

**Date :** May 24, 2019

**CERTIFICATE OF ANALYSIS – GC PROFILING**

*SAMPLE IDENTIFICATION*

**Internal code :** 19E14-PTH03-1-SCC

**Customer identification :** Melissa - Bulgaria - MH010078R

**Type :** Essential oil

**Source :** *Melissa officinalis*

**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 :** May 22, 2019

Checked and approved by :

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

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*PHYSICOCHEMICAL DATA*

**Physical aspect:** Yellow liquid

**Refractive index:**  $1.4849 \pm 0.0003$  (20 °C)

*CONCLUSION*

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

## ANALYSIS SUMMARY

Identification	DB-5 (%)	DB-WAX (%)	Classe
Ethanol	0.01	0.01	Aliphatic alcohol
Dimethylsulfide	tr	tr	Aliphatic sulfide
Isobutyral	0.02		Aliphatic aldehyde
2-Methyl-3-buten-2-ol	0.02	0.03	Aliphatic alcohol
Isobutanol	0.01	0.01	Aliphatic alcohol
Isovaleral	0.12	0.12	Aliphatic aldehyde
2-Methylbutyral	0.09	0.09	Aliphatic aldehyde
2-Ethylfuran	0.07	0.06	Furan
Isoamyl alcohol	0.03	0.04*	Aliphatic alcohol
2-Methylbutanol	0.03	[0.04]*	Aliphatic alcohol
Toluene	tr	0.01	Simple phenolic
Hexanal	0.02	0.02	Aliphatic aldehyde
(2E)-Hexenal	0.09	0.10	Aliphatic aldehyde
(3Z)-Hexenol	0.14	0.16	Aliphatic alcohol
<i>cis</i> -1-Methyl-3-(1-methylethyl)-cyclopentane?	0.01		Normonoterpene
<i>trans</i> -1-Methyl-3-(1-methylethyl)-cyclopentane?	0.01	0.01	Normonoterpene
(2E)-Hexenol	0.03	0.04	Aliphatic alcohol
Hexanol	0.11	0.13	Aliphatic alcohol
$\alpha$ -Pinene	0.04	0.03	Monoterpene
Benzaldehyde	0.01	0.02	Simple phenolic
Ethyl isohexanoate	0.01	0.08	Aliphatic ester
Sabinene	0.01*	0.01	Monoterpene
$\beta$ -Pinene	[0.01]*		Monoterpene
Octen-3-ol	0.40	0.42	Aliphatic alcohol
6-Methyl-5-hepten-2-one	2.81*	2.49	Aliphatic ketone
Octan-3-one	[2.81]*	0.75*	Aliphatic ketone
Myrcene	0.20	0.18	Monoterpene
6-Methyl-5-hepten-2-ol	0.02	0.03*	Aliphatic alcohol
Octan-3-ol	0.02	0.04	Aliphatic alcohol
Ethyl hexanoate	0.03	0.02	Aliphatic ester
(3Z)-Hexenyl acetate	0.14	0.14	Aliphatic ester
Hexyl acetate	0.08	0.08*	Aliphatic ester
para-Cymene	0.02	0.01	Monoterpene
Unknown	0.06*	0.01	Unknown
Limonene	[0.06]*	0.04	Monoterpene
Unknown	[0.06]	0.01	Unknown
Benzeneacetaldehyde	0.04	0.04	Simple phenolic
(Z)- $\beta$ -Ocimene	0.07	0.07*	Monoterpene
(E)- $\beta$ -Ocimene	0.51	[0.75]*	Monoterpene
2,6-Dimethyl-5-heptenal (melonal)	0.03	0.09*	Aliphatic aldehyde
$\gamma$ -Terpinene	0.01	[0.07]*	Monoterpene
<i>cis</i> -Linalool oxide (fur.)	0.01	0.01	Monoterpenic alcohol
Terpinolene	0.04*	[0.08]*	Monoterpene
<i>trans</i> -Linalool oxide (fur.)	[0.04]*	0.42	Monoterpenic alcohol
Rosefuran	0.20	0.19	Monoterpenic ether
Linalool	0.32	0.32	Monoterpenic alcohol

Nonanal	0.07	0.06	Aliphatic aldehyde
<i>cis</i> -Rose oxide	0.09	[0.09]*	Monoterpenic ether
Unknown	0.03	0.06	Unknown
<i>trans</i> -para-Mentha-2,8-dien-1-ol	0.04	0.03	Monoterpenic alcohol
<i>trans</i> -Rose oxide	0.04	0.04	Monoterpenic ether
Melonol ?	0.04		Normonoterpene
Unknown	0.43*	[0.23]*	Unknown
<i>cis</i> -para-Mentha-2,8-dien-1-ol	[0.43]*	26.14*	Monoterpenic alcohol
neo-Isopulegol	0.06*	0.08*	Monoterpenic alcohol
Isopulegol	[0.06]*	[0.08]*	Monoterpenic alcohol
exo-Isocitral	0.79*	0.23	Monoterpenic aldehyde
<i>trans</i> -Chrysanthemal	[0.79]*	0.63	Monoterpenic aldehyde
Citronellal	1.83	1.70	Monoterpenic aldehyde
iso-Isopulegol	0.04	0.05	Monoterpenic alcohol
Isoneral	0.88*	0.79	Monoterpenic aldehyde
<i>cis</i> -Linalool oxide (pyr.)	[0.88]*	0.03	Monoterpenic alcohol
Unknown	0.16	0.20*	Oxygenated monoterpene
Terpinen-4-ol	0.16*	0.02	Monoterpenic alcohol
Rosefuran oxide	[0.16]*	0.02	Monoterpenic ether
<i>trans</i> -Linalool oxide (pyr.)	[0.16]*	3.97*	Monoterpenic alcohol
Isogeranial	1.38	1.49*	Monoterpenic aldehyde
$\alpha$ -Terpineol	0.10	[1.97]*	Monoterpenic alcohol
<i>trans</i> -Isopiperitenol	0.04	0.04	Monoterpenic alcohol
Unknown	0.07		Oxygenated monoterpene
Unknown	0.01		Oxygenated monoterpene
Nerol	1.34	1.37	Monoterpenic alcohol
Citronellol	0.45	0.46	Monoterpenic alcohol
Neral	25.79	[26.14]*	Monoterpenic aldehyde
Piperitone	0.08	0.08	Monoterpenic ketone
Geraniol	2.66	2.75	Monoterpenic alcohol
Methyl citronellate	0.30	[1.49]*	Monoterpenic ester
Geranial	34.12	34.48*	Monoterpenic aldehyde
Unknown	[34.12]	0.04	Oxygenated monoterpene
Thymol	0.01	0.01	Monoterpenic alcohol
Methyl geranate	0.73	1.97	Monoterpenic ester
Citronellic acid	0.08		Monoterpenic acid
Unknown	0.12	0.20*	Unknown
Citronellyl acetate	0.07	[26.14]*	Monoterpenic ester
Neryl acetate	0.52*	[34.48]*	Monoterpenic ester
$\alpha$ -Ylangene	[0.52]*	[0.03]*	Sesquiterpene
Geranic acid	[0.52]*	0.41	Aliphatic acid
$\alpha$ -Copaene	0.18	0.20	Sesquiterpene
$\beta$ -Bourbonene	0.15	[0.23]*	Sesquiterpene
Geranyl acetate	3.95*	[3.97]*	Monoterpenic ester
$\beta$ -Cubebene	[3.95]*	0.06	Sesquiterpene
$\beta$ -Elemene	0.08	9.74*	Sesquiterpene
Isocaryophyllene	0.09	0.05	Sesquiterpene
$\beta$ -Caryophyllene	9.84	[9.74]*	Sesquiterpene
$\beta$ -Copaene	0.11	0.06	Sesquiterpene
( <i>Z</i> )- $\beta$ -Farnesene?	0.02	0.01	Sesquiterpene
Isogermacrene D	0.01	0.01	Sesquiterpene
$\alpha$ -Humulene	0.56	0.54	Sesquiterpene

allo-Aromadendrene	0.09	0.11	Sesquiterpene
(E)- $\beta$ -Farnesene	0.09	0.09	Sesquiterpene
$\gamma$ -Muurolene	1.31*	[0.20]*	Sesquiterpene
Germacrene D	[1.31]*	[1.97]*	Sesquiterpene
Bicyclogermacrene	0.09	0.23*	Sesquiterpene
$\alpha$ -Muurolene	0.22*	[0.23]*	Sesquiterpene
(3Z,6E)- $\alpha$ -Farnesene	[0.22]*	0.14	Sesquiterpene
$\gamma$ -Cadinene	0.16*	0.13	Sesquiterpene
(3E,6E)- $\alpha$ -Farnesene	[0.16]*	0.09	Sesquiterpene
$\delta$ -Cadinene	0.22	0.24	Sesquiterpene
<i>trans</i> -Cadina-1,4-diene	0.01	0.01	Sesquiterpene
$\alpha$ -Cadinene	0.02	0.02	Sesquiterpene
Isocaryophyllene epoxide B	0.04	0.07	Sesquiterpenic ether
Germacrene D-4-ol	0.01	0.01	Sesquiterpenic alcohol
Caryophyllene oxide	1.08*	0.91	Sesquiterpenic ether
Caryophyllene oxide isomer	[1.08]*	[0.20]*	Sesquiterpenic ether
Humulene epoxide II	0.07	0.08	Sesquiterpenic ether
1-epi-Cubenol	0.01	0.02	Sesquiterpenic alcohol
$\tau$ -Muurolol	0.05	0.06	Sesquiterpenic alcohol
$\alpha$ -Muurolol	0.02	0.03	Sesquiterpenic alcohol
$\alpha$ -Cadinol	0.08	0.07	Sesquiterpenic alcohol
(3Z)-Caryophylla-3,8(13)-dien-5 $\beta$ -ol	0.02	0.02	Sesquiterpenic alcohol
Germacra-4(15),5,10(14)-trien-1 $\alpha$ -ol	0.03	0.04	Sesquiterpenic alcohol
(2E,6E)-Farnesal	0.01	0.01	Sesquiterpenic aldehyde
Phytone	0.03	0.04	Terpenic ketone
Nonadecane	0.01	0.02	Alkane
Eicosane	0.01	0.03	Alkane
Heneicosane	0.04	0.03	Alkane
<b>Total identified</b>	<b>96.52%</b>	<b>96.70%</b>	

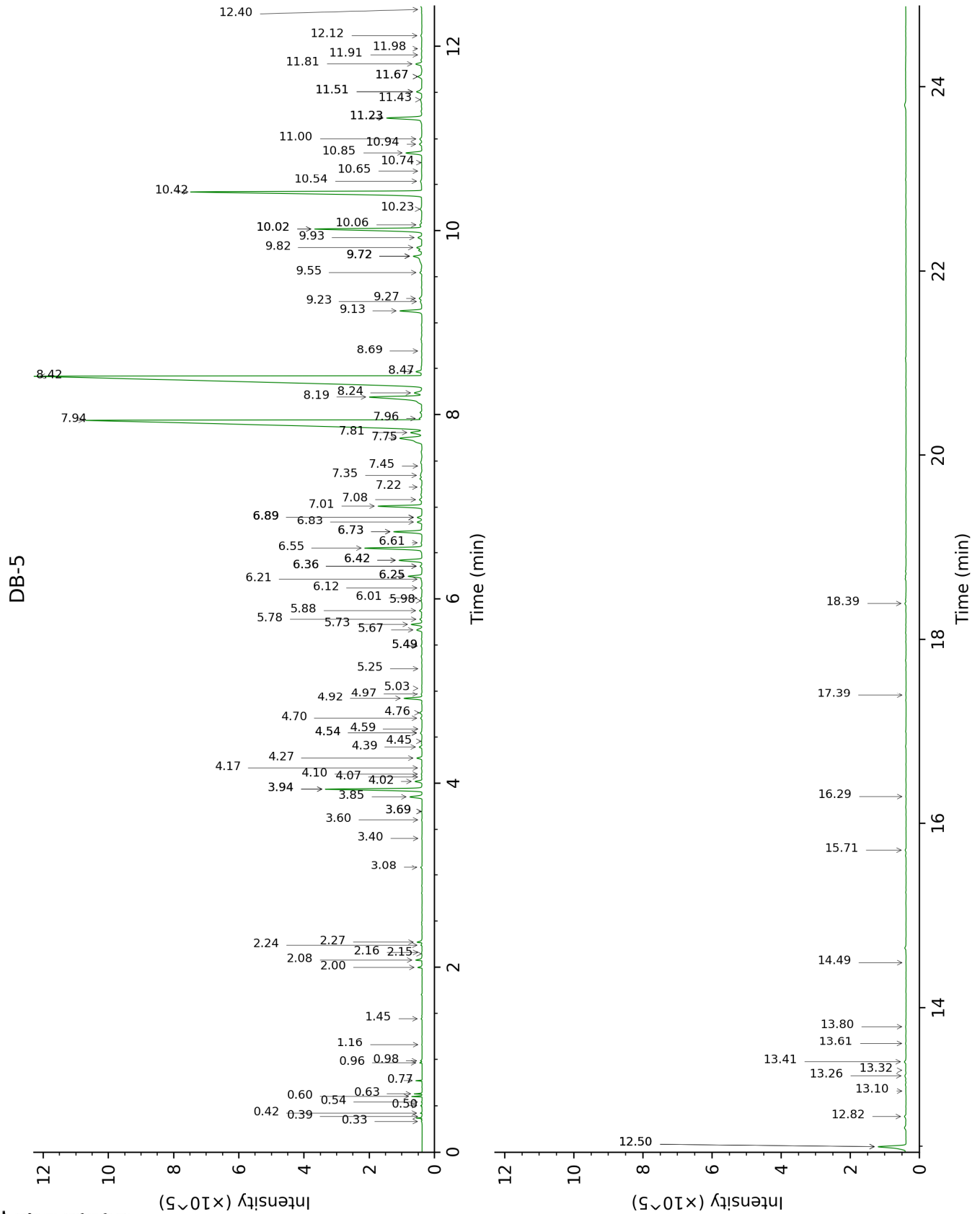
\*: Two or more compounds are coeluting on this column

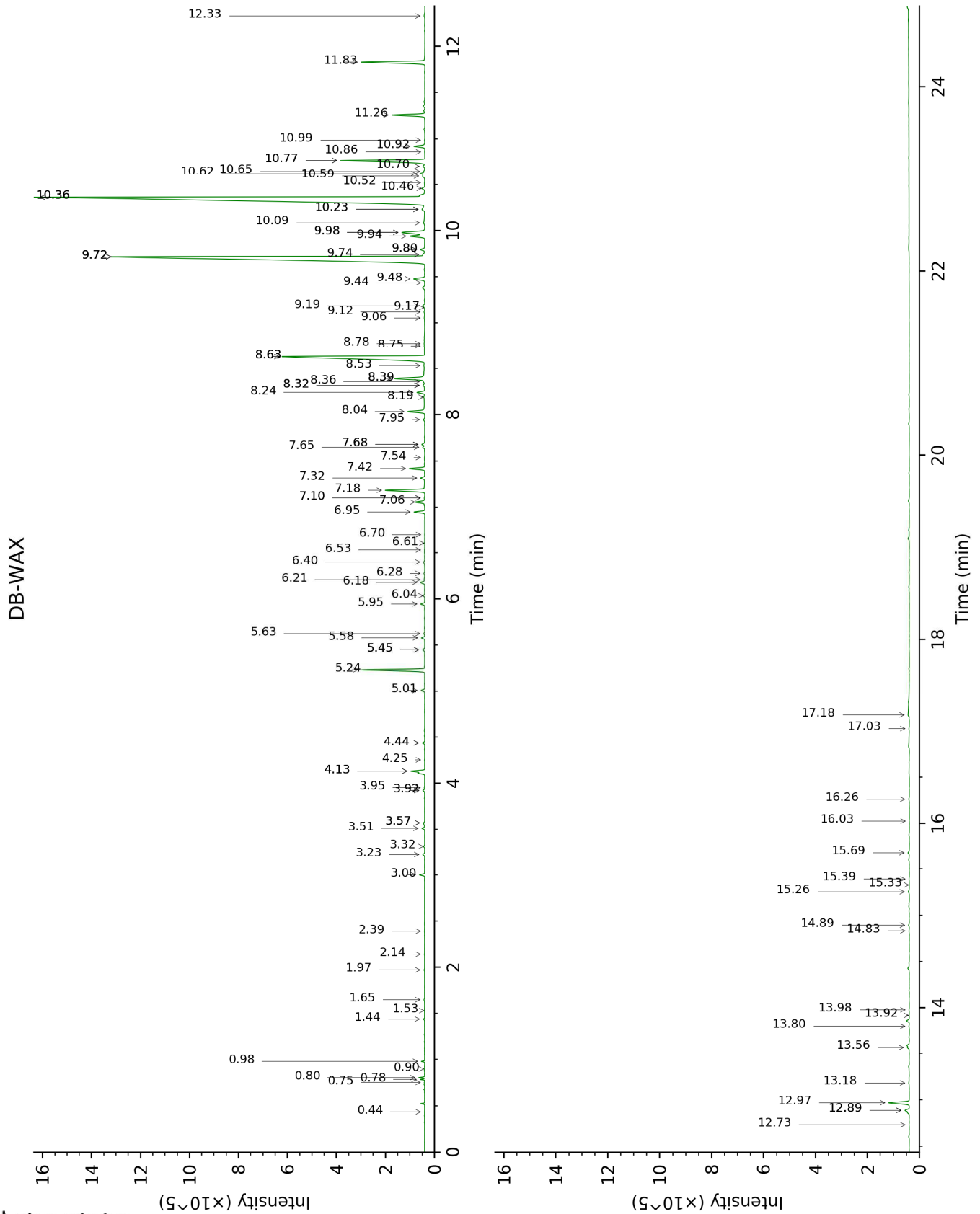
[xx]: Duplicate percentage due to coelutions, not taken account in the identified total

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

Note: no correction factor was applied

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FULL ANALYSIS DATA

Identification	Column DB-5			Column DB-WAX		
	R.T	R.I	%	R.T	R.I	%
Ethanol	0.33	518	0.01	0.90	906	0.01
Dimethylsulfide	0.39	518	tr	0.44	710	tr
Isobutyral	0.42	533	0.02			
2-Methyl-3-buten-2-ol	0.50	592	0.02	1.65	1013	0.03
Isobutanol	0.54	618	0.01	2.14	1060	0.01
Isovaleral	0.60	641	0.12	0.80	887	0.12
2-Methylbutyral	0.63	652	0.09	0.78	880	0.09
2-Ethylfuran	0.77	706	0.07	0.98	919	0.06
Isoamyl alcohol	0.96	734	0.03	3.57*	1176	0.04
2-Methylbutanol	0.98	737	0.03	3.57*	1176	[0.04]
Toluene	1.16	761	tr	1.53	1001	0.01
Hexanal	1.44	800	0.02	1.97	1044	0.02
(2E)-Hexenal	2.00	848	0.09	3.51	1171	0.10
(3Z)-Hexenol	2.08	854	0.14	5.95	1346	0.16
<i>cis</i> -1-Methyl-3-(1-methylethyl)-cyclopentane?	2.15	860	0.01			
<i>trans</i> -1-Methyl-3-(1-methylethyl)-cyclopentane?	2.16	861	0.01	0.75	869	0.01
(2E)-Hexenol	2.24	867	0.03	6.28	1370	0.04
Hexanol	2.27	870	0.11	5.58	1320	0.13
$\alpha$ -Pinene	3.08	930	0.04	1.44	991	0.03
Benzaldehyde	3.40	951	0.01	7.54	1462	0.02
Ethyl isohexanoate	3.60	964	0.01	3.23	1150	0.08
Sabinene	3.70*	970	0.01	2.39	1084	0.01
$\beta$ -Pinene	3.70*	970	[0.01]			
Octen-3-ol	3.85	981	0.40	6.95	1419	0.42
6-Methyl-5-hepten-2-one	3.94*	986	2.81	5.24	1296	2.49
Octan-3-one	3.94*	986	[2.81]	4.13*†	1217	0.75
Myrcene	4.02	992	0.20	3.00	1132	0.18
6-Methyl-5-hepten-2-ol	4.07	995	0.02	7.10*	1430	0.03
Octan-3-ol	4.10	997	0.02	6.21	1365	0.04
Ethyl hexanoate	4.17	1001	0.03	3.95	1204	0.02
(3Z)-Hexenyl acetate	4.27	1008	0.14	5.01	1280	0.14
Hexyl acetate	4.39	1016	0.08	4.44*	1239	0.08
para-Cymene	4.45	1020	0.02	4.25	1226	0.01
Unknown [m/z 59, 43 (13), 41 (11), 109 (11), 127 (9), 55 (8)...]	4.54*†	1025	0.06	6.53	1388	0.01
Limonene	4.54*†	1025	[0.06]	3.32	1156	0.04
Unknown [m/z 59, 43 (16), 41 (13), 109 (12), 127 (8), 55 (8)...]	4.59†	1028	[0.06]	6.61	1393	0.01
Benzeneacetaldehyde	4.70	1035	0.04	9.06	1577	0.04

(Z)-β-Ocimene	4.76	1039	0.07	3.92*	1202	0.07
(E)-β-Ocimene	4.92	1049	0.51	4.13*†	1217	[0.75]
2,6-Dimethyl-5-heptenal (melonal)	4.97	1052	0.03	5.45*	1311	0.09
γ-Terpinene	5.03	1056	0.01	3.92*	1202	[0.07]
cis-Linalool oxide (fur.)	5.25	1070	0.01	6.70	1400	0.01
Terpinolene	5.49*	1085	0.04	4.44*	1239	[0.08]
trans-Linalool oxide (fur.)	5.49*	1085	[0.04]	7.06	1427	0.42
Rosefuran	5.67	1096	0.20	6.18	1363	0.19
Linalool	5.73	1100	0.32	8.24	1515	0.32
Nonanal	5.78	1104	0.07	6.04	1353	0.06
cis-Rose oxide	5.88	1110	0.09	5.45*	1311	[0.09]
Unknown [m/z 81, 79 (19), 41 (12), 92 (8), 77 (8)...]	5.98	1117	0.03	6.40	1379	0.06
trans-para-Mentha-2,8-dien-1-ol	6.01	1119	0.04	9.12	1582	0.03
trans-Rose oxide	6.12	1126	0.04	5.63	1323	0.04
Melonol ?	6.22	1132	0.04			
Unknown [m/z 95, 67 (86), 41 (68), 82 (64), 123 (62)...]	6.25*	1134	0.43	7.68*†	1472	[0.23]
cis-para-Mentha-2,8-dien-1-ol	6.25*	1134	[0.43]	9.72*	1630	26.14
neo-Isopulegol	6.36*	1141	0.06	8.32*	1521	0.08
Isopulegol	6.36*	1141	[0.06]	8.32*	1521	[0.08]
exo-Isocitral	6.42*	1146	0.79	7.65†	1470	0.23
trans-Chrysanthemal	6.42*	1146	[0.79]	7.42	1453	0.63
Citronellal	6.55	1154	1.83	7.18	1436	1.70
iso-Isopulegol	6.61	1158	0.04	8.19	1511	0.05
Isoneral	6.73*	1166	0.88	8.04	1499	0.79
cis-Linalool oxide (pyr.)	6.73*	1166	[0.88]	10.52	1695	0.03
Unknown [m/z 84, 83 (74), 137 (56), 41 (47), 93 (43), 108 (40)... 152 (2)]	6.83	1173	0.16	9.80*	1636	0.20
Terpinen-4-ol	6.89*	1176	0.16	8.78	1556	0.02
Rosefuran oxide	6.89*	1176	[0.16]	8.75	1554	0.02
trans-Linalool oxide (pyr.)	6.89*	1176	[0.16]	10.77*	1715	3.97
Isogeranial	7.01	1184	1.38	8.39*	1526	1.49
α-Terpineol	7.08	1189	0.10	9.98*†	1651	[1.97]
trans-Isopiperitenol	7.22	1198	0.04	10.65	1705	0.04
Unknown [m/z 84, 41 (83), 83 (79), 91 (76), 93 (67), 119 (64), 137 (63), 109 (54), 108 (54)... 152 (4)]	7.35	1206	0.07			
Unknown [m/z 107,	7.45	1213	0.01			

79 (99), 91 (57), 94 (54), 135 (44), 150 (44)]						
Nerol	7.75	1234	1.34	11.26	1757	1.37
Citronellol	7.81	1238	0.45	10.92	1728	0.46
Neral	7.94	1248	25.79	9.72*	1630	[26.14]
Piperitone	7.96	1249	0.08	10.08	1660	0.08
Geraniol	8.19	1265	2.66	11.83	1806	2.75
Methyl citronellate	8.24	1268	0.30	8.39*	1526	[1.49]
Geranial	8.42†	1281	34.12	10.36*	1682	34.48
Unknown [m/z 43, 69 (77), 41 (70), 109 (54)... 152 (6)]	8.47†	1284	[34.12]	13.18	1926	0.04
Thymol	8.69	1300	0.01	15.33	2130	0.01
Methyl geranate	9.13	1325	0.73	9.94†	1648	1.97
Citronellic acid	9.23	1332	0.08			
Unknown [m/z 82, 59 (44), 41 (43), 95 (31), 43 (29), 81 (24)...]	9.27	1334	0.12	12.89*	1899	0.20
Citronellyl acetate	9.55	1354	0.07	9.72*	1630	[26.14]
Neryl acetate	9.72*	1367	0.52	10.36*	1682	[34.48]
α-Ylangene	9.72*	1367	[0.52]	7.10*	1430	[0.03]
Geranic acid	9.72*	1367	[0.52]	17.18	2320	0.41
α-Copaene	9.82	1374	0.18	7.32	1446	0.20
β-Bourbonene	9.93	1381	0.15	7.68*†	1472	[0.23]
Geranyl acetate	10.02*	1388	3.95	10.77*	1715	[3.97]
β-Cubebene	10.02*	1388	[3.95]	7.95	1492	0.06
β-Elemene	10.06	1391	0.08	8.63*	1545	9.74
Isocaryophyllene	10.23	1403	0.09	8.36	1524	0.05
β-Caryophyllene	10.42	1417	9.84	8.63*	1545	[9.74]
β-Copaene	10.54	1426	0.11	8.53	1537	0.06
(Z)-β-Farnesene?	10.65	1434	0.02	9.44	1607	0.01
Isogermacrene D	10.74	1441	0.01	9.17	1586	0.01
α-Humulene	10.85	1449	0.56	9.48	1611	0.54
allo-Aromadendrene	10.94	1456	0.09	9.19	1588	0.11
(E)-β-Farnesene	11.00	1460	0.09	9.74	1632	0.09
γ-Murolene	11.23*	1477	1.31	9.80*	1636	[0.20]
Germacrene D	11.23*	1477	[1.31]	9.98*†	1651	[1.97]
Bicyclogermacrene	11.42	1492	0.09	10.23*	1671	0.23
α-Murolene	11.51*	1499	0.22	10.23*	1671	[0.23]
(3Z,6E)-α-Farnesene	11.51*	1499	[0.22]	10.46	1690	0.14
γ-Cadinene	11.67*	1511	0.16	10.59	1701	0.13
(3E,6E)-α-Farnesene	11.67*	1511	[0.16]	10.70	1710	0.09
δ-Cadinene	11.81	1522	0.22	10.62	1703	0.24
trans-Cadina-1,4-diene	11.91	1530	0.01	10.86	1723	0.01
α-Cadinene	11.98	1535	0.02	10.99	1734	0.02
Isocaryophyllene epoxide B	12.12	1546	0.04	12.33	1850	0.07
Germacrene D-4-ol	12.40	1568	0.01	13.92	1994	0.01
Caryophyllene oxide	12.50*	1576	1.08	12.97	1907	0.91
Caryophyllene oxide	12.50*	1576	[1.08]	12.89*	1899	[0.20]

isomer						
Humulene epoxide II	12.82	1602	0.07	13.56	1961	0.08
1-epi-Cubenol	13.10	1624	0.01	13.98	2000	0.02
$\tau$ -Muurolol	13.26	1637	0.05	15.26	2123	0.06
$\alpha$ -Muurolol	13.32	1642	0.02	15.39	2137	0.03
$\alpha$ -Cadinol	13.41	1650	0.08	15.68	2166	0.07
(3Z)-Caryophylla- 3,8(13)-dien-5 $\beta$ -ol	13.61	1666	0.02	17.03	2304	0.02
Germacra- 4(15),5,10(14)-trien- 1 $\alpha$ -ol	13.80	1682	0.03	16.26	2225	0.04
(2E,6E)-Farnesal	14.49	1741	0.01	16.03	2200	0.01
Phytone	15.71	1849	0.03	14.89	2087	0.04
Nonadecane	16.29	1902	0.01	12.73	1885	0.02
Eicosane	17.39	2006	0.01	13.80	1983	0.03
Heneicosane	18.39	2105	0.04	14.83	2081	0.03
<b>Total identified</b>		<b>96.52%</b>			<b>96.70%</b>	
<b>Total reported</b>		<b>97.11%</b>			<b>96.83%</b>	

\*: 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