

Date : March 16, 2021

CERTIFICATE OF ANALYSIS – GC PROFILING

SAMPLE IDENTIFICATION

Internal code : 21B23-FEP02


Customer identification : Black Pepper - India - 12593-16

Type : Essential oil

Source : *Piper nigrum*

Customer : Fern & Petal

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

Analysis date : March 15, 2021

Checked and approved by :

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

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PHYSICOCHEMICAL DATA

Physical aspect: Clear liquid

Refractive index: 1.4826 ± 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	tr	Aliphatic aldehyde
2-Methylbutyral	tr	Aliphatic aldehyde
Toluene	tr	Simple phenolic
Tricyclene	0.02	Monoterpene
α -Thujene	0.81	Monoterpene
α -Pinene	10.18	Monoterpene
Camphene	0.31	Monoterpene
α -Fenchene	0.02	Monoterpene
Thuja-2,4(10)-diene	0.01	Monoterpene
meta-Cymene	0.02	Monoterpene
Sabinene	12.22	Monoterpene
β -Pinene	9.50	Monoterpene
Dehydro-1,8-cineole	0.07	Monoterpenic ether
Myrcene	1.02	Monoterpene
2-Carene	0.02	Monoterpene
α -Phellandrene	0.85	Monoterpene
Pseudolimonene	0.03	Monoterpene
Δ^3 -Carene	8.72	Monoterpene
α -Terpinene	0.11	Monoterpene
ortho-Cymene	0.09	Monoterpene
para-Cymene	0.97	Monoterpene
β -Phellandrene	0.76	Monoterpene
Limonene	12.79	Monoterpene
(Z)- β -Ocimene	0.02	Monoterpene
(E)- β -Ocimene	0.05	Monoterpene
Unknown	0.01	Monoterpene
γ -Terpinene	0.19	Monoterpene
cis-Sabinene hydrate	0.10	Monoterpenic alcohol
Isoterpinolene	0.08	Monoterpene
Terpinolene	0.28	Monoterpene
para-Cresol	0.05	Simple phenolic
para-Cymenene	0.02	Monoterpene
α -Pinene oxide	0.02	Monoterpenic ether
trans-Sabinene hydrate	0.07	Monoterpenic alcohol
Unknown	0.02	Unknown
Linalool	0.41	Monoterpenic alcohol
Verbenol analog?	0.01	Monoterpenic alcohol
Unknown	0.01	Unknown
trans-para-Mentha-2,8-dien-1-ol	0.05	Monoterpenic alcohol
cis-Limonene oxide	0.02	Monoterpenic ether
cis-para-Mentha-2,8-dien-1-ol	0.07	Monoterpenic alcohol
trans-Limonene oxide	0.02	Monoterpenic ether
trans-para-Menth-2-en-1-ol	0.04	Monoterpenic alcohol
trans-Verbenol	0.02	Monoterpenic alcohol
1,4-Dimethyl-4-acetylcyclohexene	0.01	Monoterpenic ketone

meta-Mentha-4,6-dien-8-ol	0.01	Monoterpenic alcohol
Sabinaketone	0.01	Normonoterpenic ketone
Pinocarvone	0.01	Monoterpenic ketone
cis-Sabinol	0.02	Monoterpenic alcohol
Terpinen-4-ol	0.43	Monoterpenic alcohol
Cryptone	0.01	Normonoterpenic ketone
meta-Cymen-8-ol	0.03	Monoterpenic alcohol
para-Cymen-8-ol	0.04	Monoterpenic alcohol
Unknown	0.01	Unknown
α-Terpineol	0.10	Monoterpenic alcohol
Myrtenol	0.05	Monoterpenic alcohol
cis-α-Phellandrene epoxide (IPP vs Me)	0.03	Monoterpenic ether
Verbenone	0.01	Monoterpenic ketone
Unknown	0.08	Oxygenated monoterpene
trans-Carveol	0.04	Monoterpenic alcohol
cis-Carveol	0.02	Monoterpenic alcohol
Cuminal	0.03	Monoterpenic aldehyde
Carvone	0.02	Monoterpenic ketone
Car-3-en-2-one	0.01	Monoterpenic ketone
Unknown	0.05	Unknown
trans-Ascaridole glycol	0.01	Monoterpenic alcohol
Bornyl acetate	0.01	Monoterpenic ester
Unknown	0.02	Monoterpenic ester
Unknown	0.02	Oxygenated monoterpene
para-Menth-5-en-1,2-diol isomer II	0.05	Monoterpenic alcohol
para-Menth-5-en-1,2-diol isomer III	0.07	Monoterpenic alcohol
Methyl geranate	0.01	Monoterpenic ester
δ-Elemene isomer	0.04	Sesquiterpene
δ-Elemene	1.16	Sesquiterpene
α-Cubebene	0.15	Sesquiterpene
Cyclosativene I	0.04	Sesquiterpene
Cyclosativene II	0.06	Sesquiterpene
α-Ylangene	0.04	Sesquiterpene
α-Copaene	1.35	Sesquiterpene
cis-β-Elemene	0.04	Sesquiterpene
β-Cubebene	0.11	Sesquiterpene
β-Elemene	0.69	Sesquiterpene
Isocaryophyllene	0.09	Sesquiterpene
α-Gurjunene	0.20	Sesquiterpene
β-Caryophyllene	25.45	Sesquiterpene
cis-α-Bergamotene	0.10	Sesquiterpene
β-Copaene	0.54	Sesquiterpene
γ-Elemene	0.07	Sesquiterpene
trans-α-Bergamotene	0.25*	Sesquiterpene
α-Guaiene	[0.25]*	Sesquiterpene
Unknown	0.01	Unknown
α-Humulene	1.08	Sesquiterpene
allo-Aromadendrene	0.03	Sesquiterpene
(E)-β-Farnesene	0.01	Sesquiterpene
β-Santalene	0.04	Sesquiterpene
γ-Gurjunene	0.02	Sesquiterpene
trans-Cadina-1(6),4-diene	0.01	Sesquiterpene

γ-Muurolene	0.10	Sesquiterpene
Germacrene D	0.35	Sesquiterpene
β-Selinene	1.01	Sesquiterpene
<i>trans</i> -Muurolo-4(15),5-diene	0.08	Sesquiterpene
α-Selinene	0.67	Sesquiterpene
epi-Cubebol	0.06	Sesquiterpenic alcohol
Bicyclogermacrene	0.01	Sesquiterpene
Viridiflorene	0.11	Sesquiterpene
α-Muurolene	0.24	Sesquiterpene
β-Bisabolene	0.11	Sesquiterpene
Cubebol	0.10	Sesquiterpenic alcohol
(3 <i>E</i> ,6 <i>E</i>)-α-Farnesene	0.04	Sesquiterpene
7-epi-α-Selinene	0.02	Sesquiterpene
δ-Cadinene	0.51	Sesquiterpene
<i>trans</i> -Calamenene	0.08	Sesquiterpene
α-Cadinene	0.01	Sesquiterpene
α-Calacorene	0.01	Sesquiterpene
(<i>E</i>)-α-Bisabolene	0.03	Sesquiterpene
Isocaryophyllene epoxide B	0.11	Sesquiterpenic ether
α-Elemol	0.01	Sesquiterpenic alcohol
Unknown	0.01	Aliphatic alcohol
Germacrene B	0.05	Sesquiterpene
(<i>E</i>)-Nerolidol	0.01	Sesquiterpenic alcohol
Caryophyllene oxide isomer	0.27	Sesquiterpenic ether
Caryophyllene oxide	1.16	Sesquiterpenic ether
Humulene epoxide II	0.06	Sesquiterpenic ether
α-Corocalene	0.02	Sesquiterpene
Alismol	0.23	Sesquiterpenic alcohol
Caryophylladienol I	0.05	Sesquiterpenic alcohol
Caryophylladienol II	0.03	Sesquiterpenic alcohol
τ-Muurolol	0.03	Sesquiterpenic alcohol
α-Muurolol	0.11	Sesquiterpenic alcohol
α-Cadinol	0.02	Sesquiterpenic alcohol
<i>trans</i> -Calamenen-10-ol	0.01	Sesquiterpenic alcohol
(3 <i>Z</i>)-Caryophylla-3,8(13)-dien-5β-ol	0.01	Sesquiterpenic alcohol
Dehydrojinkoh-eremol	0.01	Sesquiterpenic alcohol
Unknown	0.01	Oxygenated sesquiterpene
meta-Camphorene	0.02	Diterpene
para-Camphorene	0.01	Diterpene
Consolidated total	98.71%	

*: 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

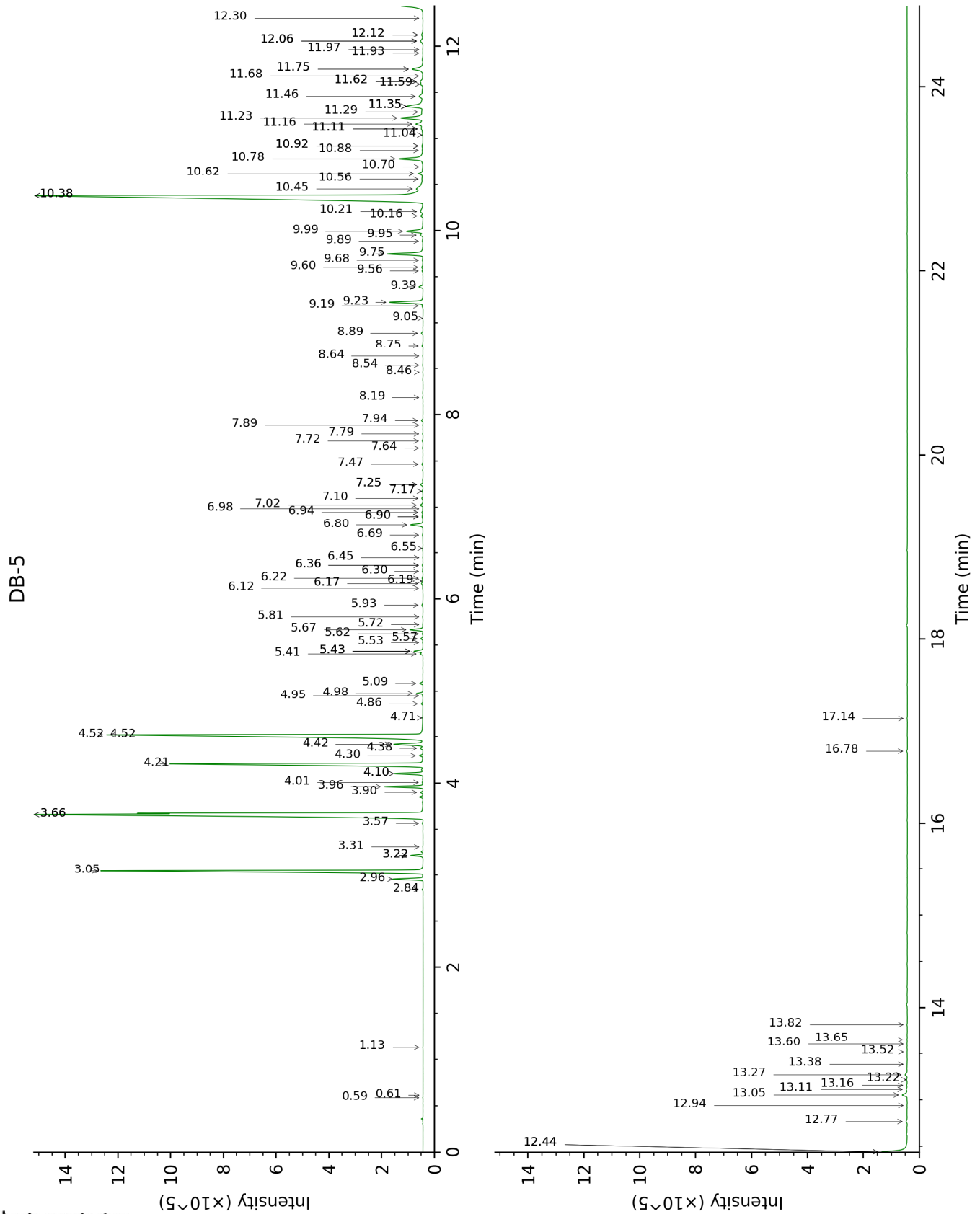
tr: The compound has been detected below 0.005% of total signal.

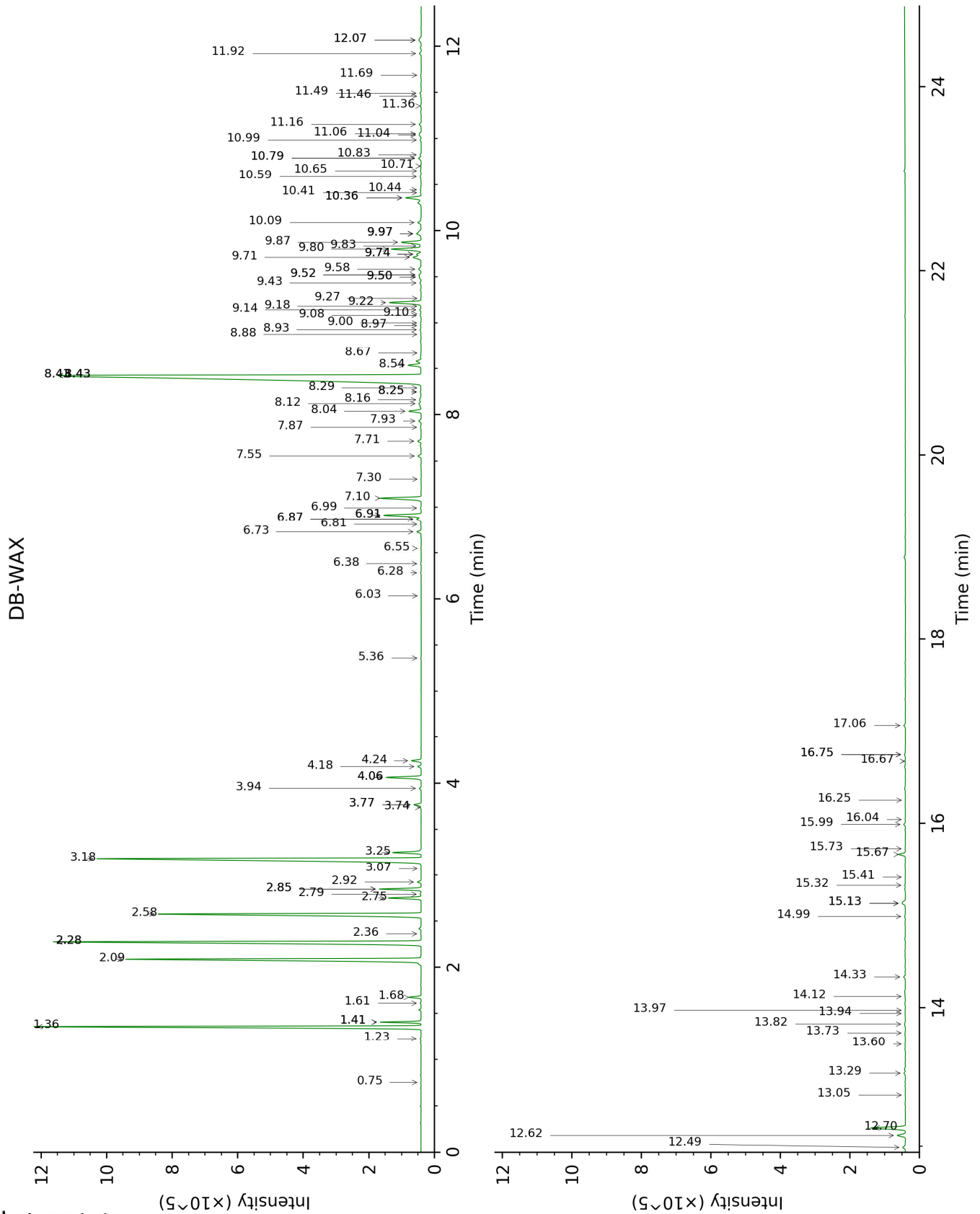
Note: no correction factor was applied

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	0.59	642	tr	0.75	887	tr
2-Methylbutyral	0.62	652	tr			
Toluene	1.13	759	tr	1.41*	1001	0.80
Tricyclene	2.84	918	0.02	1.23	972	0.02
α -Thujene	2.96	925	0.81	1.41*	1001	[0.80]
α -Pinene	3.05	931	10.18	1.36	993	10.04
Camphene	3.22*	942	0.32	1.68	1027	0.31
α -Fenchene	3.22*	942	[0.32]	1.61	1021	0.02
Thuja-2,4(10)-diene	3.31	949	0.01	2.28*	1086	12.23
meta-Cymene	3.57	966	0.02	2.85*	1134	1.05
Sabinene	3.66*†	972	21.79	2.28*	1086	[12.23]
β -Pinene	3.66*†	972	[21.79]	2.09	1068	9.50
Dehydro-1,8-cineole	3.90	988	0.07	3.07	1151	0.01
Myrcene	3.96	992	1.02	2.85*	1134	[1.05]
2-Carene	4.01	995	0.02	2.36	1095	0.01
α -Phellandrene	4.10*	1001	0.86	2.75	1126	0.85
Pseudolimonene	4.10*	1001	[0.86]	2.79	1129	0.03
Δ 3-Carene	4.21	1008	8.72	2.58	1113	8.65
α -Terpinene	4.30	1014	0.11	2.92	1140	0.10
ortho-Cymene	4.38	1019	0.09	4.06*	1226	1.03
para-Cymene	4.42	1022	0.97	4.06*	1226	[1.03]
β -Phellandrene	4.52*	1028	13.59	3.25	1165	0.76
Limonene	4.52*	1028	[13.59]	3.18	1160	12.79
(Z)- β -Ocimene	4.71	1040	0.02	3.74	1203	0.02
(E)- β -Ocimene	4.86	1049	0.05	3.94	1218	0.05
Unknown [m/z 93, 91 (54), 92 (31), 77 (29), 79 (17), 43 (13), 41 (10), 136 (9)]	4.95	1055	0.01	3.77*	1205	0.21
γ -Terpinene	4.98	1057	0.19	3.77*	1205	[0.21]
cis-Sabinene hydrate	5.09	1064	0.10	6.87*	1430	0.17
Isoterpinolene	5.41	1084	0.08	4.18	1235	0.10
Terpinolene	5.44*	1086	0.30	4.24	1239	0.28
para-Cresol	5.44*	1086	[0.30]	13.82	2013	0.05
para-Cymenene	5.44*	1086	[0.30]	6.28	1386	0.02
α -Pinene oxide	5.53	1092	0.02	5.36	1320	0.02
trans-Sabinene hydrate	5.57	1094	0.07	7.93	1510	0.09
Unknown [m/z 109, 43 (65), 95 (54), 119 (50), 91 (47)... 149 (8)...]	5.62	1097	0.02	6.03	1368	0.01
Linalool	5.67	1100	0.41	8.04	1518	0.39
Verbenol analog?	5.72	1104	0.01	8.29	1538	0.02

Unknown [m/z 94, 59 (83), 43 (81), 95 (56), 109 (50), 79 (50), 91 (40)...]	5.81	1109	0.01			
<i>trans</i> -para-Mentha-2,8-dien-1-ol	5.93	1117	0.05	8.93	1587	0.05
<i>cis</i> -Limonene oxide	6.12	1129	0.02	6.38	1394	0.02
<i>cis</i> -para-Mentha-2,8-dien-1-ol	6.17	1132	0.07	9.43	1628	0.05
<i>trans</i> -Limonene oxide	6.19	1134	0.02	6.55	1406	0.01
<i>trans</i> -para-Menth-2-en-1-ol	6.22	1136	0.04	8.88	1583	0.02
<i>trans</i> -Verbenol	6.30	1141	0.02	9.50*†	1633	0.16
1,4-Dimethyl-4-acetylcyclohexene	6.36*	1145	0.03	7.30	1462	0.01
meta-Mentha-4,6-dien-8-ol	6.36*	1145	[0.03]	9.27	1614	0.01
Sabinaketon	6.45	1150	0.01	8.67	1567	0.01
Pinocarvone	6.55	1157	0.01	7.86	1504	0.04
<i>cis</i> -Sabinol	6.69	1166	0.02	10.79*	1740	0.10
Terpinen-4-ol	6.80	1173	0.43	8.54	1557	0.42
Cryptone	6.90*	1180	0.05	9.10	1601	0.01
meta-Cymen-8-ol	6.90*	1180	[0.05]	11.46	1797	0.03
para-Cymen-8-ol	6.94	1182	0.04	11.49	1800	0.04
Unknown [m/z 43, 135 (73), 59 (46), 93 (39), 91 (35), 81 (32)...]	6.98	1185	0.01			
α-Terpineol	7.02	1188	0.10	9.74*	1653	0.15
Myrtenol	7.10	1192	0.05	10.83	1743	0.03
<i>cis</i> -α-Phellandrene epoxide (IPP vs Me)	7.17	1197	0.03	10.99	1757	0.04
Verbenone	7.25*	1202	0.09	9.52*†	1635	[0.16]
Unknown [m/z 109, 91 (100), 81 (88), 94 (75), 119 (74), 96 (73), 41 (63)... 150 (2)]	7.25*	1202	[0.09]	10.79*	1740	[0.10]
<i>trans</i> -Carveol	7.47	1217	0.04	11.36	1788	0.02
<i>cis</i> -Carveol	7.64	1229	0.02	11.69	1817	0.02
Cuminal	7.72	1234	0.03	10.59	1722	0.06
Carvone	7.79	1239	0.02	9.97*	1671	0.26
Car-3-en-2-one	7.89	1246	0.01	10.36*	1703	0.53
Unknown [m/z 43, 97 (69), 107 (46), 41 (28), 55 (21), 109 (20)...]	7.94	1249	0.05	11.04	1761	0.06

<i>trans</i> -Ascaridole glycol	8.19	1266	0.01	14.12	2041	0.02
Bornyl acetate	8.46	1285	0.01	8.25*	1534	0.04
Unknown [m/z 93, 43 (60), 108 (58), 69 (36), 41 (35)... 150 (5), 184 (1)]	8.54	1290	0.02	13.05	1942	0.01
Unknown [m/z 43, 93 (66), 91 (44), 41 (38), 69 (35)... 152? (1)]	8.64	1297	0.02			
para-Menth-5-en-1,2-diol isomer II	8.75	1304	0.05	14.33	2061	0.07
para-Menth-5-en-1,2-diol isomer III	8.89	1314	0.07	15.13*	2139	0.17
Methyl geranate	9.05	1326	0.01	9.74*	1653	[0.15]
δ-Elemene isomer	9.19	1331	0.04	6.81	1425	0.02
δ-Elemene	9.23	1334	1.16	6.91*	1433	1.20
α-Cubebene	9.39	1346	0.15	6.73	1419	0.15
Cyclosativene I	9.56	1358	0.04	6.87*	1430	[0.17]
Cyclosativene II	9.60	1360	0.06	6.91*	1433	[1.20]
α-Ylangene	9.68	1366	0.04	6.99	1439	0.03
α-Copaene	9.75	1371	1.35	7.10	1447	1.34
<i>cis</i> -β-Elemene	9.89	1380	0.04	8.25*	1534	[0.04]
β-Cubebene	9.95	1385	0.11	7.72	1493	0.13
β-Elemene	9.99	1388	0.69	8.43*	1548	26.45
Isocaryophyllene	10.16	1400	0.09	8.12	1524	0.10
α-Gurjunene	10.21	1403	0.20	7.56	1481	0.11
β-Caryophyllene	10.38*	1416	25.55	8.43*	1548	[26.45]
<i>cis</i> -α-Bergamotene	10.38*	1416	[25.55]	8.16	1528	0.10
β-Copaene	10.45	1421	0.54	8.43*	1548	[26.45]
γ-Elemene	10.56	1429	0.07	8.97	1591	0.02
<i>trans</i> -α-Bergamotene	10.62*	1434	0.25	8.43*	1548	[26.45]
α-Guaiene	10.62*	1434	[0.25]	8.43*	1548	[26.45]
Unknown [m/z 41, 97 (78), 69 (77), 43 (71), 125 (67), 55 (56)... 168 (39)]	10.70	1439	0.01	17.06	2338	0.05
α-Humulene	10.78	1446	1.08	9.22	1610	1.08
allo-Aromadendrene	10.88	1453	0.03	9.00	1593	0.02
(<i>E</i>)-β-Farnesene	10.92*	1456	0.05	9.52*†	1635	[0.16]
β-Santalene	10.92*	1456	[0.05]	9.08	1599	0.04
γ-Gurjunene	11.04	1465	0.02	9.14	1604	0.05
<i>trans</i> -Cadina-1(6),4-diene	11.11*	1470	0.12	9.18	1607	0.01
γ-Muurolene	11.11*	1470	[0.12]	9.50*†	1633	[0.16]
Germacrene D	11.16	1474	0.35	9.71	1650	0.35
β-Selinene	11.23	1479	1.01	9.80	1658	1.01
<i>trans</i> -Muurola-4(15),5-diene	11.29	1484	0.08	9.83	1660	0.03

α -Selinene	11.35*	1488	0.90	9.87	1664	0.67
epi-Cubebol	11.35*	1488	[0.90]	11.92	1838	0.06
Bicyclogermacrene	11.35*	1488	[0.90]	9.97*	1671	[0.26]
Viridiflorene	11.35*	1488	[0.90]	9.58	1640	0.11
α -Muurolene	11.46	1496	0.24	9.97*	1671	[0.26]
β -Bisabolene	11.59	1506	0.11	10.09	1681	0.13
Cubebol	11.62*	1508	0.15	12.49	1888	0.10
(3E,6E)- α -Farnesene	11.62*	1508	[0.15]	10.44	1710	0.04
7-epi- α -Selinene	11.68	1513	0.02	10.41	1708	0.03
δ -Cadinene	11.75*	1519	0.58	10.36*	1703	[0.53]
<i>trans</i> -Calamenene	11.75*	1519	[0.58]	11.16	1771	0.08
α -Cadinene	11.93	1532	0.01	10.70	1733	0.02
α -Calacorene	11.97	1535	0.01	12.07*	1850	0.14
(E)- α -Bisabolene	12.06*	1542	0.15	10.65	1728	0.03
Isocaryophyllene epoxide B	12.06*	1542	[0.15]	12.07*	1850	[0.14]
α -Elemol	12.06*	1542	[0.15]	13.97	2027	0.01
Unknown [m/z 91, 41 (97), 107 (96), 93 (95), 133 (88), 69 (88), 149 (84)... 218 (19)]	12.12*	1548	0.08	13.94	2024	0.01
Germacrene B	12.12*	1548	[0.08]	11.06	1762	0.05
(E)-Nerolidol	12.30	1562	0.01	13.73	2004	0.02
Caryophyllene oxide isomer	12.44*	1573	1.52	12.62	1899	0.27
Caryophyllene oxide	12.44*	1573	[1.52]	12.70	1909	1.16
Humulene epoxide II	12.77	1598	0.06	13.29	1963	0.05
α -Corocalene	12.94	1612	0.02	13.60	1992	0.02
Alismol	13.05	1621	0.23	15.67	2192	0.21
Caryophylladienol I	13.11	1626	0.05	15.99	2226	0.06
Caryophylladienol II	13.16	1630	0.03	16.04	2231	0.01
τ -Muurolol	13.22	1635	0.03	14.99	2125	0.04
α -Muurolol	13.27	1639	0.11	15.13*	2139	[0.17]
α -Cadinol	13.38	1649	0.02	15.41	2167	0.01
<i>trans</i> -Calamenen-10-ol	13.52	1660	0.01	16.75*	2304	0.04
(3Z)-Caryophylla-3,8(13)-dien-5 β -ol	13.60	1667	0.01	16.75*	2304	[0.04]
Dehydrojinkoh-eremol	13.65	1671	0.01	16.25	2253	0.01
Unknown [m/z 43, 108 (62), 93 (51), 41 (42), 109 (37), 69 (36)...]	13.82	1684	0.01	16.67	2297	0.01
meta-Camphorene	16.78	1949	0.02	15.32	2158	0.03
para-Camphorene	17.14	1982	0.01	15.73	2199	0.01

Total identified	98.74%	97.69%
Total reported	98.91%	97.84%

*: 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