

**Date :** December 13, 2018

**CERTIFICATE OF ANALYSIS – GC PROFILING**

**SAMPLE IDENTIFICATION**

**Internal code :** 18L05-PTH02-1-CC

**Customer identification :** Lavender Organic - Bulgaria - L5011077R

**Type :** Essential oil

**Source :** *Lavandula angustifolia*

**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 :** December 06, 2018

Checked and approved by :

---

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

*Note: This report may not be published, including online, without the written consent from Laboratoire PhytoChemia.*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

PHYSICOCHEMICAL DATA

**Physical aspect:** Clear liquid

**Refractive index:** 1.4605 ± 0.0003 (20 °C)

ISO 3515:2004 - OIL OF CLONAL LAVENDER - BULGARIA

Compound	Min. %	Max. %	Observed %	Complies?
α-Terpineol	0.8	2.0	1.2	Yes
Lavandulyl acetate	2	5	3	Yes
Terpinen-4-ol	2	5	4	Yes
Lavandulol	0.3		1.1	Yes
Linalyl acetate	30	42	30	Yes
Linalool	22	34	33	Yes
Camphor		0.6	0.2	Yes
Octan-3-one	0.2	1.6	1.5	Yes
(E)-β-Ocimene	2	5	2	Yes
(Z)-β-Ocimene	3	9	4	Yes
β-Phellandrene		0.6		
1,8-Cineole		2.0	0.9*	Yes
Limonene		0.6	0.3	Yes
<b>Refractive index</b>	1.4590	1.4630	1.4605	Yes

\*Coeluted on both columns

CONCLUSION

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

## ANALYSIS SUMMARY

Identification	DB-5 (%)	DB-WAX (%)	Classe
Ethanol	tr	tr	Aliphatic alcohol
Acetone	0.02	0.04	Aliphatic ketone
Methacrolein	tr	tr	Aliphatic aldehyde
3-Buten-2-one	0.01	0.02	Aliphatic ketone
2-Methyl-3-buten-2-ol	0.02	0.01	Aliphatic alcohol
Isovaleral	0.01	0.01	Aliphatic aldehyde
2-Methylbutyral	0.01	0.01	Aliphatic aldehyde
Isoamyl alcohol	0.01	0.03	Aliphatic alcohol
Toluene	tr	tr	Simple phenolic
Hexanal	0.01	0.01	Aliphatic aldehyde
Butyl acetate	0.02	0.02	Aliphatic ester
Methyl hexyl ether	0.10	0.10	Aliphatic ether
(3Z)-Hexenol	0.02	0.91*	Aliphatic alcohol
Hexanol	0.09	0.12*	Aliphatic alcohol
Tricyclene	0.02	0.02	Monoterpene
$\alpha$ -Thujene	0.12	0.11	Monoterpene
$\alpha$ -Pinene	0.24	0.23	Monoterpene
Camphene	0.16	0.16	Monoterpene
5,5-Dimethyl-2(5H)-furanone	0.01	0.01	Aliphatic lactone
Butyl isobutyrate	0.01	0.01	Aliphatic ester
$\beta$ -Pinene	0.08	0.04	Monoterpene
Sabinene	[0.08]	0.05	Monoterpene
Octen-3-ol	0.30	0.31	Aliphatic alcohol
Octan-3-one	1.49*	1.52	Aliphatic ketone
6-Methyl-5-hepten-2-one	[1.49]*	0.02	Aliphatic ketone
Myrcene	0.71*	0.67	Monoterpene
Dehydro-1,8-cineole	[0.71]*	0.02	Monoterpenic ether
Butyl butyrate	0.33*	0.10	Aliphatic ester
Octan-3-ol	[0.33]*	0.25	Aliphatic alcohol
$\alpha$ -Phellandrene	0.04*	0.03	Monoterpene
Pseudolimonene	[0.04]*	0.01	Monoterpene
$\Delta^3$ -Carene	0.12*	0.11	Monoterpene
<i>cis</i> -Dehydroxylinalool oxide	[0.12]*	0.01	Monoterpenic ether
$\alpha$ -Terpinene	0.04	0.04	Monoterpene
Hexyl acetate	0.56	0.65*	Aliphatic ester
ortho-Cymene	0.04	0.25*	Simple phenolic
para-Cymene	0.22	[0.25]*	Monoterpene
Limonene	1.21*	0.32	Monoterpene
$\beta$ -Phellandrene	[1.21]*	0.87*	Monoterpene
1,8-Cineole	[1.21]*	[0.87]*	Monoterpenic ether
Benzyl alcohol	0.02	0.02	Simple phenolic
(Z)- $\beta$ -Ocimene	3.91	3.81	Monoterpene
(E)- $\beta$ -Ocimene	2.34	2.23	Monoterpene
$\gamma$ -Terpinene	0.14	0.13	Monoterpene
<i>cis</i> -Sabinene hydrate	0.08	0.25*	Monoterpenic alcohol
<i>cis</i> -Linalool oxide (fur.)	0.23	0.23	Monoterpenic alcohol
Octanol	0.03	[62.21]*	Aliphatic alcohol
$\alpha$ -Pinene oxide analog	0.02	[0.12]*	Monoterpenic ether

Isoterpinolene	tr	0.01	Monoterpene
Terpinolene	0.27*	[0.65]*	Monoterpene
<i>trans</i> -Linalool oxide (fur.)	[0.27]*	[0.25]*	Monoterpenic alcohol
$\alpha$ -Pinene oxide	0.01	[0.12]*	Monoterpenic ether
Rosefuran	0.08	0.07	Monoterpenic ether
Linalool	32.65	62.21	Monoterpenic alcohol
( <i>Z</i> )-6-Methyl-3,5-heptadien-2-one	0.09	[62.21]*	Aliphatic ketone
Octen-3-yl acetate	0.89	[0.91]*	Aliphatic ester
Unknown	0.04	1.11*	Unknown
Octan-3-yl acetate	0.12	0.15	Aliphatic ester
allo-Ocimene	0.05	0.04	Monoterpene
( <i>Z</i> )-Myroxide	0.04	0.04	Monoterpenic ether
Camphor	0.25	0.26	Monoterpenic ketone
( <i>E</i> )-Myroxide	0.01	0.02	Monoterpenic ether
Unknown	0.02	0.01	Oxygenated monoterpene
Hexyl isobutyrate	0.07	0.06	Aliphatic ester
Nerol oxide	0.03	0.02	Aliphatic ether
Borneol	0.57	2.04*	Monoterpenic alcohol
<i>cis</i> -Linalool oxide (pyr.)	0.02	0.02	Monoterpenic alcohol
Lavandulol	1.09	[1.11]*	Monoterpenic alcohol
Terpinen-4-ol	4.46	4.35	Monoterpenic alcohol
Cryptone	0.18	0.18*	Normonoterpenic ketone
<i>para</i> -Cymen-8-ol	0.07	0.05	Monoterpenic alcohol
$\alpha$ -Terpineol	1.19*	[2.04]*	Monoterpenic alcohol
Myrtenal	[1.19]*	0.02	Monoterpenic aldehyde
Hodiendiol	0.40*	0.43*	Monoterpenic alcohol
Hexyl butyrate	[0.40]*	0.35	Aliphatic ester
Verbenone	0.02	[1.11]*	Monoterpenic ketone
Unknown	0.03	0.03	Unknown
Octyl acetate	0.01	0.02	Aliphatic ester
<i>trans</i> -Carveol	0.02	0.02	Monoterpenic alcohol
Bornyl formate	0.03	0.02	Monoterpenic ester
Nerol	0.22	0.23	Monoterpenic alcohol
Hexyl 2-methylbutyrate	0.07	0.04	Aliphatic ester
Hexyl isovalerate	0.06*	0.03	Aliphatic ester
Neral	[0.06]*	0.03	Monoterpenic aldehyde
Carvone	[0.06]*	0.04	Monoterpenic ketone
Geraniol	30.45*	0.54	Monoterpenic alcohol
Linalyl acetate	[30.45]*	[62.21]*	Monoterpenic ester
Geranial	0.04	0.40*	Monoterpenic aldehyde
2,6-Dimethyl-1,7-octadiene-3,6-diol	0.01	0.02	Monoterpenic alcohol
Bornyl acetate	0.13	0.53*	Monoterpenic ester
Cuminol	0.03	0.03	Monoterpenic alcohol
Lavandulyl acetate	3.26	3.29	Monoterpenic ester
Hexyl tiglate	0.05	0.03	Aliphatic ester
Hodiendiol derivative	0.02	0.05	Oxygenated monoterpene
Unknown	0.09	0.04	Oxygenated monoterpene
Unknown	0.06	0.04	Oxygenated monoterpene
Neryl acetate	0.36*	[0.40]*	Monoterpenic ester
Hodiendiol derivative III	[0.36]*	0.06*	Oxygenated monoterpene
$\beta$ -Bourbonene	0.06	0.06	Sesquiterpene
Geranyl acetate	0.65	0.61	Monoterpenic ester

Hexyl hexanoate	0.11	0.09	Aliphatic ester
7-epi-Sesquithujene	0.04	0.08	Sesquiterpene
$\alpha$ -Funebrene	0.01	0.01	Sesquiterpene
Isocaryophyllene	0.03	[62.21]*	Sesquiterpene
$\beta$ -Caryophyllene	2.91*	2.96*	Sesquiterpene
<i>cis</i> - $\alpha$ -Bergamotene	[2.91]*	[0.53]*	Sesquiterpene
$\alpha$ -Santalene	0.34	[0.53]*	Sesquiterpene
Coumarin	0.03	0.04	Coumarin
Lavandulyl isobutyrate	0.02	0.10	Monoterpenic ester
<i>trans</i> - $\alpha$ -Bergamotene	0.11	[2.96]*	Sesquiterpene
Sesquisabinene A	0.06*	[0.18]*	Sesquiterpene
<i>cis</i> - $\beta$ -Bergamotene?	[0.06]*		Sesquiterpene
$\alpha$ -Humulene	0.09	0.09	Sesquiterpene
Lavandulyl butyrate?	0.09	0.09	Monoterpenic ester
$\beta$ -Santalene	2.74*	[0.18]*	Sesquiterpene
( <i>E</i> )- $\beta$ -Farnesene	[2.74]*	2.77	Sesquiterpene
Dauca-5,8-diene?	0.01	[0.18]*	Sesquiterpene
Germacrene D	0.31	[2.04]*	Sesquiterpene
<i>trans</i> - $\beta$ -Bergamotene	0.05	[1.11]*	Sesquiterpene
Isodaucene	0.02	0.01	Sesquiterpene
Hodiendiol derivative II	0.03	[0.43]*	Oxygenated monoterpene
$\beta$ -Bisabolene	0.16*	[0.40]*	Sesquiterpene
$\gamma$ -Cadinene	[0.16]*	0.12	Sesquiterpene
Lavandulyl isovalerate	[0.16]*	0.01	Monoterpenic ester
$\delta$ -Cadinene	0.04*	[0.12]	Sesquiterpene
$\beta$ -Sesquiphellandrene	[0.04]*	0.06	Sesquiterpene
Isocaryophyllene epoxide B	0.04	0.05	Sesquiterpenic ether
Caryophyllene oxide isomer	0.46*	[0.06]*	Sesquiterpenic ether
Caryophyllene oxide	[0.46]*	[0.43]*	Sesquiterpenic ether
Dendrolasin	[0.46]*	0.03	Sesquiterpenic ether
Humulene epoxide II	0.01	0.02	Sesquiterpenic ether
$\tau$ -Cadinol	0.06	0.09	Sesquiterpenic alcohol
(3 <i>Z</i> )-Caryophylla-3,8(13)-dien-5 $\beta$ -ol	0.01	0.01	Sesquiterpenic alcohol
<b>Total identified</b>	<b>98.64%</b>	<b>97.85%</b>	

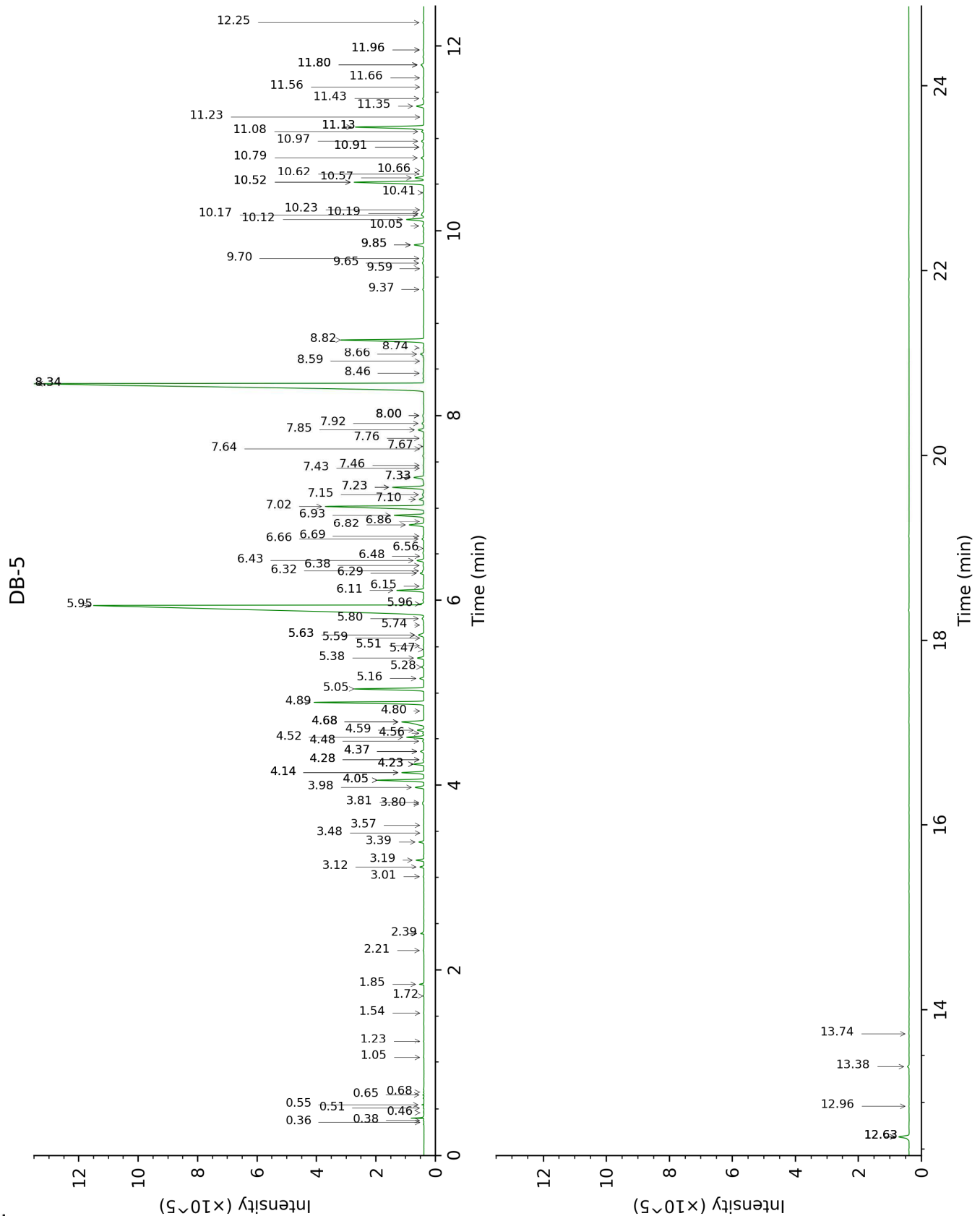
\*: Two or more compounds are coeluting on this column

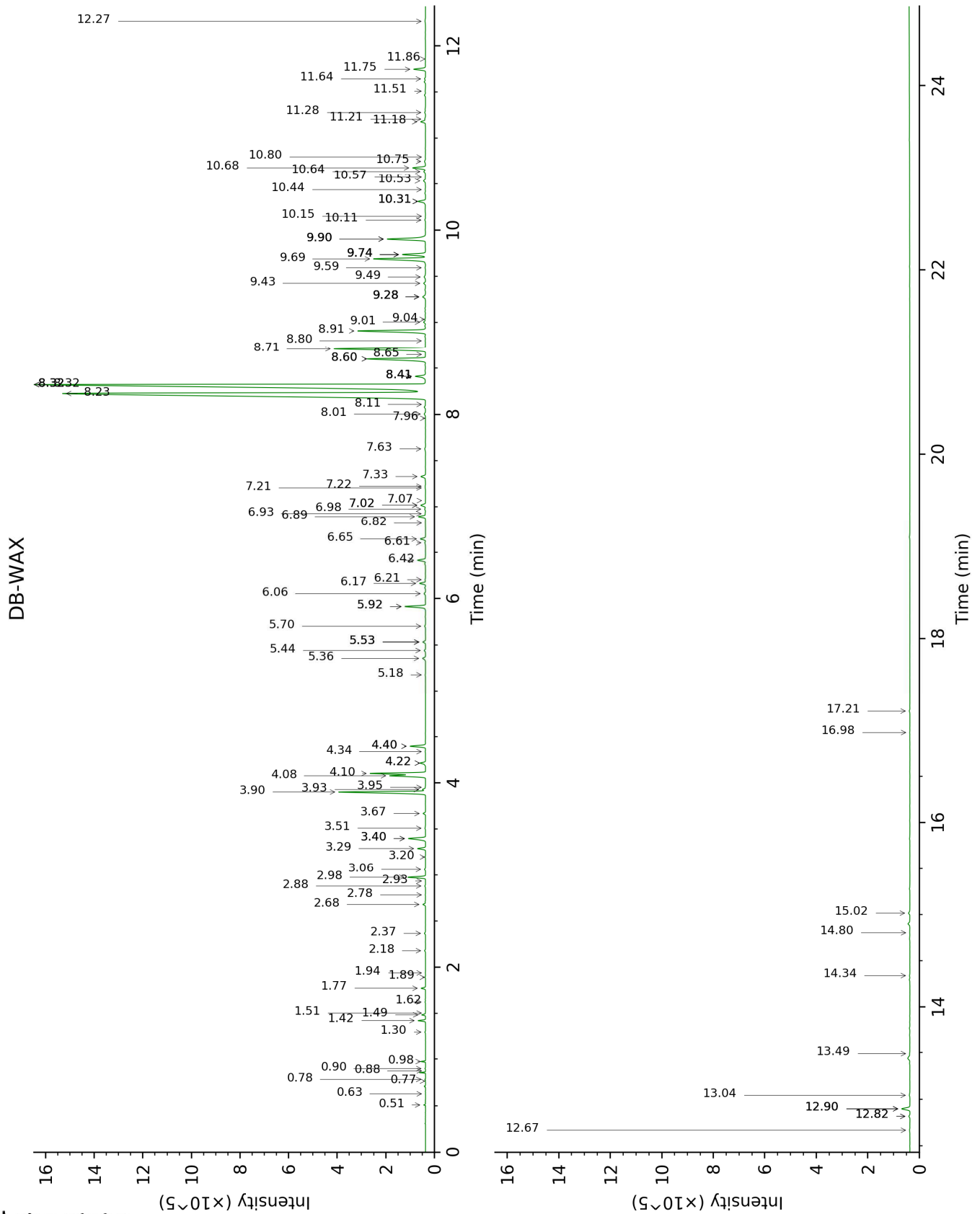
[xx]: Duplicate percentage due to coelutions, not taken account in the identified total

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

Note: no correction factor was applied

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	%
Ethanol	0.36	515	tr	0.88	911	tr
Acetone	0.38	515	0.02	0.51	781	0.04
Methacrolein	0.46	554	tr	0.63	839	tr
3-Buten-2-one	0.51	584	0.01	0.90	915	0.02
2-Methyl-3-buten-2-ol	0.54	606	0.02	1.62	1014	0.01
Isovaleral	0.65	641	0.01	0.78	887	0.01
2-Methylbutyral	0.68	650	0.01	0.77	882	0.01
Isoamyl alcohol	1.05	732	0.01	3.51	1175	0.03
Toluene	1.23	756	tr	1.51	1002	tr
Hexanal	1.54	797	0.01	1.94	1043	0.01
Butyl acetate	1.72	816	0.02	1.89	1039	0.02
Methyl hexyl ether	1.85	826	0.10	0.98	926	0.10
(3Z)-Hexenol	2.21	855	0.02	5.92*	1349	0.91
Hexanol	2.39	870	0.09	5.53*	1322	0.12
Tricyclene	3.01	917	0.02	1.30	973	0.02
α-Thujene	3.12	924	0.12	1.49	1001	0.11
α-Pinene	3.19	929	0.24	1.42	992	0.23
Camphene	3.39	942	0.16	1.77	1028	0.16
5,5-Dimethyl-2(5H)-furanone	3.48	948	0.01	8.65	1552	0.01
Butyl isobutyrate	3.57	954	0.01	2.78	1118	0.01
β-Pinene	3.80†	969	0.08	2.18	1066	0.04
Sabinene	3.81†	970	[0.08]	2.37	1084	0.05
Octen-3-ol	3.98	981	0.30	6.89	1420	0.31
Octan-3-one	4.06*	986	1.49	4.08	1219	1.52
6-Methyl-5-hepten-2-one	4.06*	986	[1.49]	5.18	1302	0.02
Myrcene	4.14*	991	0.71	2.98	1133	0.67
Dehydro-1,8-cineole	4.14*	991	[0.71]	3.20	1151	0.02
Butyl butyrate	4.23*	997	0.33	3.67	1188	0.10
Octan-3-ol	4.23*	997	[0.33]	6.17	1367	0.25
α-Phellandrene	4.28*	1000	0.04	2.88	1126	0.03
Pseudolimonene	4.28*	1000	[0.04]	2.93	1130	0.01
Δ3-Carene	4.36*	1006	0.12	2.68	1110	0.11
cis-Dehydroxylinalool oxide	4.36*	1006	[0.12]	3.95	1210	0.01
α-Terpinene	4.48	1013	0.04	3.06	1140	0.04
Hexyl acetate	4.52	1016	0.56	4.40*	1243	0.65
ortho-Cymene	4.56	1018	0.04	4.22*	1229	0.25
para-Cymene	4.59	1021	0.22	4.22*	1229	[0.25]
Limonene	4.68*	1026	1.21	3.29	1158	0.32
β-Phellandrene	4.68*	1026	[1.21]	3.40*	1167	0.87
1,8-Cineole	4.68*	1026	[1.21]	3.40*	1167	[0.87]
Benzyl alcohol	4.80	1034	0.02	11.86	1815	0.02
(Z)-β-Ocimene	4.89	1039	3.91	3.90	1206	3.81

(E)-β-Ocimene	5.05	1049	2.34	4.10	1221	2.23
γ-Terpinene	5.16	1056	0.14	3.93	1208	0.13
cis-Sabinene hydrate	5.28	1064	0.08	7.02*	1429	0.25
cis-Linalool oxide (fur.)	5.38	1070	0.23	6.65	1402	0.23
Octanol	5.47	1076	0.03	8.32*†	1527	[62.21]
α-Pinene oxide analog	5.51	1078	0.02	5.53*	1322	[0.12]
Isoterpinolene	5.59	1084	tr	4.34	1239	0.01
Terpinolene	5.63*	1086	0.27	4.40*	1243	[0.65]
trans-Linalool oxide (fur.)	5.63*	1086	[0.27]	7.02*	1429	[0.25]
α-Pinene oxide	5.74	1092	0.01	5.53*	1322	[0.12]
Rosefuran	5.80	1097	0.08	6.06	1359	0.07
Linalool	5.95	1106	32.65	8.23†	1520	62.21
(Z)-6-Methyl-3,5-heptadien-2-one	5.96	1107	0.09	8.32*†	1527	[62.21]
Octen-3-yl acetate	6.11	1116	0.89	5.92*	1349	[0.91]
Unknown [m/z 82, 81 (72), 43 (64), 54 (32), 41 (20)...]	6.15	1119	0.04	9.74*	1638	1.11
Octan-3-yl acetate	6.29	1128	0.12	5.36	1309	0.15
allo-Ocimene	6.32	1130	0.05	5.70	1334	0.04
(Z)-Myroxide	6.38	1134	0.04	6.98	1426	0.04
Camphor	6.43	1137	0.25	7.33	1452	0.26
(E)-Myroxide	6.48	1140	0.01	7.21	1443	0.02
Unknown [m/z 95, 43 (74), 109 (72), 82 (62), 110 (50)... 152 (14)]	6.56	1146	0.02	7.07	1433	0.01
Hexyl isobutyrate	6.66	1152	0.07	5.44	1315	0.06
Nerol oxide	6.69	1154	0.03	6.93	1422	0.02
Borneol	6.82	1162	0.57	9.90*	1651	2.04
cis-Linalool oxide (pyr.)	6.86	1165	0.02	10.44	1694	0.02
Lavandulol	6.93	1169	1.09	9.74*	1638	[1.11]
Terpinen-4-ol	7.02	1176	4.46	8.71	1557	4.35
Cryptone	7.10	1180	0.18	9.28*	1601	0.18
para-Cymen-8-ol	7.15	1184	0.07	11.64	1796	0.05
α-Terpineol	7.23*	1189	1.19	9.90*	1651	[2.04]
Myrtenal	7.23*	1189	[1.19]	8.80	1564	0.02
Hodiendiol	7.33*	1196	0.40	12.90*	1908	0.43
Hexyl butyrate	7.33*	1196	[0.40]	6.42	1385	0.35
Verbenone	7.43	1202	0.02	9.74*	1638	[1.11]
Unknown [m/z 43, 71 (66), 59 (52), 41 (47), 68 (46)...]	7.46	1204	0.03	6.21	1370	0.03
Octyl acetate	7.64	1217	0.01	7.22	1444	0.02
trans-Carveol	7.67	1218	0.02	11.51	1785	0.02
Bornyl formate	7.76	1224	0.03	8.11	1510	0.02
Nerol	7.85	1231	0.22	11.18	1757	0.23

Hexyl 2-methylbutyrate	7.92	1235	0.07	6.61	1399	0.04
Hexyl isovalerate	8.00*	1241	0.06	6.82	1414	0.03
Neral	8.00*	1241	[0.06]	9.59	1626	0.03
Carvone	8.00*	1241	[0.06]	10.11	1668	0.04
Geraniol	8.34*	1265	30.45	11.75	1805	0.54
Linalyl acetate	8.34*	1265	[30.45]	8.32*†	1527	[62.21]
Geranial	8.46	1273	0.04	10.31*	1684	0.40
2,6-Dimethyl-1,7-octadiene-3,6-diol	8.59	1282	0.01	14.80	2087	0.02
Bornyl acetate	8.66	1287	0.13	8.41*	1534	0.53
Cuminol	8.74	1292	0.03	14.34	2042	0.03
Lavandulyl acetate	8.82	1298	3.26	8.91	1572	3.29
Hexyl tiglate	9.37	1330	0.05	9.04	1582	0.03
Hodiendiol derivative	9.59	1346	0.02	13.04	1921	0.05
Unknown [m/z 43, 79 (47), 71 (31), 94 (27), 81 (23), 41 (22)... 197 (0)]	9.65	1350	0.09	11.21	1760	0.04
Unknown [m/z 43, 79 (46), 71 (30), 94 (25), 41 (23), 81 (21)... 197 (0)]	9.70	1354	0.06	11.28	1766	0.04
Neryl acetate	9.85*	1364	0.36	10.31*	1684	[0.40]
Hodiendiol derivative III	9.85*	1364	[0.36]	12.82*	1900	0.06
β-Bourbonene	10.05	1379	0.06	7.63	1474	0.06
Geranyl acetate	10.12	1384	0.65	10.68	1715	0.61
Hexyl hexanoate	10.17	1387	0.11	9.01	1580	0.09
7-epi-Sesquithujene	10.19	1388	0.04	8.00	1502	0.08
α-Funebrene	10.23	1391	0.01	7.96	1499	0.01
Isocaryophyllene	10.41	1404	0.03	8.32*†	1527	[62.21]
β-Caryophyllene	10.52*	1413	2.91	8.60*	1548	2.96
cis-α-Bergamotene	10.52*	1413	[2.91]	8.41*	1534	[0.53]
α-Santalene	10.57	1416	0.34	8.41*	1534	[0.53]
Coumarin	10.62	1420	0.03	17.21	2334	0.04
Lavandulyl isobutyrate	10.66	1423	0.02	9.49	1618	0.10
trans-α-Bergamotene	10.79	1433	0.11	8.60*	1548	[2.96]
Sesquisabinene A	10.91*	1442	0.06	9.28*	1601	[0.18]
cis-β-Bergamotene?	10.91*	1442	[0.06]			
α-Humulene	10.97	1447	0.09	9.43	1613	0.09
Lavandulyl butyrate?	11.08	1455	0.09	10.64	1712	0.09
β-Santalene	11.13*	1458	2.74	9.28*	1601	[0.18]
(E)-β-Farnesene	11.13*	1458	[2.74]	9.69	1634	2.77
Dauca-5,8-diene?	11.23	1466	0.01	9.28*	1601	[0.18]
Germacrene D	11.35	1475	0.31	9.90*	1651	[2.04]
trans-β-	11.43	1481	0.05	9.74*	1638	[1.11]

Bergamotene						
Isodaucene	11.56	1491	0.02	10.15	1671	0.01
Hodiendiol derivative II	11.66	1498	0.03	12.90*	1908	[0.43]
β-Bisabolene	11.80*†	1509	0.16	10.31*	1684	[0.40]
γ-Cadinene	11.80*†	1509	[0.16]	10.53†	1702	0.12
Lavandulyl isovalerate	11.80*†	1509	[0.16]	10.80	1725	0.01
δ-Cadinene	11.96*	1522	0.04	10.58†	1706	[0.12]
β-Sesquiphellandrene	11.96*	1522	[0.04]	10.75	1721	0.06
Isocaryophyllene epoxide B	12.25	1545	0.04	12.27	1851	0.05
Caryophyllene oxide isomer	12.63*	1575	0.46	12.82*	1900	[0.06]
Caryophyllene oxide	12.63*	1575	[0.46]	12.90*	1908	[0.43]
Dendrolasin	12.63*	1575	[0.46]	12.67	1887	0.03
Humulene epoxide II	12.96	1601	0.01	13.49	1962	0.02
τ-Cadinol	13.38	1636	0.06	15.02	2108	0.09
(3Z)-Caryophylla-3,8(13)-dien-5β-ol	13.74	1666	0.01	16.98	2308	0.01
<b>Total identified</b>		<b>98.64%</b>			<b>97.85%</b>	
<b>Total reported</b>		<b>98.87%</b>			<b>97.97%</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