

## GC/MS BATCH NUMBER: L40109

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**ESSENTIAL OIL:** LAVENDER  
**BOTANICAL NAME:** LAVANDULA ANGUSTIFOLIA  
**ORIGIN:** BULGARIA

KEY CONSTITUENTS PRESENT IN THIS BATCH OF LAVENDER OIL	%
LINALOOL	32.7
LINALYL ACETATE	28.1
(Z)- $\beta$ -OCIMENE	4.3
TERPINEN-4-ol	3.9
$\beta$ -CARYOPHYLLENE	3.3
LAVANDULYL ACETATE	3.1
(E)- $\beta$ -FARNESENE	3.1
(E)- $\beta$ -OCIMENE	2.8
OCTAN-3-ONE	1.7
1,8-CINEOLE	1.5

Comments from Robert Tisserand: Has the wonderful 'dry' odor quality of fresh lavender flowers in the sun. All thirteen ISO constituents are within range for Bulgarian Lavender oil.

**Date :** March 23, 2018

**CERTIFICATE OF ANALYSIS - GC PROFILING**

*SAMPLE IDENTIFICATION*

**Internal code :** 18C22-PTH3-1-CC

**Customer identification :** Lavender - Bulgaria - L4010973R

**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 :** March 22, 2018

Checked and approved by :

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Sylvain Mercier, M. Sc., chimiste 2014-005

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*This report is digitally signed, it is only considered valid if the digital signature is intact.*

*PHYSICOCHEMICAL DATA*

**Physical aspect:** Faintly yellow liquid

**Refractive index:**  $1.4600 \pm 0.0003$  (20 °C)

*CONCLUSION*

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

## ANALYSIS SUMMARY

Identification	DB-5 (%)	DB-WAX (%)	Classe
Methacrolein	tr	tr	Aliphatic aldehyde
3-Buten-2-one	tr	tr	Aliphatic ketone
Acetic acid	tr	0.01	Aliphatic acid
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	0.12*	Simple phenolic
Butyl acetate	0.02	0.03	Aliphatic ester
Methyl hexyl ether	0.15	0.15	Aliphatic ether
(3Z)-Hexenol	0.02	0.03	Aliphatic alcohol
Hexanol	0.09	0.10*	Aliphatic alcohol
Tricyclene	0.02	0.02	Monoterpene
$\alpha$ -Thujene	0.12	[0.12]*	Monoterpene
$\alpha$ -Pinene	0.26	0.26	Monoterpene
Camphene	0.17*	0.16	Monoterpene
$\alpha$ -Fenchene	[0.17]*	tr	Monoterpene
5,5-Dimethyl-2(5H)-furanone	tr	3.40*	Aliphatic lactone
Butyl isobutyrate	0.01	0.01	Aliphatic ester
endo-Isocamphane	tr	tr	Monoterpene
Sabinene	0.13*	0.06	Monoterpene
$\beta$ -Pinene	[0.13]*	0.09	Monoterpene
Octen-3-ol	0.20	0.23*	Aliphatic alcohol
Dehydro-1,8-cineole	1.64*	0.01	Monoterpenic ether
6-Methyl-5-hepten-2-one	[1.64]*	0.01	Aliphatic ketone
Octan-3-one	[1.64]*	1.68	Aliphatic ketone
Myrcene	0.71*	0.70	Monoterpene
<i>trans</i> -Dehydroxylinalool oxide	[0.71]*	[0.03]*	Monoterpenic ether
Butyl butyrate	0.12	0.12	Aliphatic ester
Octan-3-ol	0.34*	0.31	Aliphatic alcohol
$\alpha$ -Phellandrene	[0.34]*	0.04	Monoterpene
Pseudolimonene	[0.34]*	0.01	Monoterpene
<i>cis</i> -Dehydroxylinalool oxide	0.01	0.18*	Monoterpenic ether
$\Delta^3$ -Carene	0.14	0.14	Monoterpene
(3Z)-Hexenyl acetate	0.01	tr	Aliphatic ester
$\alpha$ -Terpinene	0.05	0.06	Monoterpene
Hexyl acetate	0.65	0.68	Aliphatic ester
ortho-Cymene	0.04	0.20	Simple phenolic
para-Cymene	0.16	[0.20]	Monoterpene
Limonene	1.95	0.42	Monoterpene
1,8-Cineole	[1.95]	1.53	Monoterpenic ether
Lavender lactone	0.01	tr	Aliphatic lactone
(Z)- $\beta$ -Ocimene	4.26	4.33	Monoterpene
(E)- $\beta$ -Ocimene	2.81	2.79	Monoterpene
$\gamma$ -Terpinene	0.18	[0.18]*	Monoterpene
<i>cis</i> -Sabinene hydrate	0.06	0.19*	Monoterpenic alcohol
<i>cis</i> -Linalool oxide (fur.)	0.14	0.18*	Monoterpenic alcohol
Octanol	0.01	0.01	Aliphatic alcohol

α-Pinene oxide analog	0.04	[0.10]*	Monoterpenic ether
Isoterpinolene	0.01	0.01	Monoterpene
Terpinolene	0.12	0.11	Monoterpene
<i>trans</i> -Linalool oxide (fur.)	0.10	[0.19]*	Monoterpenic alcohol
α-Pinene oxide	0.01	[0.10]*	Monoterpenic ether
Rosefuran	0.02	0.01	Monoterpenic ether
Linalool	32.78*	32.74	Monoterpenic alcohol
6-Methyl-3,5-heptadien-2-one	[32.78]*	28.51*	Aliphatic ketone
Octen-3-yl acetate	0.95	0.86	Aliphatic ester
Unknown	0.04	0.05	Unknown
Octan-3-yl acetate	0.15	0.19	Aliphatic ester
allo-Ocimene	0.06	0.05	Monoterpene
( <i>Z</i> )-Myroxide	0.01	0.01	Monoterpenic ether
Camphor	0.70	0.68	Monoterpenic ketone
( <i>E</i> )-Myroxide	0.02	0.03	Monoterpenic ether
Hexyl isobutyrate	0.09	0.08	Aliphatic ester
Nerol oxide	0.02	0.01	Aliphatic ether
Borneol	0.70	1.72*	Monoterpenic alcohol
<i>cis</i> -Linalool oxide (pyr.)	0.02	0.03	Monoterpenic alcohol
Lavandulol	0.89	3.96*	Monoterpenic alcohol
(3 <i>E</i> ,5 <i>E</i> )-Undeca-1,3,5-triene	3.92*	0.07	Alkene
Terpinen-4-ol	[3.92]*	3.86	Monoterpenic alcohol
<i>trans</i> -Linalool oxide (pyr.)	0.17*	0.02*	Monoterpenic alcohol
Cryptone	[0.17]*	0.16	Normonoterpenic ketone
para-Cymen-8-ol	0.08	0.41*	Monoterpenic alcohol
α-Terpineol	0.99	[1.72]*	Monoterpenic alcohol
Hexyl butyrate	0.52*	0.47	Aliphatic ester
Hodiendiol	[0.52]*	0.22*	Monoterpenic alcohol
Unknown	0.02		Unknown
Bornyl formate	0.06		Monoterpenic ester
Nerol	0.17	0.17	Monoterpenic alcohol
Hexyl 2-methylbutyrate	0.07*	[0.18]*	Aliphatic ester
Cuminal	[0.07]*	[0.02]*	Monoterpenic aldehyde
Carvone	0.05	0.04	Monoterpenic ketone
Neral	0.02	0.02	Monoterpenic aldehyde
Hexyl isovalerate	0.02	[0.23]*	Aliphatic ester
Geraniol	28.99*	[0.41]*	Monoterpenic alcohol
Linalyl acetate	[28.99]*	[28.51]*	Monoterpenic ester
Geranial	0.04	0.05	Monoterpenic aldehyde
Bornyl acetate	0.12	0.54*	Monoterpenic ester
Lavandulyl acetate	3.12	3.10	Monoterpenic ester
Hexyl tiglate	0.07	0.05	Aliphatic ester
Hodiendiol derivative	0.02	0.03	Oxygenated monoterpene
Unknown	0.02	0.02	Oxygenated monoterpene
Unknown	0.02	0.03	Oxygenated monoterpene
Neryl acetate	0.30	0.33*	Monoterpenic ester
β-Bourbonene	0.06	0.06	Sesquiterpene
Geranyl acetate	0.48	0.51	Monoterpenic ester
7-epi-Sesquithujene	0.18*	0.01	Sesquiterpene
α-Funebrene	[0.18]*	0.05	Sesquiterpene
Hexyl hexanoate	[0.18]*	0.13	Aliphatic ester
Isocaryophyllene	0.04	[28.51]	Sesquiterpene

$\beta$ -Caryophyllene	3.29	[3.40]*	Sesquiterpene
$\alpha$ -Santalene	0.41	[0.54]*	Sesquiterpene
Lavandulyl isobutyrate	0.01	0.11*	Monoterpenic ester
<i>trans</i> - $\alpha$ -Bergamotene	0.12	[3.40]*	Sesquiterpene
$\alpha$ -Humulene	0.10	[0.11]*	Sesquiterpene
Lavandulyl butyrate?	0.09	0.07*	Monoterpenic ester
$\beta$ -Santalene	3.12*	0.02	Sesquiterpene
( <i>E</i> )- $\beta$ -Farnesene	[3.12]*	[3.96]*	Sesquiterpene
Dauca-5,8-diene?	0.01	0.01	Sesquiterpene
Germacrene D	0.42	0.42	Sesquiterpene
<i>trans</i> - $\beta$ -Bergamotene	0.09	[3.96]*	Sesquiterpene
$\beta$ -Bisabolene	0.03	[0.33]*	Sesquiterpene
$\gamma$ -Cadinene	0.13	0.09	Sesquiterpene
$\delta$ -Cadinene	0.02*	[0.07]*	Sesquiterpene
<i>trans</i> -Calamenene	[0.02]*	0.01	Sesquiterpene
$\beta$ -Sesquiphellandrene	0.03	0.04	Sesquiterpene
Isocaryophyllene epoxide B	0.02	0.03	Sesquiterpenic ether
Caryophyllene oxide	0.25*	[0.22]*	Sesquiterpenic ether
Caryophyllene oxide isomer	[0.25]*	0.04	Sesquiterpenic ether
Humulene epoxide II	0.01	0.01	Sesquiterpenic ether
$\tau$ -Cadinol	0.05	0.06	Sesquiterpenic alcohol
$\alpha$ -Bisabolol	0.03	0.03	Sesquiterpenic alcohol
Butyl hexanoate		0.04	Aliphatic ester
<b>Total identified</b>	<b>98.96%</b>	<b>98.59%</b>	

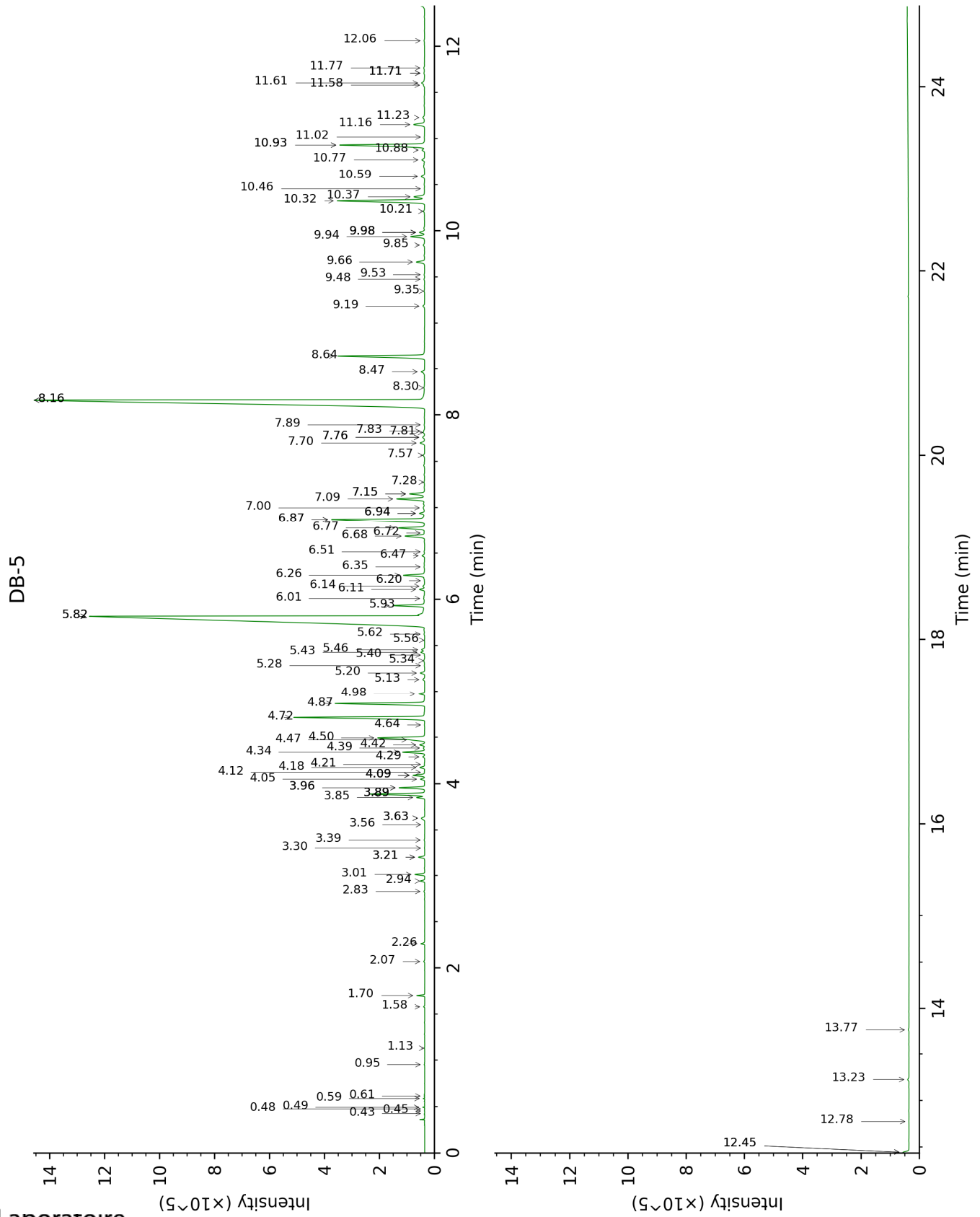
\*: Two or more compounds are coeluting on this column

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

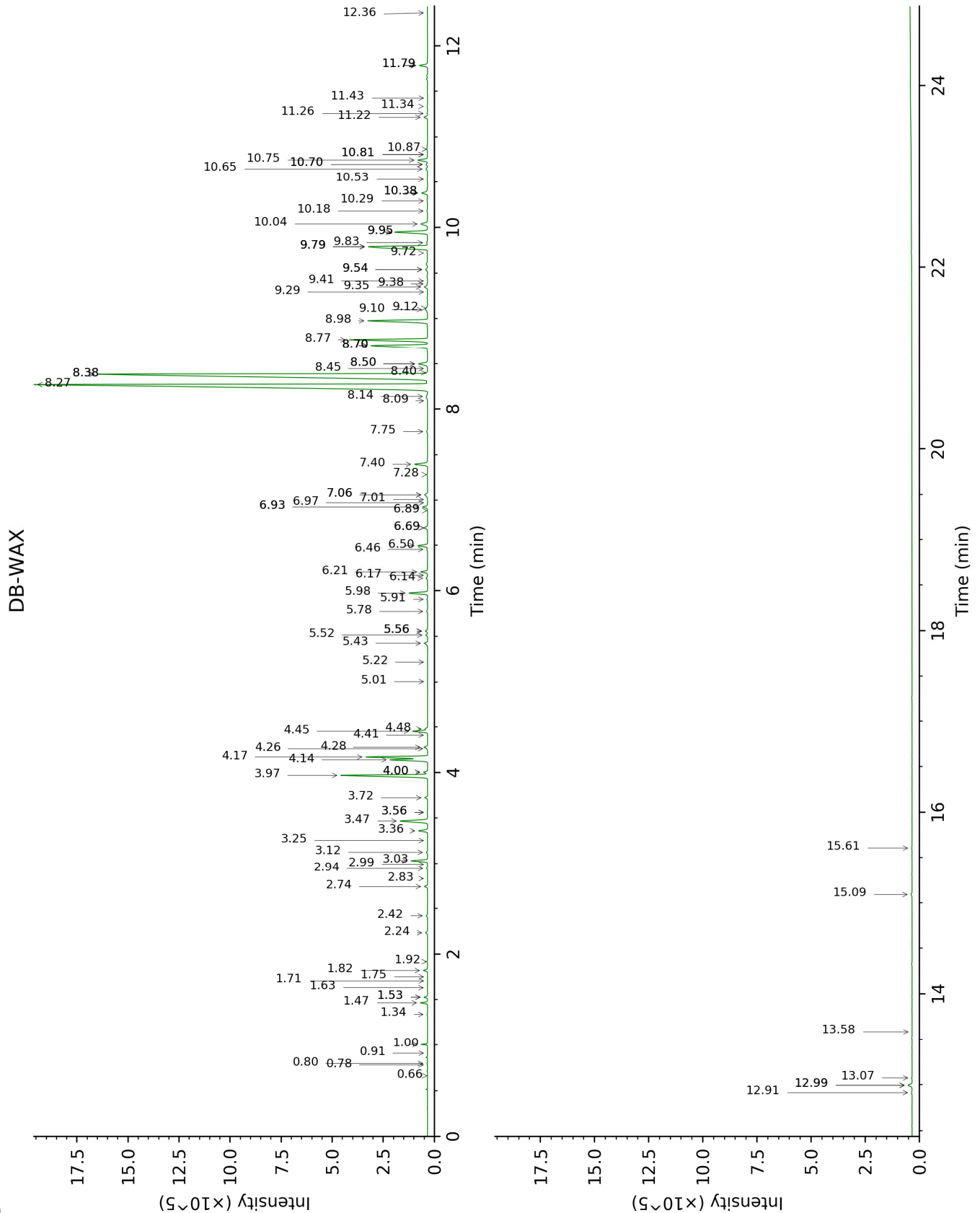
tr: The compound has been detected below 0.005% of total signal.

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	%
Methacrolein	0.43	550	tr	0.66	839	tr
3-Buten-2-one	0.45	577	tr	0.91	910	tr
Acetic acid	0.48	598	tr	6.89	1416	0.01
2-Methyl-3-buten-2-ol	0.49	606	0.02	1.63	1012	0.01
Isovaleral	0.59	639	0.01	0.80	885	0.01
2-Methylbutyral	0.61	648	0.01	0.78	879	0.01
Isoamyl alcohol	0.95	728	0.01	3.56*	1177	0.03
Toluene	1.13	754	tr	1.53*	1002	0.12
Butyl acetate	1.58	813	0.02	1.92	1040	0.03
Methyl hexyl ether	1.70	823	0.15	1.00	924	0.15
(3Z)-Hexenol	2.07	854	0.02	5.91	1346	0.03
Hexanol	2.26	870	0.09	5.56*	1320	0.10
Tricyclene	2.83	915	0.02	1.34	976	0.02
$\alpha$ -Thujene	2.94	922	0.12	1.53*	1002	[0.12]
$\alpha$ -Pinene	3.01	927	0.26	1.47	996	0.26
Camphene	3.21*	940	0.17	1.82	1030	0.16
$\alpha$ -Fenchene	3.21*	940	[0.17]	1.75	1024	tr
5,5-Dimethyl-2(5H)-furanone	3.30	947	tr	8.70*	1553	3.40
Butyl isobutyrate	3.39	952	0.01	2.83	1121	0.01
endo-Isocamphane	3.56	964	tr	1.71	1020	tr
Sabinene	3.63*	968	0.13	2.42	1088	0.06
$\beta$ -Pinene	3.63*	968	[0.13]	2.24	1070	0.09
Octen-3-ol	3.85	983	0.20	6.93*	1419	0.23
Dehydro-1,8-cineole	3.89*	986	1.64	3.26	1153	0.01
6-Methyl-5-hepten-2-one	3.89*	986	[1.64]	5.22	1296	0.01
Octan-3-one	3.89*	986	[1.64]	4.14	1219	1.68
Myrcene	3.96*	990	0.71	3.03	1136	0.70
<i>trans</i> -Dehydroxylinalool oxide	3.96*	990	[0.71]	3.56*	1177	[0.03]
Butyl butyrate	4.05	996	0.12	3.72	1189	0.12
Octan-3-ol	4.09*	999	0.34	6.21	1367	0.31
$\alpha$ -Phellandrene	4.09*	999	[0.34]	2.94	1130	0.04
Pseudolimonene	4.09*	999	[0.34]	2.99	1133	0.01
<i>cis</i> -Dehydroxylinalool oxide	4.12	1001	0.01	4.00*	1210	0.18
$\Delta^3$ -Carene	4.18	1005	0.14	2.74	1114	0.14
(3Z)-Hexenyl acetate	4.21	1007	0.01	5.01	1281	tr
$\alpha$ -Terpinene	4.29	1012	0.05	3.12	1143	0.06
Hexyl acetate	4.34	1015	0.65	4.45	1242	0.68
ortho-Cymene	4.39	1018	0.04	4.26†	1228	0.20
para-Cymene	4.42	1020	0.16	4.28†	1229	[0.20]

Limonene	4.48†	1024	1.95	3.36	1162	0.42
1,8-Cineole	4.50†	1025	[1.95]	3.47	1170	1.53
Lavender lactone	4.64	1034	0.01	9.42	1608	tr
(Z)-β-Ocimene	4.72	1039	4.26	3.97	1207	4.33
(E)-β-Ocimene	4.87	1048	2.81	4.17	1222	2.79
γ-Terpinene	4.98	1055	0.18	4.00*	1210	[0.18]
cis-Sabinene hydrate	5.13	1065	0.06	7.06*	1429	0.19
cis-Linalool oxide (fur.)	5.20	1069	0.14	6.69*	1402	0.18
Octanol	5.28	1074	0.01	8.45	1533	0.01
α-Pinene oxide analog	5.34	1078	0.04	5.56*	1320	[0.10]
Isoterpinolene	5.40	1082	0.01	4.41	1239	0.01
Terpinolene	5.43	1084	0.12	4.48	1244	0.11
trans-Linalool oxide (fur.)	5.46	1085	0.10	7.06*	1429	[0.19]
α-Pinene oxide	5.56	1092	0.01	5.56*	1320	[0.10]
Rosefuran	5.62	1096	0.02	6.17	1364	0.01
Linalool	5.82*†	1108	32.78	8.27	1520	32.74
6-Methyl-3,5-heptadien-2-one	5.82*†	1108	[32.78]	8.38*†	1528	28.51
Octen-3-yl acetate	5.93	1116	0.95	5.98	1350	0.86
Unknown [m/z 82, 81 (72), 43 (64), 54 (32), 41 (20)...]	6.01	1120	0.04	9.83	1642	0.05
Octan-3-yl acetate	6.11	1127	0.15	5.43	1311	0.19
allo-Ocimene	6.14	1129	0.06	5.78	1336	0.05
(Z)-Myroxide	6.20	1133	0.01	7.01	1425	0.01
Camphor	6.26	1136	0.70	7.40	1454	0.68
(E)-Myroxide	6.35	1142	0.02	7.28	1446	0.03
Hexyl isobutyrate	6.47	1150	0.09	5.52	1317	0.08
Nerol oxide	6.52	1153	0.02	6.98	1423	0.01
Borneol	6.68	1164	0.70	9.95*	1652	1.72
cis-Linalool oxide (pyr.)	6.72	1166	0.02	10.53	1699	0.03
Lavandulol	6.77	1169	0.89	9.79*	1639	3.96
(3E,5E)-Undeca-1,3,5-triene	6.87*	1175	3.92	6.14	1362	0.07
Terpinen-4-ol	6.87*	1175	[3.92]	8.77	1558	3.86
trans-Linalool oxide (pyr.)	6.94*	1180	0.17	10.81*	1722	0.02
Cryptone	6.94*	1180	[0.17]	9.35	1603	0.16
para-Cymen-8-ol	7.00	1184	0.08	11.78*	1805	0.41
α-Terpineol	7.09	1190	0.99	9.95*	1652	[1.72]
Hexyl butyrate	7.15*	1193	0.52	6.50	1388	0.47
Hodiendiol	7.15*	1193	[0.52]	13.00*	1913	0.22
Unknown [m/z 43, 71 (66), 59 (52), 41 (47), 68 (46)...]	7.28	1201	0.02			
Bornyl formate	7.57	1221	0.06			
Nerol	7.70	1230	0.17	11.22	1757	0.17

Hexyl 2-methylbutyrate	7.76*	1234	0.07	6.69*	1402	[0.18]
Cuminal	7.76*	1234	[0.07]	10.81*	1722	[0.02]
Carvone	7.81	1237	0.05	10.18	1670	0.04
Neral	7.83	1238	0.02	9.72	1633	0.02
Hexyl isovalerate	7.90	1243	0.02	6.93*	1419	[0.23]
Geraniol	8.16*	1261	28.99	11.78*	1805	[0.41]
Linalyl acetate	8.16*	1261	[28.99]	8.38*†	1528	[28.51]
Geranial	8.30	1270	0.04	10.29	1679	0.05
Bornyl acetate	8.47	1281	0.12	8.50*	1537	0.54
Lavandulyl acetate	8.64	1293	3.12	8.98	1574	3.10
Hexyl tiglate	9.19	1331	0.07	9.12	1585	0.05
Hodiendiol derivative	9.35	1342	0.02	13.08	1920	0.03
Unknown [m/z 43, 79 (47), 71 (31), 94 (27), 81 (23), 41 (22)... 197 (0)]	9.48	1351	0.02	11.26	1760	0.02
Unknown [m/z 43, 79 (46), 71 (30), 94 (25), 41 (23), 81 (21)... 197 (0)]	9.53	1355	0.02	11.34	1767	0.03
Neryl acetate	9.66	1364	0.30	10.38*	1686	0.33
β-Bourbonene	9.85	1377	0.06	7.76	1480	0.06
Geranyl acetate	9.94	1384	0.48	10.75	1717	0.51
7-epi-Sesquithujene	9.98*	1387	0.18	8.09	1506	0.01
α-Funebrene	9.98*	1387	[0.18]	8.14	1509	0.05
Hexyl hexanoate	9.98*	1387	[0.18]	9.10	1584	0.13
Isocaryophyllene	10.21	1403	0.04	8.40†	1529	[28.51]
β-Caryophyllene	10.32	1412	3.29	8.70*	1553	[3.40]
α-Santalene	10.37	1415	0.41	8.50*	1537	[0.54]
Lavandulyl isobutyrate	10.46	1421	0.01	9.54*	1618	0.11
trans-α-Bergamotene	10.59	1431	0.12	8.70*	1553	[3.40]
α-Humulene	10.77	1445	0.10	9.54*	1618	[0.11]
Lavandulyl butyrate?	10.88	1453	0.09	10.70*	1713	0.07
β-Santalene	10.93*	1457	3.12	9.38	1606	0.02
(E)-β-Farnesene	10.93*	1457	[3.12]	9.79*	1639	[3.96]
Dauca-5,8-diene?	11.02	1463	0.01	9.29	1598	0.01
Germacrene D	11.16	1473	0.42	10.04	1659	0.42
trans-β-Bergamotene	11.23	1479	0.09	9.79*	1639	[3.96]
β-Bisabolene	11.58	1505	0.03	10.38*	1686	[0.33]
γ-Cadinene	11.61	1507	0.13	10.65	1709	0.09
δ-Cadinene	11.71*	1516	0.02	10.70*	1713	[0.07]
trans-Calamenene	11.71*	1516	[0.02]	11.43	1774	0.01
β-Sesquiphellandrene	11.77	1520	0.03	10.87	1727	0.04
Isocaryophyllene	12.06	1543	0.02	12.36	1856	0.03

epoxide B						
Caryophyllene oxide	12.44*	1573	0.25	13.00*	1913	[0.22]
Caryophyllene oxide isomer	12.44*	1573	[0.25]	12.92	1905	0.04
Humulene epoxide II	12.78	1599	0.01	13.58	1967	0.01
τ-Cadinol	13.23	1636	0.05	15.09	2112	0.06
α-Bisabolol	13.77	1681	0.03	15.61	2163	0.03
Butyl hexanoate				6.46	1385	0.04
<b>Total identified</b>		<b>98.96%</b>			<b>98.59%</b>	
<b>Total reported</b>		<b>99.07%</b>			<b>98.70%</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