

**Date :** February 25, 2022

**CERTIFICATE OF ANALYSIS – GC PROFILING**

*SAMPLE IDENTIFICATION*

**Internal code :** 22B11-ZAA06

**Customer identification :** Peppermint - India - EAB636744IN87021B

**Type :** Essential oil

**Source :** *Mentha x piperita*

**Customer :** ZAYAT AROMA

*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 :** 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*Notes: This report may not be published, including online, without the written consent from Laboratoire PhytoChemia.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.*

*PHYSICOCHEMICAL DATA*

**Physical aspect:** Clear liquid

**Refractive index:**  $1.4607 \pm 0.0003$  (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
Isobutyral	tr	Aliphatic aldehyde
Isobutanol	tr	Aliphatic alcohol
Isovaleral	0.01	Aliphatic aldehyde
2-Methylbutyral	0.01	Aliphatic aldehyde
2-Ethylfuran	tr	Furan
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
Heptanal	0.01	Aliphatic aldehyde
Hashishene	tr	Monoterpene
$\alpha$ -Thujene	0.03	Monoterpene
$\alpha$ -Pinene	0.90	Monoterpene
<i>trans</i> -3-Methylcyclohexanol	0.01	Aliphatic alcohol
Camphene	0.02	Monoterpene
3-Methylcyclohexanone	0.10	Aliphatic ketone
Thuja-2,4(10)-diene	0.01	Monoterpene
Benzaldehyde	0.01	Simple phenolic
Sabinene	0.44	Monoterpene
$\beta$ -Pinene	1.00	Monoterpene
<i>cis</i> -para-Menthane	0.03	Monoterpene
Octen-3-ol	0.03	Aliphatic alcohol
<i>cis</i> -Carane	0.02	Monoterpene
Octan-3-one	0.03	Aliphatic ketone
Myrcene	0.23	Monoterpene
$\alpha$ -Phellandrene	0.03	Monoterpene
Pseudolimonene	0.02	Monoterpene
Octan-3-ol	0.23	Aliphatic alcohol
$\Delta^3$ -Carene	0.01	Monoterpene
$\alpha$ -Terpinene	0.14	Monoterpene
para-Cymene	0.14	Monoterpene
1,8-Cineole	5.43	Monoterpenic ether
Limonene	2.49	Monoterpene
2-Ethylhexanol	0.01	Aliphatic alcohol
(Z)- $\beta$ -Ocimene	0.11	Monoterpene
(E)- $\beta$ -Ocimene	0.05	Monoterpene
$\gamma$ -Terpinene	0.22	Monoterpene
<i>cis</i> -Sabinene hydrate	0.18	Monoterpenic alcohol
<i>cis</i> -Linalool oxide (fur.)	0.03	Monoterpenic alcohol
Octanol	0.04	Aliphatic alcohol
Isoterpinolene	0.01	Monoterpene
Terpinolene	0.09	Monoterpene
para-Cymenene	0.02	Monoterpene

<i>trans</i> -Sabinene hydrate	0.03	Monoterpenic alcohol
Nonan-3-ol	0.01	Aliphatic alcohol
Linalool	0.08	Monoterpenic alcohol
2-Methylbutyl 2-methylbutyrate	0.08	Aliphatic ester
$\beta$ -Thujone	0.01	Monoterpenic ketone
Amyl isovalerate	0.02	Aliphatic ester
endo-Fenchol	0.02	Monoterpenic alcohol
<i>cis</i> -para-Menth-2-en-1-ol	0.04	Monoterpenic alcohol
Octan-3-yl acetate	0.02	Aliphatic ester
<i>trans</i> -Sabinol	0.02	Monoterpenic alcohol
Isopulegol	0.16	Monoterpenic alcohol
Menthone	26.00	Monoterpenic ketone
Isomenthone	4.53	Monoterpenic ketone
Menthofuran	2.92	Monoterpenic ether
neo-Menthol	2.20	Monoterpenic alcohol
$\delta$ -Terpineol	0.22	Monoterpenic alcohol
Lavandulol	0.03	Monoterpenic alcohol
Terpinen-4-ol	0.72	Monoterpenic alcohol
Menthol	34.78	Monoterpenic alcohol
para-Cymen-8-ol	0.02	Monoterpenic alcohol
Isomenthol	0.36	Monoterpenic alcohol
$\alpha$ -Terpineol	0.48	Monoterpenic alcohol
neoiso-Menthol	0.16	Monoterpenic alcohol
Myrtenal	0.04	Monoterpenic aldehyde
Methylchavicol	0.01	Phenylpropanoid
<i>trans</i> -Isopiperitenol	0.05	Monoterpenic alcohol
Unknown	0.05	Unknown
<i>trans</i> -Piperitol	0.03	Monoterpenic alcohol
iso-Dihydrocarveol ?	0.01	Monoterpenic alcohol
<i>trans</i> -Carveol	0.01	Monoterpenic alcohol
(3Z)-Hexenyl 2-methylbutyrate	tr	Aliphatic ester
Citronellol	0.02	Monoterpenic alcohol
Pulegone	2.19	Monoterpenic ketone
Carvone	0.04	Monoterpenic ketone
(2E)-Hexenyl isovalerate	0.03	Aliphatic ester
Piperitone	0.72	Monoterpenic ketone
Isopiperitenone	0.01	Monoterpenic ketone
neo-Menthyl acetate	0.17	Monoterpenic ester
Decanol	0.05	Aliphatic alcohol
2-Ethylmenthone?	0.04	Aliphatic ketone
Dihydroedulan I	0.04	Terpenic ether
Menthyl acetate	4.90	Monoterpenic ester
Dihydroedulan II	0.02	Terpenic ether
Thymol	0.01	Monoterpenic alcohol
Isomenthyl acetate	0.13	Monoterpenic alcohol
neoiso-Menthyl acetate?	0.01	Monoterpenic ester
Bicycloelemene	0.08	Sesquiterpene
<i>trans</i> -Carvyl acetate	0.02	Monoterpenic ester
Piperitenone	0.01	Monoterpenic ketone
Menthofuroolactone isomer II	0.02	Monoterpenic lactone
$\alpha$ -Cubebene	0.01	Sesquiterpene
Eugenol	0.04	Phenylpropanoid

α-Ylangene	0.02	Sesquiterpene
α-Copaene	0.06	Sesquiterpene
β-Bourbonene	0.23	Sesquiterpene
β-Cubebene	0.02	Sesquiterpene
β-Elemene	0.09	Sesquiterpene
Unknown	0.02	Unknown
Longifolene	0.04	Sesquiterpene
Isocaryophyllene	0.01	Sesquiterpene
Unknown	0.01	Sesquiterpene
β-Caryophyllene	2.66	Sesquiterpene
β-Ylangene	0.16	Sesquiterpene
Unknown	0.02	Unknown
β-Copaene	0.06	Sesquiterpene
Aromadendrene	0.04	Sesquiterpene
Isogermacrene D	0.03	Sesquiterpene
α-Humulene	0.26	Sesquiterpene
Muurola-4,11-diene	0.03	Sesquiterpene
(E)-β-Farnesene	0.16	Sesquiterpene
γ-Murolene	0.04	Sesquiterpene
Germacrene D	0.66	Sesquiterpene
Menthylactone	0.01	Monoterpenic lactone
Bicyclogermacrene	0.11	Sesquiterpene
Viridiflorene	0.09	Sesquiterpene
α-Murolene	0.03	Sesquiterpene
5-Methyl-2,4-diisopropylphenol	0.02	Terpene derivative
ε-Amorphene	0.01	Sesquiterpene
γ-Cadinene	0.03	Sesquiterpene
δ-Cadinene	0.08	Sesquiterpene
(E)-Nerolidol	0.01	Sesquiterpenic alcohol
Spathulenol	0.02	Sesquiterpenic alcohol
Caryophyllene oxide isomer	0.01	Sesquiterpenic ether
Caryophyllene oxide	0.05	Sesquiterpenic ether
Viridiflorol	0.06	Sesquiterpenic alcohol
Humulene epoxide II	0.01	Sesquiterpenic ether
Isospathulenol	0.01	Sesquiterpenic alcohol
τ-Cadinol	0.01	Sesquiterpenic alcohol
(3Z)-Caryophylla-3,8(13)-dien-5β-ol	0.01	Sesquiterpenic alcohol
Mint sulfide?	0.01	Sesquiterpenic sulfide
meta-Camphorene	0.01	Diterpene
para-Camphorene	0.01	Diterpene
Unknown	0.01	Unknown
<b>Consolidated total</b>	<b>99.01%</b>	

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

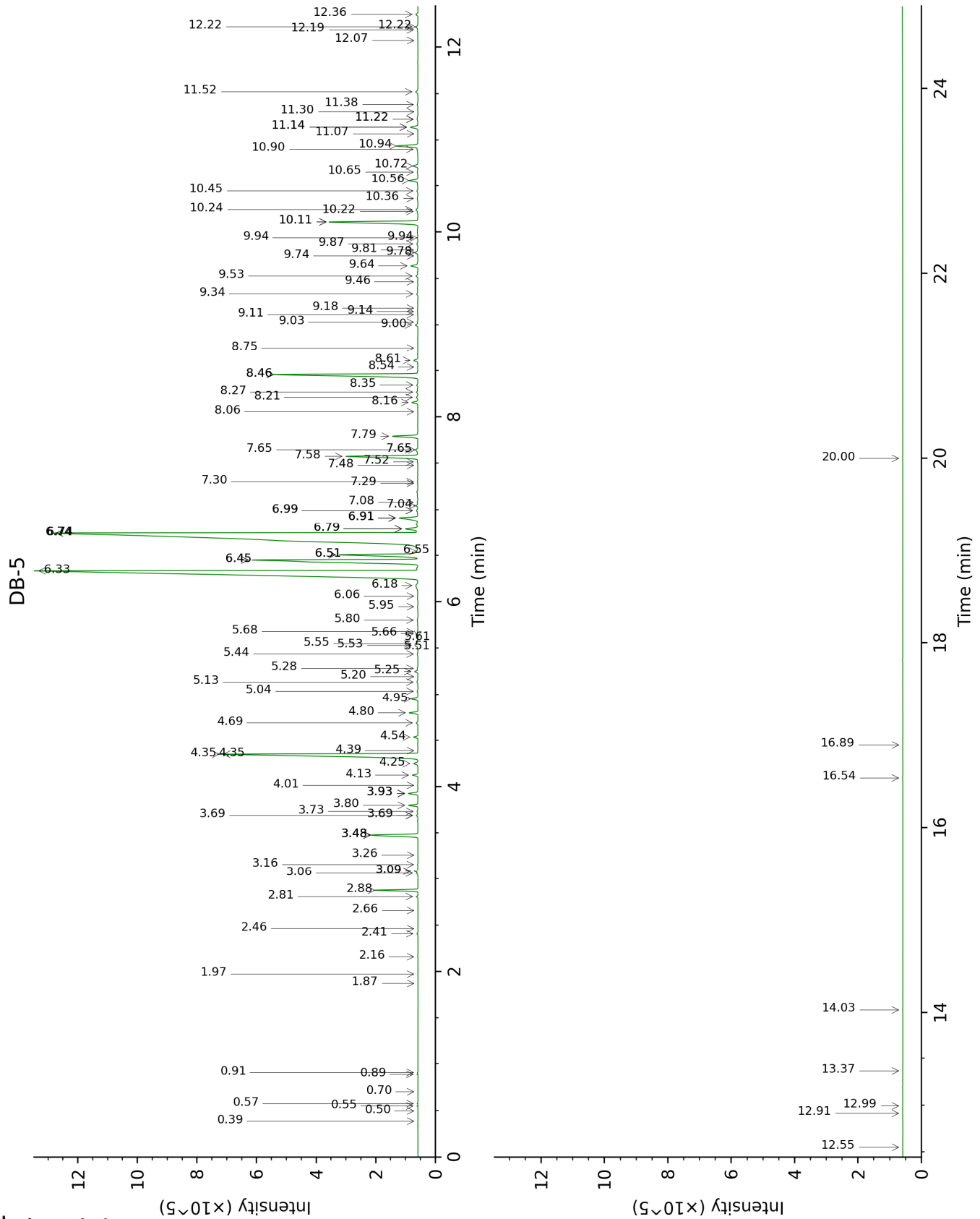
Note: no correction factor was applied

**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.

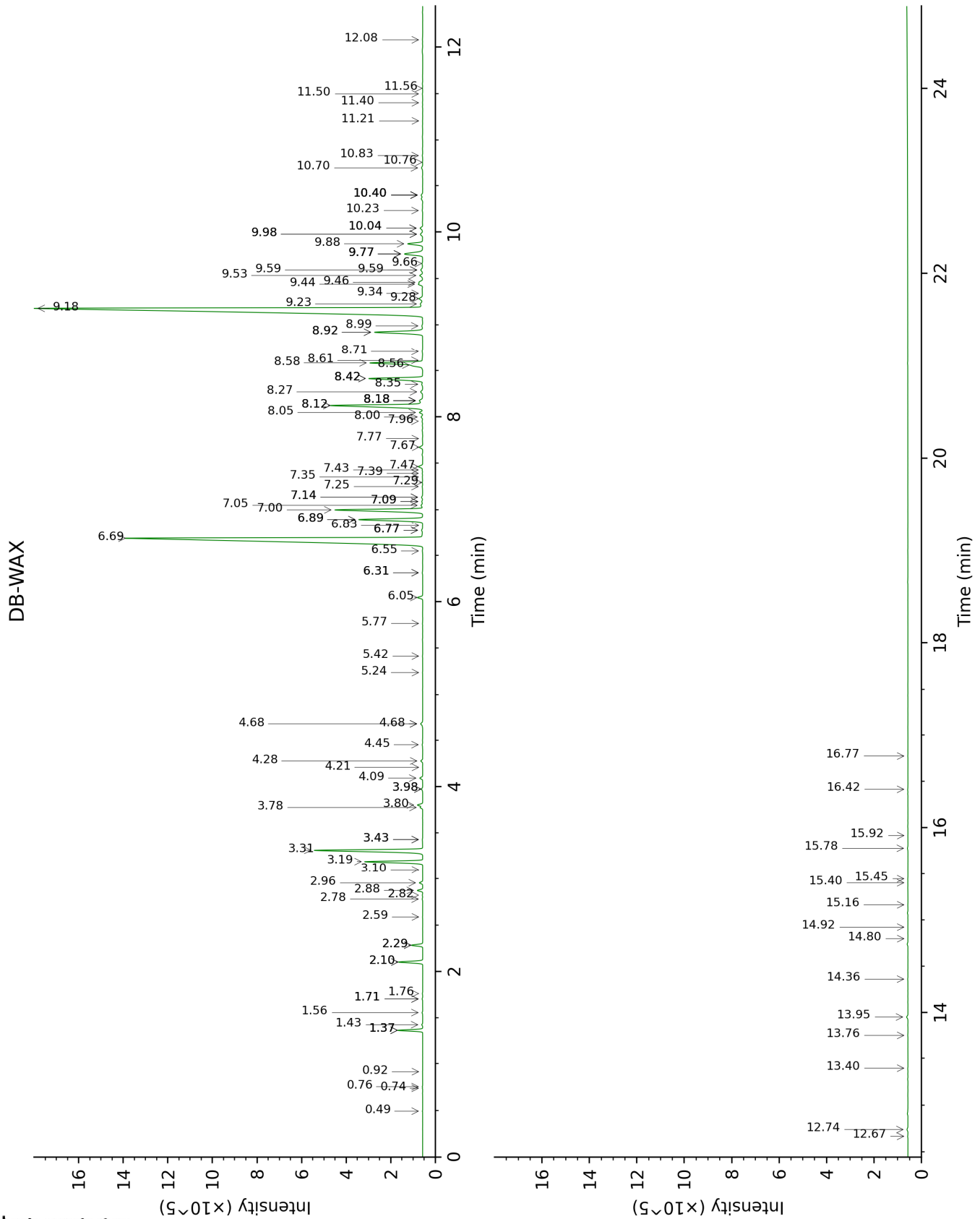
**Unknowns:** Unknown compounds' mass spectral data is presented in the "Full analysis data" table. The occurrence of unknown compounds is to be expected in many samples, and does not denote particular problems unless noted otherwise in the conclusion.



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	%
Isobutyral	0.39	537	tr	0.49	780	0.01
Isobutanol	0.50	620	tr	2.10*	1064	1.00
Isovaleral	0.55	641	0.01	0.76	884	0.01
2-Methylbutyral	0.57	651	0.01	0.74	878	0.01
2-Ethylfuran	0.70	701	tr	0.92	917	tr
Isoamyl alcohol	0.89	732	0.01	3.43*	1176	0.04
2-Methylbutanol	0.91	735	0.01	3.43*	1176	[0.04]
Ethyl 2-methylbutyrate	1.87	850	tr	1.70*	1025	0.03
(3Z)-Hexenol	1.97	858	0.01	5.77	1345	0.01
Hexanol	2.16	875	0.01	5.42	1319	0.01
<i>trans</i> -2,5-Diethyltetrahydrofuran	2.41	897	0.02	1.56	1011	0.02
Heptanal	2.46	901	0.01	3.10	1150	0.01
Hashishene	2.66	915	tr	1.37*	990	0.90
$\alpha$ -Thujene	2.81	926	0.03	1.43	998	0.04
$\alpha$ -Pinene	2.88	930	0.90	1.37*	990	[0.90]
<i>trans</i> -3-Methylcyclohexanol	3.06†	943	0.13	6.82	1422	0.01
Camphene	3.09*†	944	[0.13]	1.70*	1025	[0.03]
3-Methylcyclohexanone	3.09*†	944	[0.13]	4.68*	1270	0.12
Thuja-2,4(10)-diene	3.16	949	0.01	2.28*	1082	0.45
Benzaldehyde	3.26	956	0.01	7.35	1461	0.03
Sabinene	3.48*	971	1.46	2.28*	1082	[0.45]
$\beta$ -Pinene	3.48*	971	[1.46]	2.10*	1064	[1.00]
<i>cis</i> -para-Menthane	3.48*	971	[1.46]	1.37*	990	[0.90]
Octen-3-ol	3.69*	986	0.04	6.77*	1418	0.07
<i>cis</i> -Carane	3.69*	986	[0.04]	1.76	1031	0.02
Octan-3-one	3.73	988	0.03	3.98*	1218	0.06
Myrcene	3.80	993	0.23	2.88	1132	0.22
$\alpha$ -Phellandrene	3.93*	1002	0.27	2.78	1124	0.03
Pseudolimonene	3.93*	1002	[0.27]	2.82	1128	0.02
Octan-3-ol	3.93*	1002	[0.27]	6.05	1365	0.23
$\Delta$ 3-Carene	4.02	1007	0.01	2.59	1109	0.01
$\alpha$ -Terpinene	4.13	1014	0.14	2.96	1138	0.14
para-Cymene	4.25	1022	0.14	4.09	1226	0.13
1,8-Cineole	4.35*	1028	7.95	3.32	1167	5.43
Limonene	4.35*	1028	[7.95]	3.19	1157	2.49
2-Ethylhexanol	4.39	1031	0.01	7.30	1457	0.02
(Z)- $\beta$ -Ocimene	4.54	1040	0.11	3.78	1203	0.10
(E)- $\beta$ -Ocimene	4.69	1050	0.05	3.98*	1218	[0.06]
$\gamma$ -Terpinene	4.80	1057	0.22	3.80	1205	0.23
<i>cis</i> -Sabinene hydrate	4.95	1066	0.18	6.90*	1427	3.13
<i>cis</i> -Linalool oxide (fur.)	5.04	1072	0.03	6.55	1401	0.02
Octanol	5.14	1078	0.04	8.18*†	1523	[5.37]
Isoterpinolene	5.20	1082	0.01	4.21	1235	0.01
Terpinolene	5.25	1086	0.09	4.28	1240	0.08
para-Cymenene	5.28	1088	0.02	6.31*	1384	0.03

<i>trans</i> -Sabinene hydrate	5.44	1098	0.03	7.96	1506	0.03
Nonan-3-ol	5.51	1102	0.01	7.39	1464	0.02
Linalool	5.53	1103	0.08	8.05	1513	0.15
2-Methylbutyl 2-methylbutyrate	5.55	1104	0.08	4.45	1253	0.03
$\beta$ -Thujone	5.61	1108	0.01	6.31*	1384	[0.03]
Amyl isovalerate	5.66	1112	0.02	4.68*	1270	[0.12]
endo-Fenchol	5.68	1113	0.02	8.42*	1542	2.77
<i>cis</i> -para-Menth-2-en-1-ol	5.80	1121	0.04	8.18*†	1523	[5.37]
Octan-3-yl acetate	5.95	1130	0.02	5.24	1307	0.01
<i>trans</i> -Sabinol	6.06	1138	0.02	9.77*	1649	1.16
Isopulegol	6.18	1145	0.16	8.12*†	1519	5.37
Menthone	6.34	1155	26.00	6.69	1411	25.97
Isomenthone	6.45*	1162	7.45	7.00	1435	4.53
Menthofuran	6.45*	1162	[7.45]	6.90*	1427	[3.13]
neo-Menthol	6.51*	1166	2.56	8.58†	1555	[2.92]
$\delta$ -Terpineol	6.51*	1166	[2.56]	9.46†	1624	[0.38]
Lavandulol	6.55	1169	0.03	9.66	1640	0.04
Terpinen-4-ol	6.74*	1181	35.50	8.56†	1553	2.92
Menthol	6.74*	1181	[35.50]	9.18	1601	34.78
para-Cymen-8-ol	6.79*	1184	0.42	11.50	1794	0.02
Isomenthol	6.79*	1184	[0.42]	8.92*	1581	2.55
$\alpha$ -Terpineol	6.91*	1192	0.67	9.77*	1649	[1.16]
neoiso-Menthol	6.91*	1192	[0.67]	9.44†	1622	0.38
Myrtenal	6.91*	1192	[0.67]	8.71	1565	0.04
Methylchavicol	6.99*	1197	0.06	9.34	1614	0.01
<i>trans</i> -Isopiperitenol	6.99*	1197	[0.06]	10.40*	1700	0.08
Unknown [m/z 43, 99 (84), 81 (46), 986 (43), 126 (36), 71 (28)... 170 (12)]	7.04	1201	0.05			
<i>trans</i> -Piperitol	7.08	1203	0.03	10.40*	1700	[0.08]
iso-Dihydrocarveol ?	7.29	1217	0.01	10.83	1737	0.02
<i>trans</i> -Carveol	7.30	1218	0.01	11.40	1786	0.01
(3 <i>Z</i> )-Hexenyl 2-methylbutyrate	7.48	1230	tr	7.09*	1441	0.05
Citronellol	7.52	1232	0.02	10.76	1731	0.01
Pulegone	7.58	1236	2.19	8.92*	1581	[2.55]
Carvone	7.65*	1241	0.08	9.98*	1666	0.14
(2 <i>E</i> )-Hexenyl isovalerate	7.65*	1241	[0.08]	7.25	1453	0.03
Piperitone	7.79	1251	0.72	9.88	1658	0.74
Isopiperitenone	8.06	1268	0.01	11.21	1769	0.01
neo-Menthyl acetate	8.16	1275	0.17	7.68	1485	0.16
Decanol	8.21	1279	0.05	10.70	1726	0.07
2-Ethylmenthone?	8.27	1283	0.04			
Dihydroedulan I	8.34	1288	0.04	7.14*	1445	0.07
Menthyl acetate	8.46*	1295	4.92	8.12*†	1519	[5.37]
Dihydroedulan II	8.46*	1295	[4.92]	7.43	1467	0.02
Thymol	8.54	1301	0.01	15.16	2135	0.01

Isomenthyl acetate	8.61	1306	0.13	8.27	1531	0.12
neoiso-Menthyl acetate?	8.75	1316	0.01			
Bicycloelemene	9.00	1333	0.08	7.05	1438	0.09
<i>trans</i> -Carvyl acetate	9.03	1335	0.02	10.23	1687	0.03
Piperitenone	9.11	1341	0.01	12.08	1845	0.02
Menthofuroolactone isomer II	9.14	1344	0.02			
$\alpha$ -Cubebene	9.18	1346	0.01	6.77*	1418	[0.07]
Eugenol	9.34	1357	0.04	14.80	2099	0.01
$\alpha$ -Ylangene	9.46	1366	0.02	7.09*	1441	[0.05]
$\alpha$ -Copaene	9.53	1371	0.06	7.14*	1445	[0.07]
$\beta$ -Bourbonene	9.64	1378	0.23	7.47	1469	0.21
$\beta$ -Cubebene	9.74	1386	0.02	7.77	1492	0.02
$\beta$ -Elemene	9.78	1389	0.09	8.42*	1542	[2.77]
Unknown [m/z 107, 121 (79), 119 (66), 91 (58), 136 (55), 105 (49)... 194 (1)]	9.81	1391	0.02			
Longifolene	9.87	1395	0.04	8.00	1510	0.08
Isocaryophyllene	9.94*	1400	0.02	8.18*†	1523	[5.37]
Unknown [m/z 106, 119 (99), 43 (78), 91 (74), 105 (60), 134 (55)... 204 (19)]	9.94*	1400	[0.02]	11.56	1799	0.01
$\beta$ -Caryophyllene	10.11*	1412	2.81	8.42*	1542	[2.77]
$\beta$ -Ylangene	10.11*	1412	[2.81]	8.18*†	1523	[5.37]
Unknown [m/z 177, 109 (32), 192 (26), 95 (25), 137 (23)]	10.22	1421	0.02			
$\beta$ -Copaene	10.24	1422	0.06	8.35	1537	0.05
Aromadendrene	10.36	1431	0.04	8.61	1557	0.04
Isogermacrene D	10.44	1437	0.03	8.99	1586	0.04
$\alpha$ -Humulene	10.56	1446	0.26	9.28	1610	0.22
Muurolo-4,11-diene	10.66	1453	0.03	9.23	1605	0.16
( <i>E</i> )- $\beta$ -Farnesene	10.72	1458	0.16	9.53	1630	0.16
$\gamma$ -Muurolole	10.90	1471	0.04	9.59*	1635	0.12
Germacrene D	10.94	1474	0.66	9.77*	1649	[1.16]
Menthylactone	11.07	1484	0.01	15.92	2211	0.01
Bicyclogermacrene	11.14*	1489	0.24	10.04*	1671	0.14
Viridiflorene	11.14*	1489	[0.24]	9.59*	1635	[0.12]
$\alpha$ -Muurolole	11.22*	1496	0.05	10.04*	1671	[0.14]
5-Methyl-2,4-diisopropylphenol	11.22*	1496	[0.05]	16.42	2263	0.02
$\epsilon$ -Amorphene	11.30	1502	0.01	9.98*	1666	[0.14]
$\gamma$ -Cadinene	11.38	1508	0.03	10.40*	1700	[0.08]
$\delta$ -Cadinene	11.52	1518	0.08	10.40*	1700	[0.08]
( <i>E</i> )-Nerolidol	12.07	1562	0.01	13.76	1998	0.01
Spathulenol	12.19	1571	0.02	14.36	2056	0.02
Caryophyllene oxide isomer	12.22*	1574	0.07	12.67	1897	0.01
Caryophyllene oxide	12.22*	1574	[0.07]	12.74	1904	0.05

Viridiflorol	12.36	1584	0.06	13.95	2017	0.07
Humulene epoxide II	12.55	1599	0.01	13.40	1965	0.01
Isospathulenol	12.91	1629	0.01	15.44	2163	0.01
$\tau$ -Cadinol	12.99	1636	0.01	14.92	2111	0.01
(3Z)-Caryophylla-3,8(13)-dien-5 $\beta$ -ol	13.37	1667	0.01	16.77	2300	0.01
Mint sulfide?	14.03	1723	0.01			
meta-Camphorene	16.54	1949	0.01	15.40	2159	0.01
para-Camphorene	16.89	1983	0.01	15.78	2197	0.03
Unknown [m/z 165, 166 (48), 137 (11), 67 (9), 124 (7), 43 (7)...]	20.00	2303	0.01			
<b>Total identified</b>		<b>99.17%</b>			<b>99.10%</b>	
<b>Total reported</b>		<b>99.26%</b>			<b>99.11%</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