

**Date :** January 20, 2023

**CERTIFICATE OF ANALYSIS – GC PROFILING**

**SAMPLE IDENTIFICATION**

**Internal code :** 23A06-NSO03


**Customer identification :** Organic EO : Peppermint Lot No: SO-338/23-23 Botanical Species: Mentha piperita

**Type :** Essential oil

**Source :** *Mentha x piperita*

**Customer :** Natural Sourcing LLC

**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 2014-005

**Analysis date :** January 12, 2023

Checked and approved by :

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

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#### PHYSICOCHEMICAL DATA

**Physical aspect:** Faintly yellow liquid

**Refractive index:**  $1.4610 \pm 0.0003$  (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
Isobutanol	tr	Aliphatic alcohol
Isovaleral	tr	Aliphatic aldehyde
2-Methylbutyral	tr	Aliphatic aldehyde
Isoamyl alcohol	0.01	Aliphatic alcohol
2-Methylbutanol	0.01	Aliphatic alcohol
Ethyl 2-methylbutyrate	tr	Aliphatic ester
(3Z)-Hexenol	0.01	Aliphatic alcohol
Hexanol	0.01	Aliphatic alcohol
<i>trans</i> -2,5-Diethyltetrahydrofuran	0.02	Furan
Nonane	tr	Alkane
$\alpha$ -Thujene	0.03	Monoterpene
$\alpha$ -Pinene	0.82	Monoterpene
3-Methylcyclohexanone	0.09	Aliphatic ketone
Camphene	0.02	Monoterpene
Thuja-2,4(10)-diene	0.01	Monoterpene
$\beta$ -Pinene	1.05	Monoterpene
Sabinene	0.43	Monoterpene
<i>cis</i> -para-Menthane	0.01	Monoterpene
Octen-3-ol	0.01	Aliphatic alcohol
<i>cis</i> -Carane	0.01	Monoterpene
Octan-3-one	0.02	Aliphatic ketone
Myrcene	0.12	Monoterpene
Octan-3-ol	0.23	Aliphatic alcohol
$\alpha$ -Phellandrene	0.02	Monoterpene
Pseudolimonene	0.02	Monoterpene
$\alpha$ -Terpinene	0.11	Monoterpene
para-Cymene	0.28	Monoterpene
1,8-Cineole	5.21	Monoterpenic ether
Limonene	2.52	Monoterpene
(Z)- $\beta$ -Ocimene	0.08	Monoterpene
(E)- $\beta$ -Ocimene	0.04	Monoterpene
$\gamma$ -Terpinene	0.20	Monoterpene
<i>cis</i> -Sabinene hydrate	0.24	Monoterpenic alcohol
<i>cis</i> -Linalool oxide (fur.)	0.03	Monoterpenic alcohol
Octanol	0.04	Aliphatic alcohol
Terpinolene	0.09	Monoterpene
para-Cymenene	0.02	Monoterpene
<i>trans</i> -Sabinene hydrate	0.04	Monoterpenic alcohol
Nonan-3-ol	0.02	Aliphatic alcohol
Linalool	0.17	Monoterpenic alcohol
2-Methylbutyl 2-methylbutyrate	0.04	Aliphatic ester
Amyl isovalerate	0.02	Aliphatic ester
endo-Fenchol	0.02	Monoterpenic alcohol
Octen-3-yl acetate	0.01	Aliphatic ester
<i>cis</i> -para-Menth-2-en-1-ol	0.05	Monoterpenic alcohol

Octan-3-yl acetate	0.01	Aliphatic ester
allo-Ocimene	0.01	Monoterpene
trans-Sabinol	0.02	Monoterpenic alcohol
Isopulegol	0.13	Monoterpenic alcohol
cis- $\alpha$ -Dihydroterpineol	0.03	Monoterpenic alcohol
Menthone	25.80	Monoterpenic ketone
Isomenthone	4.36	Monoterpenic ketone
Menthofuran	2.57	Monoterpenic ether
neo-Menthol	3.22	Monoterpenic alcohol
$\delta$ -Terpineol	0.08	Monoterpenic alcohol
Lavandulol	0.04	Monoterpenic alcohol
Terpinen-4-ol	0.58	Monoterpenic alcohol
Menthol	34.74	Monoterpenic alcohol
Isomenthol	0.46	Monoterpenic alcohol
para-Cymen-8-ol	0.03	Monoterpenic alcohol
Myrtenal	0.02	Monoterpenic aldehyde
$\alpha$ -Terpineol	0.37	Monoterpenic alcohol
neoiso-Menthol	0.21	Monoterpenic alcohol
cis-Piperitol	0.02	Monoterpenic alcohol
Methylchavicol	0.04	Phenylpropanoid
Myrtenol	0.02	Monoterpenic alcohol
trans-Isopiperitenol	0.03	Monoterpenic alcohol
Unknown	0.02	Unknown
trans-Piperitol	0.02	Monoterpenic alcohol
Decanal	0.01	Aliphatic aldehyde
iso-Dihydrocarveol ?	0.01	Monoterpenic alcohol
trans-Carveol	0.01	Monoterpenic alcohol
(3Z)-Hexenyl 2-methylbutyrate	0.02	Aliphatic ester
Citronellol	0.02	Monoterpenic alcohol
Pulegone	1.67	Monoterpenic ketone
Carvone	0.06	Monoterpenic ketone
(3Z)-Hexenyl isovalerate	0.07	Aliphatic ester
Piperitone	0.61	Monoterpenic ketone
Isopiperitenone	0.02	Monoterpenic ketone
neo-Menthyl acetate	0.26	Monoterpenic ester
Decanol	0.07	Aliphatic alcohol
2-Ethylmenthone?	0.07	Aliphatic ketone
Dihydroedulan I	0.03	Terpenic ether
Menthyl acetate	5.33	Monoterpenic ester
Dihydroedulan II	0.06	Terpenic ether
Thymol	0.02	Monoterpenic alcohol
Isomenthyl acetate	0.20	Monoterpenic alcohol
neoiso-Menthyl acetate?	0.01	Monoterpenic ester
Dihydrocarvyl acetate	0.01	Monoterpenic ester
Bicycloelemene	0.08	Sesquiterpene
Piperitenone	0.02	Monoterpenic ketone
$\alpha$ -Cubebene	0.02	Sesquiterpene
Evodone	0.01	Monoterpenic ketone
Eugenol	0.09	Phenylpropanoid
$\alpha$ -Ylangene	0.02	Sesquiterpene
$\alpha$ -Copaene	0.06	Sesquiterpene
$\beta$ -Bourbonene	0.18	Sesquiterpene

1,5-diepi- $\beta$ -Bourbonene	0.03	Sesquiterpene
$\beta$ -Cubebene	0.02	Sesquiterpene
$\beta$ -Elemene	0.10	Sesquiterpene
Unknown	0.02	Unknown
(Z)-Jasmone	0.01	Jasmonate
Unknown	tr	Sesquiterpene
Isocaryophyllene	0.03	Sesquiterpene
$\beta$ -Caryophyllene	2.47	Sesquiterpene
$\beta$ -Ylangene	0.16	Sesquiterpene
$\beta$ -Copaene	0.07	Sesquiterpene
Aromadendrene	0.02	Sesquiterpene
<i>trans</i> - $\alpha$ -Bergamotene	0.02	Sesquiterpene
Isogermacrene D	0.03	Sesquiterpene
$\alpha$ -Humulene	0.22	Sesquiterpene
Muurolo-4,11-diene	0.02	Sesquiterpene
(E)- $\beta$ -Farnesene	0.10	Sesquiterpene
9-epi- $\beta$ -Caryophyllene	0.02	Sesquiterpene
$\gamma$ -Muurolole	0.04	Sesquiterpene
Germacrene D	0.50	Sesquiterpene
Menthylactone	0.07	Monoterpenic lactone
Bicyclogermacrene	0.20	Sesquiterpene
Viridiflorene	0.02	Sesquiterpene
$\alpha$ -Muurolole	0.03	Sesquiterpene
$\epsilon$ -Amorphene	0.01	Sesquiterpene
$\gamma$ -Cadinene	0.03	Sesquiterpene
<i>trans</i> -Calamenene	0.01	Sesquiterpene
$\delta$ -Cadinene	0.08	Sesquiterpene
Isocaryophyllene epoxide B	0.02	Sesquiterpenic ether
(E)-Nerolidol	0.01	Sesquiterpenic alcohol
Caryophyllenyl alcohol	0.01	Sesquiterpenic alcohol
Spathulenol	0.04	Sesquiterpenic alcohol
Caryophyllene oxide	0.11	Sesquiterpenic ether
Caryophyllene oxide isomer	0.03	Sesquiterpenic ether
Viridiflorol	0.08	Sesquiterpenic alcohol
Humulene epoxide II	0.01	Sesquiterpenic ether
Isospathulenol	0.01	Sesquiterpenic alcohol
$\tau$ -Muurolole	0.01	Sesquiterpenic alcohol
Unknown	0.01	Sesquiterpenic alcohol
$\alpha$ -Cadinol	0.01	Sesquiterpenic alcohol
Unknown	0.01	Oxygenated sesquiterpene
<i>trans</i> -para-Menthane	tr	Monoterpene
<b>Consolidated total</b>	<b>98.75%</b>	

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

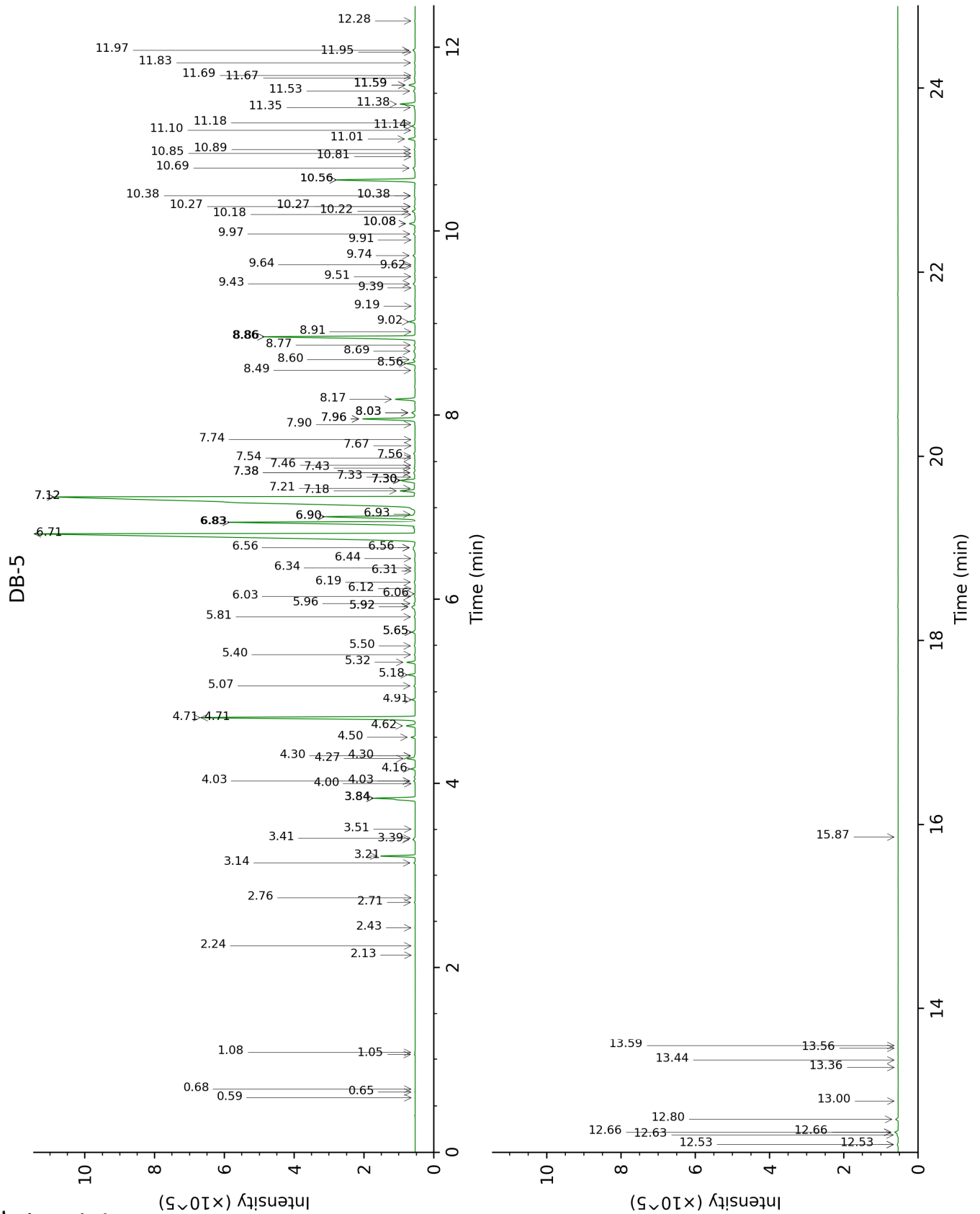
Note: no correction factor was applied

**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.

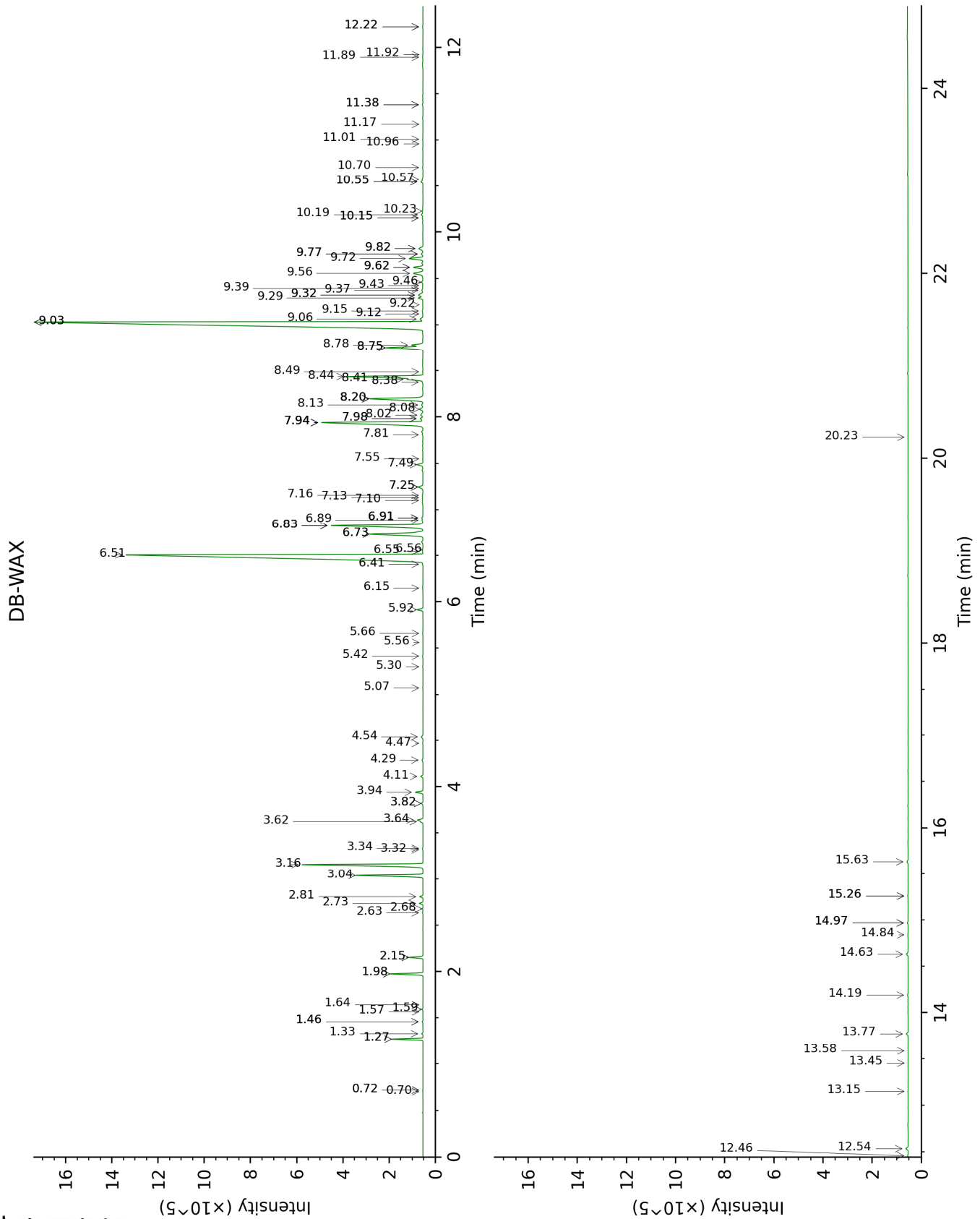
**Unknowns:** Unknown compounds' mass spectral data is presented in the "Full analysis data" table. The occurrence of unknown compounds is to be expected in many samples, and does not denote particular problems unless noted otherwise in the conclusion.



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FULL ANALYSIS DATA

Identification	Column DB-5			Column DB-WAX		
	R.T	R.I	%	R.T	R.I	%
Isobutanol	0.59	620	tr	1.98*	1064	1.05
Isovaleral	0.65	641	tr	0.72*	889	0.01
2-Methylbutyral	0.68	651	tr	0.70	882	tr
Isoamyl alcohol	1.05	733	0.01	3.32	1181	0.01
2-Methylbutanol	1.08	736	0.01	3.34	1182	0.02
Ethyl 2-methylbutyrate	2.13	849	tr	1.57	1022	tr
(3Z)-Hexenol	2.24	858	0.01	5.66	1352	0.01
Hexanol	2.43	873	0.01	5.30	1326	0.01
<i>trans</i> -2,5-Diethyltetrahydrofuran	2.71	896	0.02	1.46*	1010	0.02
Nonane	2.76	900	tr	0.72*	889	[0.01]
$\alpha$ -Thujene	3.14	926	0.03	1.33	997	0.03
$\alpha$ -Pinene	3.22	931	0.82	1.27*	990	0.83
3-Methylcyclohexanone	3.39†	942	0.10	4.54	1274	0.09
Camphene	3.41†	943	[0.10]	1.59	1024	0.02
Thuja-2,4(10)-diene	3.51	950	0.01	2.15*	1083	0.44
$\beta$ -Pinene	3.84*	972	1.48	1.98*	1064	[1.05]
Sabinene	3.84*	972	[1.48]	2.15*	1083	[0.44]
<i>cis</i> -para-Menthane	3.84*	972	[1.48]	1.27*	990	[0.83]
Octen-3-ol	4.00	982	0.01	6.56	1418	0.02
<i>cis</i> -Carane	4.03*	984	0.05	1.64	1030	0.01
Octan-3-one	4.03*	984	[0.05]	3.82*	1220	0.06
Myrcene	4.16	992	0.12	2.74	1133	0.12
Octan-3-ol	4.27†	1000	0.27	5.92	1370	0.23
$\alpha$ -Phellandrene	4.30*†	1002	[0.27]	2.63	1124	0.02
Pseudolimonene	4.30*†	1002	[0.27]	2.68	1128	0.02
$\alpha$ -Terpinene	4.50	1014	0.11	2.81	1139	0.12
para-Cymene	4.62	1022	0.28	3.94	1229	0.28
1,8-Cineole	4.71*	1028	7.72	3.16	1167	5.21
Limonene	4.71*	1028	[7.72]	3.04	1158	2.52
(Z)- $\beta$ -Ocimene	4.91	1040	0.08	3.62	1205	0.08
(E)- $\beta$ -Ocimene	5.06	1050	0.04	3.82*	1220	[0.06]
$\gamma$ -Terpinene	5.18	1057	0.20	3.64	1206	0.21
<i>cis</i> -Sabinene hydrate	5.32	1066	0.24	6.73*	1430	2.81
<i>cis</i> -Linalool oxide (fur.)	5.40	1071	0.03	6.41	1406	0.02
Octanol	5.50	1077	0.04	7.98*	1525	0.14
Terpinolene	5.65*	1086	0.11	4.11	1242	0.09
para-Cymenene	5.65*	1086	[0.11]	6.15	1387	0.02
<i>trans</i> -Sabinene hydrate	5.81	1096	0.04	7.81	1511	0.03
Nonan-3-ol	5.92*	1103	0.19	7.13	1460	0.02
Linalool	5.92*	1103	[0.19]	7.94*	1521	5.63
2-Methylbutyl 2-methylbutyrate	5.96	1105	0.04	4.29	1255	0.04
Amyl isovalerate	6.03	1110	0.02	4.47	1269	0.01
endo-Fenchol	6.06	1112	0.02	8.20*	1541	2.60
Octen-3-yl acetate	6.12	1115	0.01	5.56	1345	0.01

<i>cis</i> -para-Menth-2-en-1-ol	6.19	1120	0.05	7.94*	1521	[5.63]
Octan-3-yl acetate	6.31	1128	0.01	5.07	1309	0.01
allo-Ocimene	6.34	1130	0.01	5.42	1334	0.02
<i>trans</i> -Sabinol	6.44	1136	0.02	9.62*	1654	0.40
Isopulegol	6.56*	1144	0.16	8.02	1528	0.13
<i>cis</i> - $\alpha$ -Dihydroterpineol	6.56*	1144	[0.16]	7.98*	1525	[0.14]
Menthone	6.71	1153	25.80	6.51	1413	25.79
Isomenthone	6.84*	1161	6.89	6.82*	1437	4.45
Menthofuran	6.84*	1161	[6.89]	6.73*	1430	[2.81]
neo-Menthol	6.90*	1165	3.29	8.44	1560	3.22
$\delta$ -Terpineol	6.90*	1165	[3.29]	9.29†	1628	0.46
Lavandulol	6.93	1167	0.04	9.46	1641	0.06
Terpinen-4-ol	7.12*	1179	35.57	8.41	1558	0.58
Menthol	7.12*	1179	[35.57]	9.03*†	1606	34.98
Isomenthol	7.18	1183	0.46	8.78	1587	0.48
para-Cymen-8-ol	7.21	1185	0.03	11.38*	1802	0.03
Myrtenal	7.30*	1190	0.60	8.49	1564	0.02
$\alpha$ -Terpineol	7.30*	1190	[0.60]	9.62*	1654	[0.40]
neoiso-Menthol	7.30*	1190	[0.60]	9.32*†	1630	[0.46]
<i>cis</i> -Piperitol	7.33	1193	0.02	9.39	1636	0.01
Methylchavicol	7.38*	1196	0.07	9.15	1616	0.04
Myrtenol	7.38*	1196	[0.07]	10.70	1744	0.02
<i>trans</i> -Isopiperitenol	7.43	1199	0.03	10.15*	1698	0.04
Unknown [m/z 43, 99 (84), 81 (46), 986 (43), 126 (36), 71 (28)... 170 (12)]	7.46	1201	0.02			
<i>trans</i> -Piperitol	7.54	1206	0.02	10.23	1704	0.03
Decanal	7.56	1207	0.01	7.10	1458	0.03
iso-Dihydrocarveol ?	7.67	1215	0.01	10.57	1733	0.03
<i>trans</i> -Carveol	7.74	1219	0.01	11.17	1784	0.01
(3 <i>Z</i> )-Hexenyl 2-methylbutyrate	7.90	1230	0.02	6.89†	1442	0.09
Citronellol	7.96*	1234	1.68	10.55*	1731	0.09
Pulegone	7.96*	1234	[1.68]	8.75*	1584	1.70
Carvone	8.03*	1238	0.13	9.76*	1666	0.07
(3 <i>Z</i> )-Hexenyl isovalerate	8.03*	1238	[0.13]	6.91*†	1444	[0.09]
Piperitone	8.17	1248	0.61	9.72	1662	0.61
Isopiperitenone	8.49	1269	0.02	11.01	1770	0.02
neo-Menthyl acetate	8.56	1274	0.26	7.49	1486	0.26
Decanol	8.60	1277	0.07	10.55*	1731	[0.09]
2-Ethylmenthone?	8.69	1283	0.07			
Dihydroedulan I	8.77	1288	0.03	6.91*†	1444	[0.09]
Menthyl acetate	8.86*	1294	5.39	7.94*	1521	[5.63]
Dihydroedulan II	8.86*	1294	[5.39]	7.25*	1468	0.23
Thymol	8.91	1297	0.02	14.97*	2136	0.04
Isomenthyl acetate	9.02	1305	0.20	8.08	1532	0.17
neoiso-Menthyl acetate?	9.19	1316	0.01			
Dihydrocarvyl acetate	9.39	1330	0.01	9.22	1622	0.01

Bicycloelemene	9.43	1334	0.08	6.82*	1437	[4.45]
Piperitenone	9.51	1339	0.02	11.89	1847	0.02
α-Cubebene	9.62	1347	0.02	6.55	1416	0.02
Evodone	9.64	1348	0.01	12.22*	1876	0.02
Eugenol	9.74	1355	0.09	14.63	2102	0.08
α-Ylangene	9.91	1367	0.02	6.82*	1437	[4.45]
α-Copaene	9.97	1371	0.06	6.91*†	1444	[0.09]
β-Bourbonene	10.08*	1379	0.21	7.25*	1468	[0.23]
1,5-diepi-β-Bourbonene	10.08*	1379	[0.21]	7.16	1462	0.03
β-Cubebene	10.18	1386	0.02	7.55	1491	0.02
β-Elemene	10.22	1389	0.10	8.20*	1541	[2.60]
Unknown [m/z 107, 121 (79), 119 (66), 91 (58), 136 (55), 105 (49)... 194 (1)]	10.27*	1392	0.04			
(Z)-Jasmone	10.27*	1392	[0.04]	12.22*	1876	[0.02]
Unknown [m/z 106, 119 (99), 43 (78), 91 (74), 105 (60), 134 (55)... 204 (19)]	10.38*	1400	0.04	11.38*	1802	[0.03]
Isocaryophyllene	10.38*	1400	[0.04]	7.94*	1521	[5.63]
β-Caryophyllene	10.56*	1413	2.63	8.20*	1541	[2.60]
β-Ylangene	10.56*	1413	[2.63]	7.94*	1521	[5.63]
β-Copaene	10.69	1423	0.07	8.13	1536	0.06
Aromadendrene	10.81	1432	0.02	8.38	1555	0.02
trans-α-Bergamotene	10.85	1435	0.02	8.20*	1541	[2.60]
Isogermacrene D	10.89	1438	0.03	8.75*	1584	[1.70]
α-Humulene	11.01	1446	0.22	9.06†	1609	[34.98]
Muurola-4,11-diene	11.10	1454	0.02	9.03*†	1606	[34.98]
(E)-β-Farnesene	11.14	1457	0.10	9.32*†	1630	[0.46]
9-epi-β-Caryophyllene	11.18	1460	0.02	9.12	1614	0.01
γ-Murolene	11.35	1472	0.04	9.37	1634	0.06
Germacrene D	11.38	1475	0.50	9.56	1649	0.52
Menthylactone	11.52	1485	0.07	15.64	2203	0.06
Bicyclgermacrene	11.59*	1490	0.22	9.82*	1671	0.23
Viridiflorene	11.59*	1490	[0.22]	9.42	1638	0.02
α-Murolene	11.67	1496	0.03	9.82*	1671	[0.23]
ε-Amorphene	11.69	1498	0.01	9.76*	1666	[0.07]
γ-Cadinene	11.83	1508	0.03	10.15*	1698	[0.04]
trans-Calamenene	11.95	1517	0.01	10.96	1766	0.01
δ-Cadinene	11.97	1519	0.08	10.19	1701	0.08
Isocaryophyllene epoxide B	12.28	1544	0.02	11.92	1850	0.01
(E)-Nerolidol	12.53*	1563	0.04	13.58	2002	0.01
Caryophyllenyl alcohol	12.53*	1563	[0.04]	13.45	1989	0.01
Spathulenol	12.63	1571	0.04	14.19	2060	0.03
Caryophyllene oxide	12.66*	1573	0.13	12.54	1905	0.11
Caryophyllene oxide isomer	12.66*	1573	[0.13]	12.46	1898	0.03
Viridiflorol	12.80	1584	0.08	13.77	2020	0.08
Humulene epoxide II	13.00	1599	0.01	13.15	1961	0.02

Isospathulenol	13.36	1629	0.01	15.26*	2165	0.03
τ-Muurolol	13.44	1635	0.01	14.84	2123	0.01
Unknown cadinol analog II [m/z 95, 121 (73), 43 (57), 79 (43), 161 (43), 109 (40)... 204 (35), 222 (2)]	13.56	1646	0.01	14.97*	2136	[0.04]
α-Cadinol	13.59	1648	0.01	15.26*	2165	[0.03]
Unknown [m/z 43, 107 (97), 81 (83), 121 (77), 123 (74), 93 (73)... 220 (26)...]	15.86	1844	0.01	20.23	2716	0.01
<i>trans</i> -para-Menthane				1.46*	1010	[0.02]
<b>Total identified</b>		<b>98.93%</b>			<b>98.60%</b>	
<b>Total reported</b>		<b>98.97%</b>			<b>98.61%</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