GC PROFILING

SAMPLE IDENTIFICATION

Internal code : 19A10-PTH07-1-CC
Customer identification : Fir Needle - Siberia - F2010585R
Type : Essential oil
Source : *Abies sibirica*
Customer : Plant Therapy

ANALYSIS

Method: PC-PA-014-17J19 - 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
Analysis date : January 11, 2019

Checked and approved by :

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

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PHYSICOCHEMICAL DATA

Physical aspect: Clear liquid
Refractive index: 1.4690 ± 0.0003 (20 °C)

ISO 10869:2011 - OIL OF FIR NEEDLE, SIBERIAN

Compound	Min. %	Max. %	Observed %	Complies?
α-Humulene	0.3	0.9	0.6	Yes
Borneol	1.0	3.0	1.2	Yes
Isobornyl acetate		0.1	0.1	Yes
β-Caryophyllene	0.5	2.0	1.2	Yes
Bornyl acetate	20.0	35.0	25.3	Yes
β-Phellandrene	1.5	5.0	3.7	Yes
Limonene	4.0	10.0	5.1	Yes
Δ3-Carene	9.0	15.0	13.5	Yes
β-Pinene	1.0	3.5	2.4	Yes
Camphene	15.0	26.0	22.4	Yes
α-Pinene	10.0	22.0	13.8	Yes
Tricyclene	1.5	3.5	2.2	Yes
Santene	1.5	3.5	2.3	Yes
Refractive index	1.4680	1.4730	1.4690	Yes

CONCLUSION

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

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ANALYSIS SUMMARY

Identification	DB-5 (%)	DB-WAX (%)	Classe
Toluene	0.01	0.14*	Simple phenolic
Hexanal	tr	tr	Aliphatic aldehyde
(3Z)-Hexenol	0.01	0.01	Aliphatic alcohol
Hexanol	tr	0.01	Aliphatic alcohol
Santene	2.30	2.28*	Monoterpene
Unknown	0.03	[0.14]*	Normonoterpene
Bornylene	tr	[2.28]*	Monoterpene
Tricyclene	2.22	2.25	Monoterpene
α-Thujene	0.09	[0.14]*	Monoterpene
α-Pinene	13.76	13.62	Monoterpene
Camphene	22.51*	22.37	Monoterpene
α-Fenchene	[22.51]*	0.03	Monoterpene
Thuja-2,4(10)-diene	0.02	0.04*	Monoterpene
meta-Cymene	0.05	0.67*	Monoterpene
β-Pinene	2.44*	2.38	Monoterpene
Sabinene	[2.44]*	[0.04]*	Monoterpene
Unknown	0.01		Monoterpene
Myrcene	0.64	[0.67]*	Monoterpene
2-Carene	0.01	0.01	Monoterpene
α-Phellandrene	0.22*	0.21	Monoterpene
Pseudolimonene	[0.22]*	0.01	Monoterpene
Δ3-Carene	13.61*	13.50	Monoterpene
(3Z)-Hexenyl acetate	[13.61]*	0.01	Aliphatic ester
α-Terpinene	0.13	0.14	Monoterpene
Carvomenthene	0.01	0.01	Aliphatic alcohol
para-Cymene	0.08	0.08	Monoterpene
Limonene	8.89*	5.07	Monoterpene
1,8-Cineole	[8.89]*	3.74*	Monoterpenic ether
β-Phellandrene	[8.89]*	[3.74]*	Monoterpene
γ-Terpinene	0.19	0.19	Monoterpene
Fenchone	0.02	0.01	Aliphatic alcohol
Isoterpinolene	0.06	0.05	Monoterpene
Terpinolene	1.37*	1.29	Monoterpene
γ-Campholenal	[1.37]*	0.02	Aliphatic alcohol
Linalool	0.05*	0.02	Monoterpenic alcohol
Unknown	[0.05]*		Unknown
α-Thujone	[0.05]	tr	Monoterpenic ketone
endo-Fenchol	0.03	0.02	Monoterpenic alcohol
cis-para-Menth-2-en-1-ol	0.03	0.02	Monoterpenic alcohol
α-Campholenal	0.02	0.02	Monoterpenic aldehyde
trans-Pinocarveol	0.03	0.03	Monoterpenic alcohol
Camphor	0.20	0.19*	Monoterpenic ketone
Camphene hydrate	0.09	1.35*	Monoterpenic alcohol
meta-Mentha-4,6-dien-8-ol	0.02	0.01	Monoterpenic alcohol
Isoborneol	0.02	0.03	Monoterpenic alcohol
Pinocarvone	0.03	0.08	Monoterpenic ketone
Borneol	1.21	1.43*	Monoterpenic alcohol
Isopinocamphone	0.01	0.01	Monoterpenic ketone

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Terpinen-4-ol	0.11	0.09	Monoterpenic alcohol
meta-Cymen-8-ol	0.04*	0.05	Monoterpenic alcohol
Cryptone	[0.04]*	0.03	Normonoterpenic ketone
para-Cymen-8-ol	0.03	[0.05]	Monoterpenic alcohol
α-Terpineol	0.21	[1.43]*	Monoterpenic alcohol
Myrtenal	0.01	0.01	Monoterpenic aldehyde
Myrtenol	0.02	0.02	Monoterpenic alcohol
Verbenone	0.05	0.05	Monoterpenic ketone
endo-Fenchyl acetate	0.02	0.05*	Monoterpenic ester
Citronellol	0.01	0.01	Monoterpenic alcohol
Thymol methyl ether	0.06	[1.35]*	Monoterpenic ether
Carvone	0.01	0.01	Monoterpenic ketone
Nojigiku acetate	0.02	0.01	Monoterpenic ester
Piperitone	0.01	0.01	Monoterpenic ketone
Geraniol	0.02	0.02	Monoterpenic alcohol
Phellandral	0.03	0.05*	Monoterpenic aldehyde
Bornyl acetate	24.63*	25.30	Monoterpenic ester
Isobornyl acetate	[24.63]*	0.07	Monoterpenic ester
2-Undecanone	[24.63]*	0.03*	Aliphatic ketone
Isohexyl isocaproate	0.03	0.02	Aliphatic ester
Unknown	0.02		Unknown
α-Longipinene	0.03	[0.05]*	Sesquiterpene
α-Terpinyl acetate	0.01	0.01	Monoterpenic ester
Citronellyl acetate	0.02	0.02	Monoterpenic ester
Neryl acetate	0.05	0.23*	Monoterpenic ester
α-Ylangene	0.02	0.02	Sesquiterpene
α-Copaene	0.02	[0.19]*	Sesquiterpene
Geranyl acetate	0.19	0.18	Monoterpenic ester
Longifolene	0.17	0.13	Sesquiterpene
Methyleugenol	0.01	0.02	Phenylpropanoid
Dodecanal	0.13	0.14	Aliphatic aldehyde
β-Caryophyllene	1.20	[1.35]*	Sesquiterpene
Caryophylla-4(12),8(13)-diene	0.01	[0.03]*	Sesquiterpene
trans-α-Bergamotene	0.01	[1.35]*	Sesquiterpene
α-Himachalene	0.05	0.07	Sesquiterpene
α-Humulene	0.65	0.66	Sesquiterpene
(*E*)-β-Farnesene	0.02	0.02	Sesquiterpene
γ-Himachalene	0.04	0.04	Sesquiterpene
Dodecanol	0.03	0.03	Aliphatic alcohol
Unknown	0.05	[0.05]*	Sesquiterpene
β-Alaskene	0.02	0.02	Sesquiterpene
β-Himachalene	0.05	0.04	Sesquiterpene
α-Muurolene	0.03	0.03	Sesquiterpene
(*Z*)-α-Bisabolene	0.03	0.02	Sesquiterpene
β-Bisabolene	0.17	[0.23]*	Sesquiterpene
δ-Cadinene	0.04	0.03	Sesquiterpene
(*E*)-γ-Bisabolene	0.10	0.12	Sesquiterpene
(*E*)-α-Bisabolene	0.02	0.02	Sesquiterpene
(*E*)-Nerolidol	0.02	0.02	Sesquiterpenic alcohol
Caryophyllene oxide isomer	0.03*	0.01	Sesquiterpenic ether
Caryophyllene oxide	[0.03]*	0.03	Sesquiterpenic ether
Humulene epoxide II	0.01	0.01	Sesquiterpenic ether

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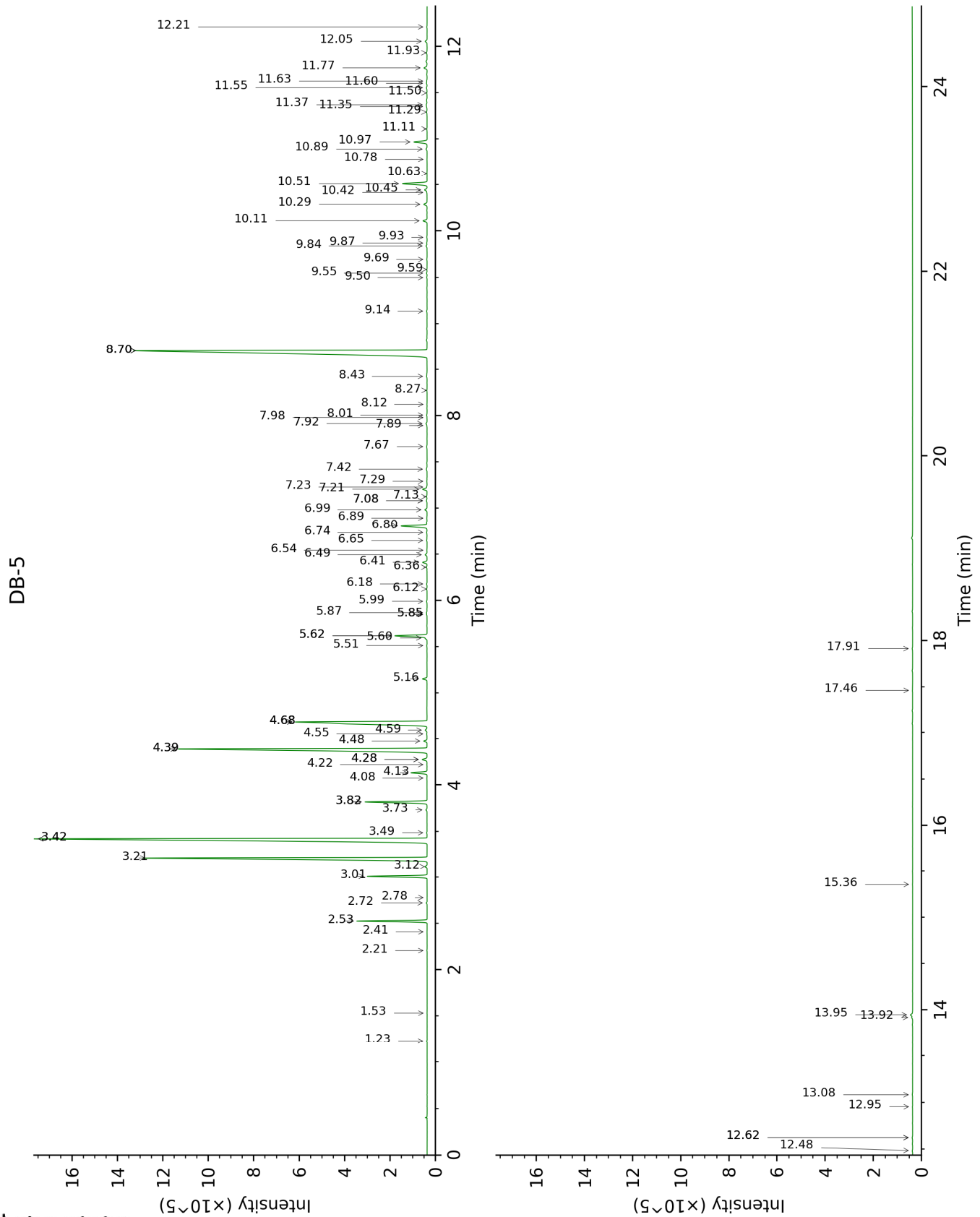|			
Selin-6-en-4α-ol?	0.03	0.02	Sesquiterpenic alcohol
epi-α-Bisabolol	0.16	0.11	Sesquiterpenic alcohol
α-Bisabolol	[0.16]	0.05	Sesquiterpenic alcohol
Manoyl oxide	0.01	0.01	Diterpenic ether
13-epi-Manoyl oxide	0.01	0.03	Diterpenic ether
Manool	0.03	0.02	Diterpenic alcohol
Total identified	**99.08%**	**99.32%**	

*: Two or more compounds are coeluting on this column
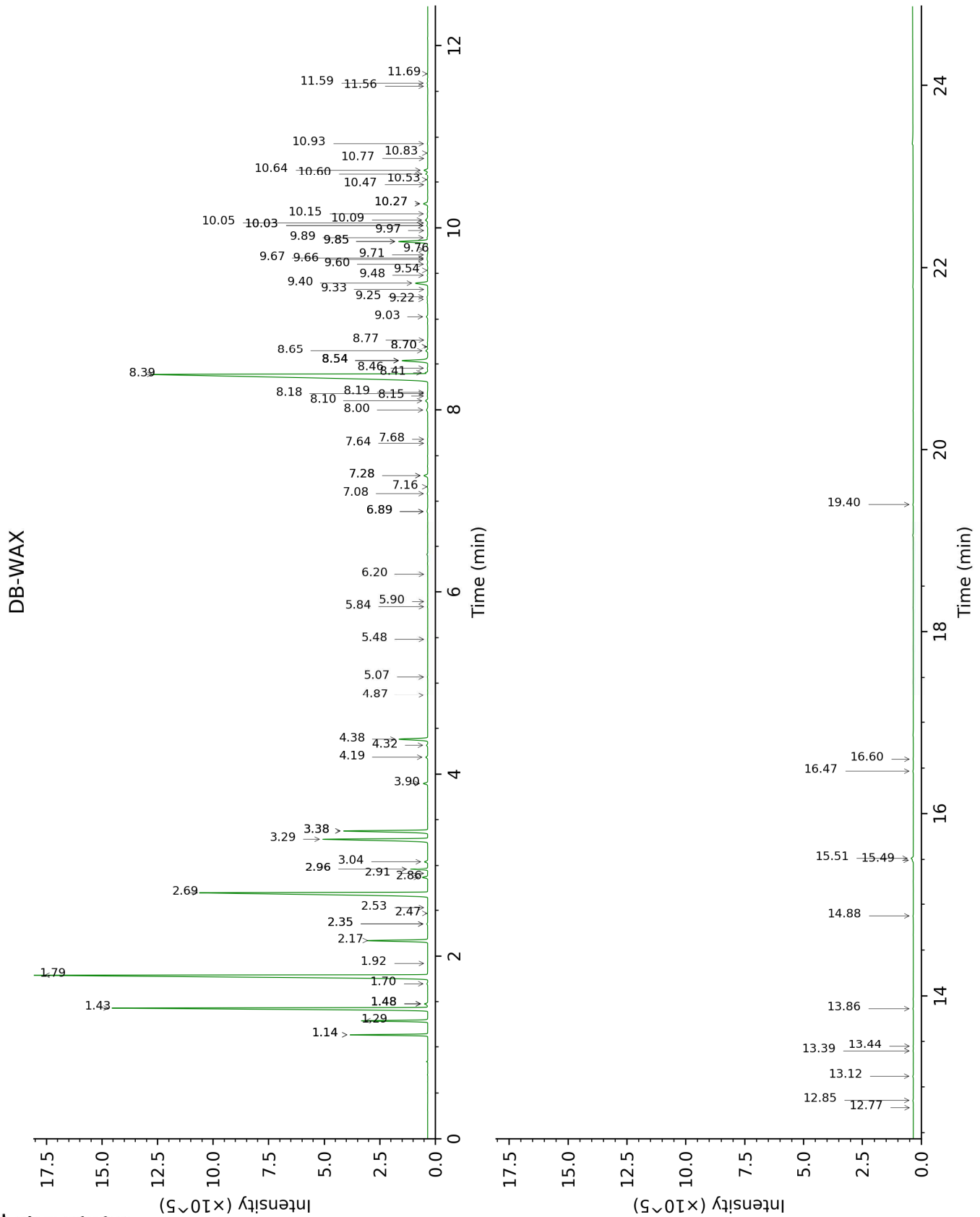
[xx]: Duplicate percentage due to coelutions, not taken account in the identified total

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

Note: no correction factor was applied

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DB-5

Top chromatogram (0–12 min):
12.21, 12.05, 11.93, 11.77, 11.63, 11.60, 11.55, 11.50, 11.37, 11.35, 11.29, 11.11, 10.97, 10.89, 10.78, 10.63, 10.51, 10.45, 10.42, 10.29, 10.11, 9.93, 9.87, 9.84, 9.69, 9.59, 9.55, 9.50, 9.14, 8.70, 8.43, 8.27, 8.12, 8.01, 7.98, 7.92, 7.89, 7.67, 7.42, 7.29, 7.23, 7.21, 7.13, 7.08, 6.99, 6.89, 6.80, 6.74, 6.65, 6.54, 6.49, 6.41, 6.36, 6.18, 6.12, 5.99, 5.87, 5.85, 5.62, 5.60, 5.51, 5.16, 4.68, 4.59, 4.55, 4.48, 4.39, 4.28, 4.22, 4.13, 4.08, 3.82, 3.73, 3.49, 3.42, 3.21, 3.12, 3.01, 2.78, 2.72, 2.53, 2.41, 2.21, 1.53, 1.23

Time (min)

Intensity (×10^5)

Bottom chromatogram (12–24 min):
17.91, 17.46, 15.36, 13.95, 13.92, 13.08, 12.95, 12.62, 12.48

Time (min)

Intensity (×10^5)

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DB-WAX

FULL ANALYSIS DATA

Identification	Column DB-5			Column DB-WAX		
	R.T	R.I	%	R.T	R.I	%
Toluene	1.23	756	0.01	1.48*	1003	0.14
Hexanal	1.53	796	tr	1.92	1044	tr
(3*Z*)-Hexenol	2.21	855	0.01	5.90	1350	0.01
Hexanol	2.41	872	tr	5.48	1320	0.01
Santene	2.53	881	2.30	1.14*	953	2.28
Unknown [m/z 79, 93 (66), 94 (52), 91 (39), 77 (37), 122 (31)]	2.72	897	0.03	1.48*	1003	[0.14]
Bornylene	2.78	902	tr	1.14*	953	[2.28]
Tricyclene	3.01	917	2.22	1.29	976	2.25
α-Thujene	3.12	925	0.09	1.48*	1003	[0.14]
α-Pinene	3.21	931	13.76	1.43	996	13.62
Camphene	3.42*	944	22.51	1.79	1032	22.37
α-Fenchene	3.42*	944	[22.51]	1.70	1024	0.03
Thuja-2,4(10)-diene	3.49	948	0.02	2.35*	1086	0.04
meta-Cymene	3.73	965	0.05	2.96*	1135	0.67
β-Pinene	3.82*	970	2.44	2.17	1068	2.38
Sabinene	3.82*	970	[2.44]	2.35*	1086	[0.04]
Unknown [m/z 91, 119 (65), 109 (51), 134 (47)]	4.08	987	0.01			
Myrcene	4.13	991	0.64	2.96*	1135	[0.67]
2-Carene	4.22	997	0.01	2.47	1097	0.01
α-Phellandrene	4.28*	1001	0.22	2.86	1128	0.21
Pseudolimonene	4.28*	1001	[0.22]	2.91	1131	0.01
Δ3-Carene	4.39*	1008	13.61	2.70	1115	13.50
(3*Z*)-Hexenyl acetate	4.39*	1008	[13.61]	4.87	1284	0.01
α-Terpinene	4.48	1013	0.13	3.04	1142	0.14
Carvomenthene	4.55	1018	0.01	2.53	1102	0.01
para-Cymene	4.59	1021	0.08	4.19	1232	0.08
Limonene	4.68*	1026	8.89	3.29	1161	5.07
1,8-Cineole	4.68*	1026	[8.89]	3.38*	1169	3.74
β-Phellandrene	4.68*	1026	[8.89]	3.38*	1169	[3.74]
γ-Terpinene	5.16	1056	0.19	3.90	1210	0.19
Fenchone	5.51	1078	0.02	5.84	1346	0.01
Isoterpinolene	5.60	1084	0.06	4.32	1242	0.05
Terpinolene	5.62*	1085	1.37	4.38	1247	1.29
γ-Campholenal	5.62*	1085	[1.37]	5.07	1300	0.02
Linalool	5.85*†	1100	0.05	8.15	1518	0.02
Unknown [m/z 79, 94 (87), 77 (25), 91 (21), 93 (16), 95 (12), 138 (8)]	5.85*†	1100	[0.05]			
α-Thujone	5.87†	1101	[0.05]	6.20	1372	tr

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endo-Fenchol	5.99	1109	0.03	8.46	1542	0.02
cis-para-Menth-2-en-1-ol	6.12	1117	0.03	8.18	1520	0.02
α-Campholenal	6.18	1121	0.02	7.08	1438	0.02
trans-Pinocarveol	6.36	1132	0.03	9.25	1604	0.03
Camphor	6.41	1136	0.20	7.28*	1452	0.19
Camphene hydrate	6.49	1141	0.09	8.54*	1549	1.35
meta-Mentha-4,6-dien-8-ol	6.54	1144	0.02	9.33	1610	0.01
Isoborneol	6.65	1151	0.02	9.48	1623	0.03
Pinocarvone	6.74	1157	0.03	8.00	1506	0.08
Borneol	6.80	1162	1.21	9.85*	1653	1.43
Isopinocamphone	6.90	1167	0.01	7.68	1482	0.01
Terpinen-4-ol	6.99	1173	0.11	8.65	1557	0.09
meta-Cymen-8-ol	7.08*	1180	0.04	11.56†	1797	0.05
Cryptone	7.08*	1180	[0.04]	9.22	1602	0.03
para-Cymen-8-ol	7.13	1182	0.03	11.59†	1800	[0.05]
α-Terpineol	7.21	1188	0.21	9.85*	1653	[1.43]
Myrtenal	7.23	1189	0.01	8.77	1567	0.01
Myrtenol	7.29	1193	0.02	10.93	1743	0.02
Verbenone	7.42	1202	0.05	9.67	1639	0.05
endo-Fenchyl acetate	7.67	1218	0.02	6.89*†	1423	0.05
Citronellol	7.90	1234	0.01	10.77	1730	0.01
Thymol methyl ether	7.92	1235	0.06	8.54*	1549	[1.35]
Carvone	7.98	1240	0.01	10.05	1670	0.01
Nojigiku acetate	8.01	1241	0.02	8.19	1522	0.01
Piperitone	8.12	1249	0.01	9.97	1663	0.01
Geraniol	8.27	1260	0.02	11.69	1809	0.02
Phellandral	8.42	1270	0.03	10.03*	1668	0.05
Bornyl acetate	8.70*	1289	24.63	8.39	1537	25.30
Isobornyl acetate	8.70*	1289	[24.63]	8.41	1538	0.07
2-Undecanone	8.70*	1289	[24.63]	8.70*	1561	0.03
Isohexyl isocaproate	9.14	1316	0.03	7.64	1479	0.02
Unknown [m/z 121, 93 (84), 43 (81), 79 (48), 117 (40), 56 (37)...]	9.50	1341	0.02			
α-Longipinene	9.55	1345	0.03	6.89*†	1423	[0.05]
α-Terpinyl acetate	9.59	1348	0.01	9.76	1646	0.01
Citronellyl acetate	9.69	1355	0.02	9.54	1628	0.02
Neryl acetate	9.84	1366	0.05	10.26*	1687	0.23
α-Ylangene	9.87	1368	0.02	7.16	1443	0.02
α-Copaene	9.93	1372	0.02	7.28*	1452	[0.19]
Geranyl acetate	10.11	1385	0.19	10.64	1718	0.18
Longifolene	10.29	1398	0.17	8.10	1514	0.13
Methyleugenol	10.42	1407	0.01	13.39	1963	0.02
Dodecanal	10.44	1409	0.13	10.09	1673	0.14
β-Caryophyllene	10.51	1414	1.20	8.54*	1549	[1.35]

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Caryophylla-4(12),8(13)-diene	10.63	1422	0.01	8.70*	1561	[0.03]
trans-α-Bergamotene	10.78	1434	0.01	8.54*	1549	[1.35]
α-Himachalene	10.89	1442	0.05	9.03	1587	0.07
α-Humulene	10.97	1448	0.65	9.40	1616	0.66
(*E*)-β-Farnesene	11.11	1459	0.02	9.66	1637	0.02
γ-Himachalene	11.29	1472	0.04	9.60	1633	0.04
Dodecanol	11.35	1477	0.03	13.12	1937	0.03
Unknown [m/z 91, 93 (92), 105 (71), 77 (69), 79 (68), 133 (63)... 204 (32)]	11.37	1478	0.05	10.03*	1668	[0.05]
β-Alaskene	11.50	1488	0.02	9.71	1642	0.02
β-Himachalene	11.56	1492	0.05	9.89	1657	0.04
α-Muurolene	11.60	1495	0.03	10.15	1678	0.03
(*Z*)-α-Bisabolene	11.63	1497	0.03	10.47	1704	0.02
β-Bisabolene	11.77	1508	0.17	10.26*	1687	[0.23]
δ-Cadinene	11.93	1521	0.04	10.53	1709	0.03
(*E*)-γ-Bisabolene	12.06	1531	0.10	10.60	1715	0.12
(*E*)-α-Bisabolene	12.21	1543	0.02	10.83	1735	0.02
(*E*)-Nerolidol	12.48	1564	0.02	13.86	2007	0.02
Caryophyllene oxide isomer	12.62*	1575	0.03	12.77	1905	0.01
Caryophyllene oxide	12.62*	1575	[0.03]	12.85	1913	0.03
Humulene epoxide II	12.95	1602	0.01	13.44	1968	0.01
Selin-6-en-4α-ol?	13.08	1612	0.03	14.88	2105	0.02
epi-α-Bisabolol	13.92†	1681	0.16	15.51	2169	0.11
α-Bisabolol	13.95†	1684	[0.16]	15.49	2167	0.05
Manoyl oxide	15.36	1805	0.01	16.60	2281	0.01
13-epi-Manoyl oxide	17.46	2001	0.01	16.47	2268	0.03
Manool	17.92	2046	0.03	19.40	2594	0.02
Total identified		**99.08%**			**99.32%**	
Total reported		**99.19%**			**99.32%**	

*: Two or more compounds are coeluting on this column

[xx]: Duplicate percentage due to coelutions, not taken account in the identified 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

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