Date : February 16, 2023

Certificate of Analysis – GC Profiling

Sample identification

Internal code : 22I20-NPA01
Customer identification : Tea Tree Oil, Lot NP0001, Zambia
Type : Essential oil
Source : *Melaleuca alternifolia* ct. Terpinen-4-ol (Tea Tree)
Customer : Nature Packaged

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 : Amélie Simard, Analyste
Analysis date : October 03, 2022

Checked and approved by :

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

Notes: 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.

This report is an update from the first version issued on October 4, 2022, to format it for online publication.

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PHYSICOCHEMICAL DATA

Physical aspect: Clear liquid
Refractive index: 1.4772 ± 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
Isobutanol	tr	Aliphatic alcohol
2-Methylbutyral	0.01	Aliphatic aldehyde
2-Methylbutanol	tr	Aliphatic alcohol
(3*Z*)-Hexenol	0.02	Aliphatic alcohol
Hexanol	tr	Aliphatic alcohol
α-Thujene	1.14	Monoterpene
α-Pinene	2.95	Monoterpene
Camphene	0.01	Monoterpene
α-Fenchene	0.01	Monoterpene
Sabinene	0.27	Monoterpene
β-Pinene	0.89	Monoterpene
3-Methyl-3-cyclohexenone	0.01	Aliphatic ketone
Octen-3-ol	0.02	Aliphatic alcohol
Myrcene	1.06	Monoterpene
Pseudolimonene	0.02	Monoterpene
α-Phellandrene	0.57	Monoterpene
Δ3-Carene	0.01	Monoterpene
(3*Z*)-Hexenyl acetate	0.01	Aliphatic ester
α-Terpinene	12.01	Monoterpene
Carvomenthene	0.02	Aliphatic alcohol
para-Cymene	2.54	Monoterpene
Limonene	1.28	Monoterpene
1,8-Cineole	5.31	Monoterpenic ether
(*Z*)-β-Ocimene	0.01	Monoterpene
(*E*)-β-Ocimene	0.02	Monoterpene
γ-Terpinene	24.72	Monoterpene
cis-Sabinene hydrate	0.02	Monoterpenic alcohol
Isoterpinolene	0.01	Monoterpene
Terpinolene	4.41	Monoterpene
para-Cymenene	0.04	Monoterpene
trans-Sabinene hydrate	0.02	Monoterpenic alcohol
Linalool	0.08	Monoterpenic alcohol
para-Mentha-1,3,8-triene	0.02	Monoterpene
endo-Fenchol	0.02	Monoterpenic alcohol
cis-para-Menth-2-en-1-ol	0.10	Monoterpenic alcohol
4-Hydroxy-4-methylcyclohex-2-enone	0.03	Aliphatic alcohol
Cosmene isomer I	0.01	Monoterpene
trans-Pinocarveol	0.04	Monoterpenic alcohol
trans-para-Menth-2-en-1-ol	0.07	Monoterpenic alcohol
Unknown	0.02	Unknown
δ-Terpineol	0.03	Monoterpenic alcohol
Terpinen-4-ol	32.27	Monoterpenic alcohol
Dill ether	0.01	Monoterpenic ether
para-Cymen-8-ol	0.04	Monoterpenic alcohol

α-Terpineol	1.76	Monoterpenic alcohol
cis-Piperitol	0.03	Monoterpenic alcohol
Unknown	0.01	Oxygenated monoterpene
trans-Piperitol	0.04	Monoterpenic alcohol
cis-para-Mentha-1(7),8-dien-2-ol	0.01	Monoterpenic alcohol
exo-2-Hydroxycineole	0.01	Monoterpenic alcohol
Nerol	0.02	Monoterpenic alcohol
Unknown	0.02	Oxygenated monoterpene
Piperitone	0.02	Monoterpenic ketone
trans-Ascaridole glycol	0.10	Monoterpenic alcohol
cis-Ascaridole glycol	0.06	Monoterpenic alcohol
Unknown	0.01	Unknown
Thymol	0.03	Monoterpenic alcohol
Unknown	0.02	Unknown
Carvacrol	0.01	Monoterpenic alcohol
Unknown	0.11	Monoterpenic alcohol
Myrtenyl acetate	0.01	Monoterpenic ester
Bicycloelemene	0.02	Sesquiterpene
α-Cubebene	0.07	Sesquiterpene
Unknown	0.05	Unknown
Cyclosativene II	0.01	Sesquiterpene
Isoledene	0.08	Sesquiterpene
α-Copaene	0.12	Sesquiterpene
7-Cubebene	0.08	Sesquiterpene
7-Cubebene epimer?	0.03	Aliphatic alcohol
β-Cubebene	0.02	Sesquiterpene
β-Elemene	0.04	Sesquiterpene
Unknown	0.04	Sesquiterpene
Methyleugenol	0.02	Phenylpropanoid
α-Gurjunene	0.37	Sesquiterpene
β-Maaliene	0.01	Sesquiterpene
β-Caryophyllene	0.38	Sesquiterpene
β-Ylangene	tr	Sesquiterpene
γ-Maaliene	0.06	Sesquiterpene
β-Gurjunene	0.02	Sesquiterpene
α-Maaliene	0.06	Sesquiterpene
Aromadendrene	0.96	Sesquiterpene
Selina-5,11-diene	0.14	Sesquiterpene
Cadina-3,5-diene isomer I?	0.13	Sesquiterpene
trans-Muurola-3,5-diene	0.10	Sesquiterpene
α-Humulene	0.10	Sesquiterpene
allo-Aromadendrene	0.40	Sesquiterpene
Valerena-4,7(11)-diene	0.03	Sesquiterpene
γ-Gurjunene	0.05	Sesquiterpene
trans-Cadina-1(6),4-diene	0.25	Sesquiterpene
Selina-4,11-diene	0.02	Sesquiterpene
γ-Muurolene	0.02	Sesquiterpene
Germacrene D	0.02	Sesquiterpene
β-Selinene	0.07	Sesquiterpene
allo-Aromadendr-9-ene	0.07	Sesquiterpene
δ-Selinene	0.04	Sesquiterpene
α-Selinene	0.10	Sesquiterpene

Viridiflorene	0.72	Sesquiterpene
Bicyclogermacrene	0.42	Sesquiterpene
α-Muurolene	0.10	Sesquiterpene
γ-Cadinene	0.04	Sesquiterpene
trans-Calamenene	0.05	Sesquiterpene
δ-Cadinene	0.61	Sesquiterpene
Zonarene	0.12	Sesquiterpene
trans-Cadina-1,4-diene	0.11	Sesquiterpene
α-Calacorene	0.01	Sesquiterpene
Epiglobulol	0.04	Sesquiterpenic alcohol
Eudesma-5,7(11)-diene	0.01	Sesquiterpene
Maaliol	0.02	Sesquiterpenic alcohol
Unknown	0.02	Oxygenated sesquiterpene
Spathulenol	0.04	Sesquiterpenic alcohol
Globulol	0.15	Sesquiterpenic alcohol
Gleenol	0.02	Sesquiterpenic alcohol
Viridiflorol	0.06	Sesquiterpenic alcohol
Cubeban-11-ol	0.06	Sesquiterpenic alcohol
Ledol	0.02	Sesquiterpenic alcohol
Eudesm-5-en-11-ol analog	0.04	Sesquiterpenic alcohol
Eudesm-5-en-11-ol	0.01	Sesquiterpenic alcohol
10-epi-Cubenol	0.01	Sesquiterpenic alcohol
Rosifoliol	0.06	Sesquiterpenic alcohol
1-epi-Cubenol	0.08	Sesquiterpenic alcohol
Isospathulenol	0.05	Sesquiterpenic alcohol
Cubenol	0.04	Sesquiterpenic alcohol
α-Muurolol	0.02	Sesquiterpenic alcohol
α-Cadinol	0.01	Sesquiterpenic alcohol
Isobutyral	0.01	Aliphatic aldehyde
Consolidated total	**99.33%**	

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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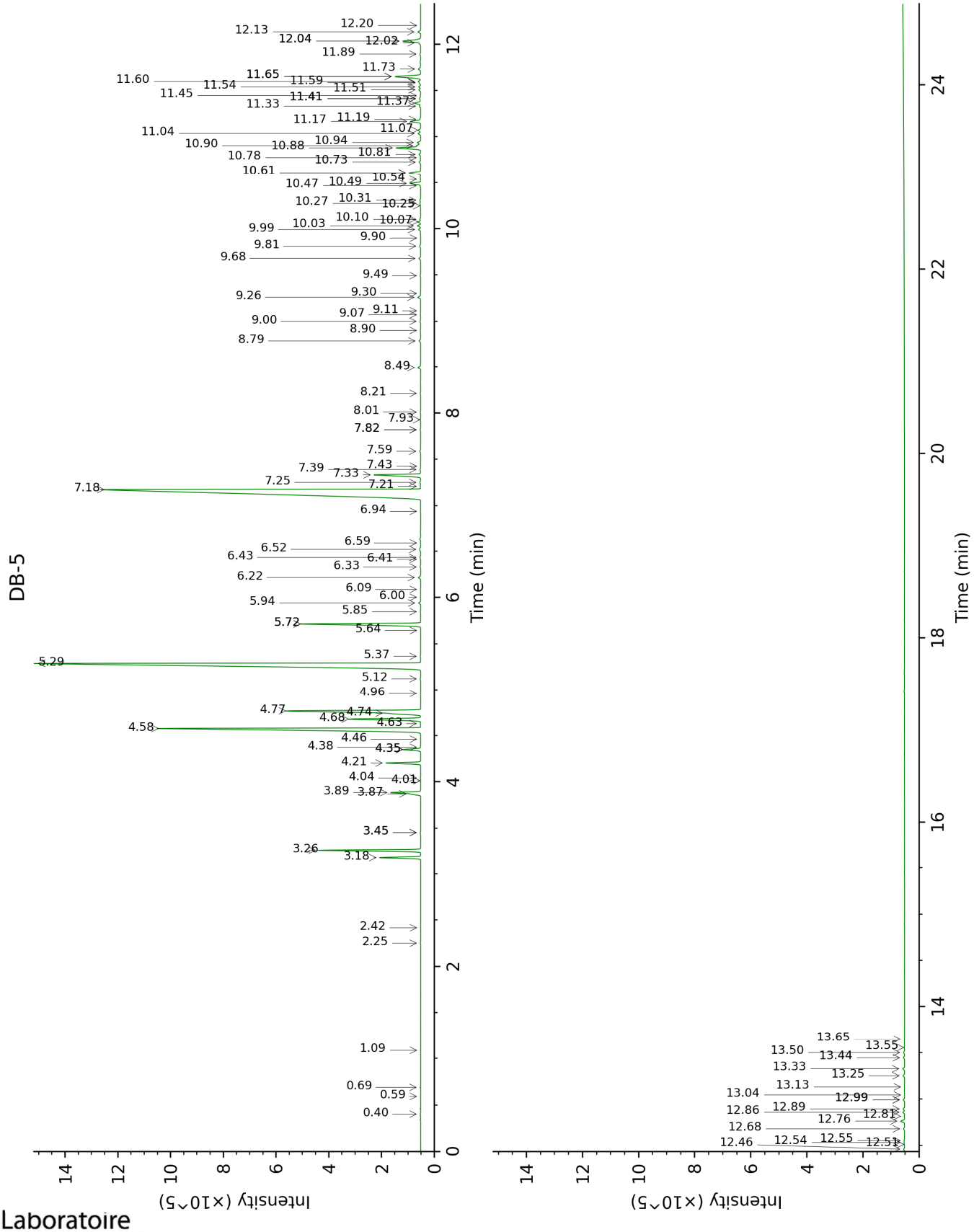
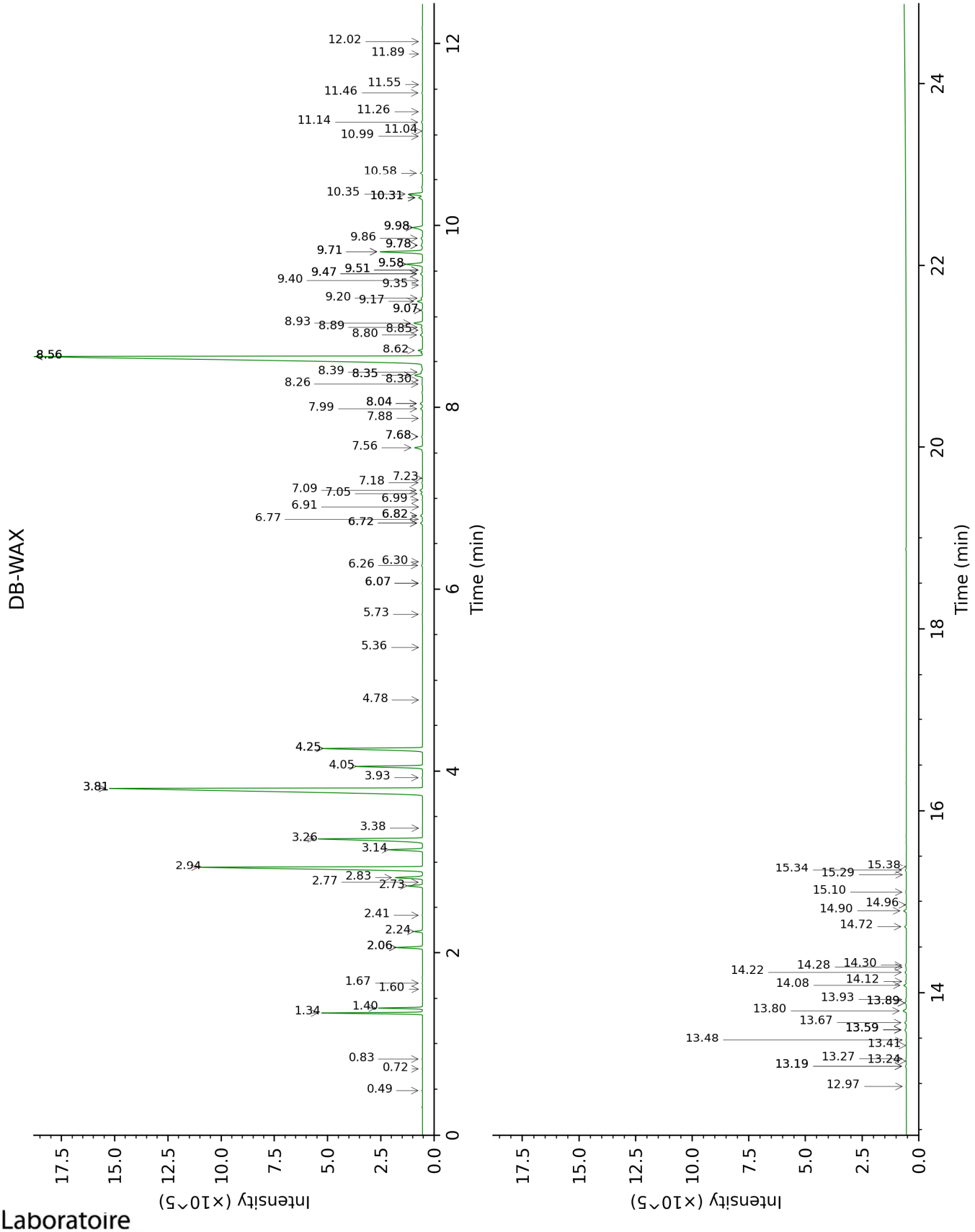

DB-5
Time (min)
Intensity (×10^5)
12.20
12.13
12.04
12.02
11.89
11.73
11.65
11.60
11.59
11.54
11.51
11.45
11.41
11.33
11.37
11.17
11.19
11.07
11.04
10.94
10.90
10.88
10.81
10.78
10.73
10.61
10.54
10.47
10.49
10.31
10.27
10.25
10.10
10.07
10.03
9.99
9.90
9.81
9.68
9.49
9.30
9.26
9.11
9.07
9.00
8.90
8.79
8.49
8.21
8.01
7.93
7.82
7.59
7.43
7.39
7.33
7.25
7.21
7.18
6.94
6.59
6.52
6.43
6.41
6.33
6.22
6.09
6.00
5.94
5.85
5.72
5.64
5.37
5.29
5.12
4.96
4.77
4.74
4.68
4.63
4.58
4.46
4.38
4.35
4.21
4.04
4.01
3.89
3.87
3.45
3.26
3.18
2.42
2.25
1.09
0.69
0.59
0.40
13.65
13.55
13.50
13.44
13.33
13.25
13.13
13.04
12.99
12.86
12.89
12.76
12.81
12.68
12.46
12.54
12.55
12.51



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FULL ANALYSIS DATA

Identification	Column DB-5			Column DB-WAX		
	R.T	R.I	%	R.T	R.I	%
Ethanol	0.40	495	0.01	0.83	907	0.01
Isobutanol	0.59	622	tr	2.06*	1068	0.90
2-Methylbutyral	0.69	652	0.01	0.72	881	0.01
2-Methylbutanol	1.09	734	tr	3.38	1177	tr
(3*Z*)-Hexenol	2.25	856	0.02	5.73	1349	0.02
Hexanol	2.42	870	tr	5.36	1323	0.01
α-Thujene	3.18	927	1.14	1.40	1000	1.15
α-Pinene	3.26	932	2.95	1.34	995	2.94
Camphene	3.45*	944	0.02	1.67	1028	0.01
α-Fenchene	3.45*	944	[0.02]	1.60	1021	0.01
Sabinene	3.87†	972	1.17	2.24	1085	0.27
β-Pinene	3.89†	973	[1.17]	2.06*	1068	[0.90]
3-Methyl-3-cyclohexenone	4.01	981	0.01	6.07*	1373	0.02
Octen-3-ol	4.04	983	0.02	6.72*	1422	0.09
Myrcene	4.21	994	1.06	2.83	1134	1.07
Pseudolimonene	4.35*	1003	0.58	2.77	1130	0.02
α-Phellandrene	4.35*	1003	[0.58]	2.74	1127	0.57
Δ3-Carene	4.38	1005	0.01			
(3*Z*)-Hexenyl acetate	4.46	1010	0.01	4.78	1280	0.01
α-Terpinene	4.58	1018	12.01	2.94	1143	12.06
Carvomenthene	4.63	1021	0.02	2.41	1101	0.02
para-Cymene	4.68	1024	2.54	4.05	1228	2.55
Limonene	4.74†	1028	6.61	3.14	1158	1.28
1,8-Cineole	4.77†	1030	[6.61]	3.26	1168	5.31
(*Z*)-β-Ocimene	4.96	1042	0.01	3.81*	1210	24.82
(*E*)-β-Ocimene	5.12	1052	0.02	3.93	1219	0.03
γ-Terpinene	5.29	1062	24.72	3.81*	1210	[24.82]
cis-Sabinene hydrate	5.37	1067	0.02	6.82*	1429	0.09
Isoterpinolene	5.64	1084	0.01	4.25*	1242	4.43
Terpinolene	5.72*	1089	4.45	4.25*	1242	[4.43]
para-Cymenene	5.72*	1089	[4.45]	6.26	1388	0.04
trans-Sabinene hydrate	5.85	1097	0.02	7.88	1509	0.02
Linalool	5.94	1103	0.08	7.99	1517	0.08
para-Mentha-1,3,8-triene	6.00	1107	0.02	6.07*	1373	[0.02]
endo-Fenchol	6.09	1112	0.02	8.30	1541	0.03
cis-para-Menth-2-en-1-ol	6.22	1120	0.10	8.04*	1521	0.10
4-Hydroxy-4-methylcyclohex-2-enone	6.33	1128	0.03	13.93	2025	0.03
Cosmene isomer I	6.41	1133	0.01	6.30	1390	0.01
trans-Pinocarveol	6.43	1134	0.04	9.07*	1602	0.05

trans-para-Menth-2-en-1-ol	6.52	1140	0.07	8.89	1587	0.07
Unknown [m/z 109, 124 (45), 119 (41), 43 (35), 91 (28), 95 (25)...]	6.59	1144	0.02	6.77	1426	0.01
δ-Terpineol	6.94	1166	0.03	9.40	1628	0.02
Terpinen-4-ol	7.18	1182	32.27	8.56*	1561	33.28
Dill ether	7.21	1184	0.01	7.23	1459	0.01
para-Cymen-8-ol	7.25	1186	0.04	11.46	1801	0.03
α-Terpineol	7.33	1192	1.76	9.71*	1654	1.81
cis-Piperitol	7.39	1195	0.03	9.47*	1634	0.10
Unknown [m/z 121, 43 (99), 91 (85), 77 (73), 93 (41), 136 (33)... 166 (3)]	7.43	1198	0.01			
trans-Piperitol	7.59	1208	0.04	10.31*	1702	0.20
cis-para-Mentha-1(7),8-dien-2-ol	7.82*	1224	0.03	11.89	1838	0.01
exo-2-Hydroxycineole	7.82*	1224	[0.03]	11.55	1809	0.01
Nerol	7.93	1231	0.02	10.99	1760	0.02
Unknown [m/z 137, 152 (28), 43 (25), 91 (24), 109 (23), 119 (19)]	8.01	1236	0.02	11.26	1783	0.02
Piperitone	8.22	1250	0.02	9.78*	1659	0.09
trans-Ascaridole glycol	8.49	1268	0.10	14.08	2040	0.11
cis-Ascaridole glycol	8.79	1288	0.06	14.72	2101	0.07
Unknown [m/z 95, 110 (95), 67 (31), 43 (29), 122 (18), 41 (14)...]	8.90	1296	0.01			
Thymol	9.00	1302	0.03	14.96	2125	0.02
Unknown [m/z 93, 111 (86), 43 (70), 110 (55), 59 (53), 69 (52), 41 (47)...]	9.07	1305	0.02	13.42	1977	0.02
Carvacrol	9.11	1308	0.01	15.29	2157	0.01
Unknown [m/z 97, 112 (92), 83 (62), 43 (44), 41 (25)... 170? (4)]	9.26	1318	0.11	14.90	2118	0.12
Myrtenyl acetate	9.30	1321	0.01	9.51*	1637	0.03
Bicycloelemene	9.49	1335	0.02	6.99	1442	0.02
α-Cubebene	9.68	1348	0.07	6.72*	1422	[0.09]
Unknown [m/z 43, 95 (62), 107 (45),	9.81	1357	0.05	13.89*	2021	0.06

110 (41), 55 (28), 67 (25)...]						
Cyclosativene II	9.90	1364	0.01	6.91	1436	0.01
Isoledene	9.99	1370	0.08	6.82*	1429	[0.09]
α-Copaene	10.03	1373	0.12	7.09	1449	0.12
7-Cubebene	10.08	1376	0.08	7.06	1447	0.08
7-Cubebene epimer?	10.10	1378	0.03	7.18	1456	0.03
β-Cubebene	10.25	1388	0.02	7.68*	1493	0.04
β-Elemene	10.27	1390	0.04	8.35*	1545	0.42
Unknown [m/z 93, 122 (98), 161 (98), 107 (86), 95 (46), 105 (72)... 204 (34)]	10.31	1392	0.04			
Methyleugenol	10.47†	1404	0.41	13.24	1962	0.02
α-Gurjunene	10.49†	1405	[0.41]	7.56	1484	0.37
β-Maaliene	10.54	1409	0.01	7.68*	1493	[0.04]
β-Caryophyllene	10.61*	1414	0.43	8.35*	1545	[0.42]
β-Ylangene	10.61*	1414	[0.43]	8.04*	1521	[0.10]
γ-Maaliene	10.73	1423	0.06	8.39	1548	0.08
β-Gurjunene	10.78	1426	0.02	8.26	1538	0.04
α-Maaliene	10.81	1429	0.06	8.56*	1561	[33.28]
Aromadendrene	10.88	1434	0.96	8.56*	1561	[33.28]
Selina-5,11-diene	10.90	1436	0.14	8.62	1566	0.14
Cadina-3,5-diene isomer I?	10.94	1439	0.13			
trans-Muurola-3,5-diene	11.04	1446	0.10	8.80	1580	0.10
α-Humulene	11.07	1449	0.10	9.20	1612	0.07
allo-Aromadendrene	11.17	1456	0.40	8.93	1590	0.40
Valerena-4,7(11)-diene	11.19	1457	0.03	8.85	1584	0.04
γ-Gurjunene	11.33	1468	0.05	9.07*	1602	[0.05]
trans-Cadina-1(6),4-diene	11.37	1471	0.25	9.17	1610	0.23
Selina-4,11-diene	11.41*	1474	0.06	9.35	1624	0.02
γ-Muurolene	11.41*	1474	[0.06]	9.51*	1637	[0.03]
Germacrene D	11.45	1476	0.02	9.71*	1654	[1.81]
β-Selinene	11.51	1481	0.07	9.78*	1659	[0.09]
allo-Aromadendr-9-ene	11.54	1484	0.07	9.47*	1634	[0.10]
δ-Selinene	11.59	1487	0.04	9.58*	1643	0.76
α-Selinene	11.60	1488	0.10	9.86	1666	0.08
Viridiflorene	11.65*	1492	1.14	9.58*	1643	[0.76]
Bicyclogermacrene	11.65*	1492	[1.14]	9.98*	1675	0.51
α-Muurolene	11.73	1498	0.10	9.98*	1675	[0.51]
γ-Cadinene	11.90	1510	0.04	10.31*	1702	[0.20]
trans-Calamenene	12.02	1520	0.05	11.14	1773	0.05
δ-Cadinene	12.04*	1521	0.76	10.35	1706	0.61
Zonarene	12.04*	1521	[0.76]	10.31*	1702	[0.20]

trans-Cadina-1,4-diene	12.14	1529	0.11	10.58	1725	0.10
α-Calacorene	12.20	1535	0.01	12.02	1850	0.01
Epiglobulol	12.46	1555	0.04	13.19*	1957	0.04
Eudesma-5,7(11)-diene	12.51	1559	0.01	11.04	1765	0.02
Maaliol	12.54	1560	0.02	12.97	1937	0.02
Unknown [m/z 161, 109 (98), 82 (93), 43 (72), 105 (68), 93 (59), 69 (56), 119 (55)... 222 (7)]	12.56	1562	0.02	13.19*	1957	[0.04]
Spathulenol	12.68	1572	0.04	14.30	2061	0.05
Globulol	12.76	1578	0.15	13.80	2013	0.17
Gleenol	12.82	1582	0.02	13.48	1983	0.02
Viridiflorol	12.86	1586	0.06	13.89*	2021	[0.06]
Cubeban-11-ol	12.89	1589	0.06	13.59*	1993	0.10
Ledol	12.99*	1596	0.05	13.27	1964	0.02
Eudesm-5-en-11-ol analog	12.99*	1596	[0.05]	14.12	2044	0.04
Eudesm-5-en-11-ol	13.04	1600	0.01	14.28	2058	0.02
10-epi-Cubenol	13.13	1607	0.01	13.59*	1993	[0.10]
Rosifoliol	13.25	1617	0.06	14.22	2053	0.06
1-epi-Cubenol	13.33	1623	0.08	13.67	2001	0.07
Isospathulenol	13.44	1633	0.05	15.34	2162	0.05
Cubenol	13.50	1638	0.04	13.59*	1993	[0.10]
α-Muurolol	13.55	1642	0.02	15.10	2139	0.04
α-Cadinol	13.65	1650	0.01	15.38	2166	0.01
Isobutyral				0.49	781	0.01
Total identified		**99.18%**			**99.11%**	
Total reported		**99.46%**			**99.27%**	

*: 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