

**Date :** April 09, 2019

**CERTIFICATE OF ANALYSIS – GC PROFILING**

**SAMPLE IDENTIFICATION**

**Internal code :** 19C28-PTH04-1-SCC

**Customer identification :** Kunzea - Australia - K10102810R

**Type :** Essential oil

**Source :** *Kunzea ambigua*

**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 :** Benoit Roger, Ph. D.

**Analysis date :** April 04, 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 viscous liquid

**Refractive index:**  $1.4743 \pm 0.0003$  (20 °C)

*CONCLUSION*

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

## ANALYSIS SUMMARY

Identification	DB-5 (%)	DB-WAX (%)	Classe
2-Methyl-3-buten-2-ol	tr	0.01*	Aliphatic alcohol
Isovaleral	0.07	0.07	Aliphatic aldehyde
2-Methylbutyral	tr	0.01	Aliphatic aldehyde
Isoamyl alcohol	0.02	0.03*	Aliphatic alcohol
2-Methylbutanol	tr	[0.03]*	Aliphatic alcohol
Toluene	0.01	0.02	Simple phenolic
2,4-Dimethyl-3-pentanone	0.10	0.10	Aliphatic ketone
Hexanal	tr		Aliphatic aldehyde
Octane	tr	0.01	Alkane
(3Z)-Hexenol	0.03	0.03	Aliphatic alcohol
Hexanol	0.01	0.01	Aliphatic alcohol
Isoamyl acetate	0.01	0.02	Aliphatic ester
2-Methylbutyl acetate	0.01	tr	Aliphatic ester
Styrene	0.02	0.02	Simple phenolic
$\alpha$ -Thujene	0.17	[44.07]	Monoterpene
$\alpha$ -Pinene	43.75	44.07	Monoterpene
Unknown	0.01*	tr	Monoterpene
$\alpha$ -Fenchene	[0.01]*	[0.01]*	Monoterpene
Camphene	0.02	0.02	Monoterpene
Thuja-2,4(10)-diene	0.04	0.65*	Monoterpene
Sabinene	1.27	[0.65]*	Monoterpene
$\beta$ -Pinene	[1.27]	0.64	Monoterpene
Isoamyl propionate	0.01	1.09*	Aliphatic ester
6-Methyl-5-hepten-2-one	0.02	0.01	Aliphatic ketone
Myrcene	0.36	0.36	Monoterpene
$\alpha$ -Phellandrene	0.07*	0.04	Monoterpene
Pseudolimonene	[0.07]*	0.02	Monoterpene
(3Z)-Hexenyl acetate	0.10	0.07	Aliphatic ester
$\alpha$ -Terpinene	0.21*	0.18	Monoterpene
Isoamyl isobutyrate	[0.21]*	0.03	Aliphatic ester
para-Cymene	0.37	0.36	Monoterpene
Limonene	14.57*	[1.09]*	Monoterpene
$\beta$ -Phellandrene	[14.57]*	13.49*	Monoterpene
1,8-Cineole	[14.57]*	[13.49]*	Monoterpenic ether
(Z)- $\beta$ -Ocimene	0.05	0.04	Monoterpene
(E)- $\beta$ -Ocimene	0.50	0.49	Monoterpene
$\gamma$ -Terpinene	0.39*	0.33	Monoterpene
Isoamyl butyrate	[0.39]*	0.09	Aliphatic ester
cis-Sabinene hydrate	0.01	0.03*	Monoterpenic alcohol
Unknown	0.03	0.03	Oxygenated monoterpene
cis-Linalool oxide (fur.)	0.01	0.02	Monoterpenic alcohol
Terpinolene	0.16*	0.11	Monoterpene
trans-Linalool oxide (fur.)	[0.16]*	[0.03]*	Monoterpenic alcohol
para-Cymenene	[0.16]*	0.04	Monoterpene
trans-Sabinene hydrate	0.01*	0.04*	Monoterpenic alcohol
Rosefuran	[0.01]*	0.01	Monoterpenic ether
Linalool	1.53*	1.37	Monoterpenic alcohol
Isoamyl 2-methylbutyrate	[1.53]*	0.16	Aliphatic ester

Isoamyl isovalerate	0.38*	0.40*	Aliphatic ester
Amyl isovalerate	[0.38]*	[0.40]*	Aliphatic ester
<i>cis</i> -Rose oxide	0.11*	0.08	Monoterpenic ether
endo-Fenchol	[0.11]*	0.03	Monoterpenic alcohol
<i>cis</i> -para-Menth-2-en-1-ol	0.02	0.02	Monoterpenic alcohol
$\alpha$ -Campholenal	0.11	0.26*	Monoterpenic aldehyde
<i>trans</i> -Rose oxide	0.04	0.04	Monoterpenic ether
Nopinone	0.01	0.06	Normonoterpenic ketone
<i>trans</i> -Pinocarveol	0.10	0.09	Monoterpenic alcohol
<i>cis</i> -Verbenol	0.01	0.01	Monoterpenic alcohol
Unknown	0.05*		Oxygenated monoterpene
Unknown	[0.05]*	0.05	Unknown
Citronellal	0.12	[0.26]*	Monoterpenic aldehyde
Pinocarvone	0.03	[0.04]*	Monoterpenic ketone
Borneol	0.01	2.03*	Monoterpenic alcohol
$\delta$ -Terpineol	0.16	0.23*	Monoterpenic alcohol
Terpinen-4-ol	0.55	0.61	Monoterpenic alcohol
para-Cymen-8-ol	0.05	0.03	Monoterpenic alcohol
$\alpha$ -Terpineol	1.93*	[2.03]*	Monoterpenic alcohol
Myrtenal	[1.93]*	0.02	Monoterpenic aldehyde
Myrtenol	0.04	0.02	Monoterpenic alcohol
Verbenone	0.07	0.09	Monoterpenic ketone
<i>trans</i> -Carveol	0.05	0.06	Monoterpenic alcohol
Citronellol	1.31*	1.36	Monoterpenic alcohol
Hexyl 2-methylbutyrate?	[1.31]*	0.02	Aliphatic ester
Carvone	0.14*	3.70*	Monoterpenic ketone
Neral	[0.14]*	[0.23]*	Monoterpenic aldehyde
Isoamyl hexanoate	0.03	0.03	Aliphatic ester
Geraniol	0.17	0.16	Monoterpenic alcohol
Geranial	0.16	0.16	Monoterpenic aldehyde
(2E)-Decenol	0.06	0.07	Aliphatic alcohol
Unknown	0.01		Oxygenated monoterpene
Myrtenyl acetate	0.04*	1.94*	Monoterpenic ester
Methyl geranate	[0.04]*	0.04	Monoterpenic ester
Citronellic acid	0.05	0.04	Monoterpenic acid
Bicycloelemene	0.08	[0.26]	Sesquiterpene
$\alpha$ -Cubebene	0.10	0.09	Sesquiterpene
Geranic acid	0.13	0.14	Aliphatic acid
$\alpha$ -Copaene	0.12	0.11	Sesquiterpene
7-Cubebene	0.08	0.07	Sesquiterpene
<i>cis</i> - $\beta$ -Elemene	0.01	0.05	Sesquiterpene
$\beta$ -Elemene	0.19	0.19	Sesquiterpene
$\alpha$ -Gurjunene	0.53	0.52	Sesquiterpene
$\beta$ -Caryophyllene	0.60	0.81*	Sesquiterpene
$\beta$ -Gurjunene	0.02	[0.81]*	Sesquiterpene
Aromadendrene	0.22	0.21	Sesquiterpene
<i>trans</i> - $\alpha$ -Bergamotene	0.21	[0.81]*	Sesquiterpene
Cadina-3,5-diene isomer I?	0.07		Sesquiterpene
6,9-Guaiadiene	0.11	0.13	Sesquiterpene
Cadina-3,5-diene ?	0.22	0.21	Sesquiterpene
$\alpha$ -Humulene	0.14	0.14	Sesquiterpene
allo-Aromadendrene	0.85	0.86	Sesquiterpene

Valerena-4,7(11)-diene	0.06	0.06	Sesquiterpene
<i>trans</i> -Cadina-1(6),4-diene	0.14	0.12	Sesquiterpene
$\gamma$ -Muurolene	0.10	[1.94]*	Sesquiterpene
Germacrene D	0.04	0.07	Sesquiterpene
$\beta$ -Selinene	0.05	0.05	Sesquiterpene
allo-Aromadendr-9-ene	0.27	0.24	Sesquiterpene
Bicyclogermacrene	5.53*	[3.70]*	Sesquiterpene
Viridiflorene	[5.53]*	[1.94]*	Sesquiterpene
Unknown	0.23*		Sesquiterpene
$\alpha$ -Muurolene	[0.23]*	[3.70]*	Sesquiterpene
$\gamma$ -Cadinene	0.23	0.36	Sesquiterpene
<i>trans</i> -Calamenene	1.84	0.91	Sesquiterpene
$\delta$ -Cadinene	[1.84]	0.86	Sesquiterpene
<i>trans</i> -Cadina-1,4-diene	0.25	0.25	Sesquiterpene
$\alpha$ -Cadinene	0.08	0.05	Sesquiterpene
$\alpha$ -Calacorene	0.06	0.08	Sesquiterpene
Isocaryophyllene epoxide B	0.05	0.09	Sesquiterpenic ether
Unknown	0.42*	0.04	Oxygenated sesquiterpene
Palustrol	[0.42]*	0.38	Sesquiterpenic alcohol
Spathulenol	0.37	0.37	Sesquiterpenic alcohol
Caryophyllene oxide	0.13*	0.13	Sesquiterpenic ether
Caryophyllene oxide isomer	[0.13]*	0.01	Sesquiterpenic ether
Globulol	2.83*	2.76	Sesquiterpenic alcohol
Unknown	[2.83]*		Oxygenated sesquiterpene
Viridiflorol	9.81	9.51	Sesquiterpenic alcohol
Ledol	1.38	1.31	Sesquiterpenic alcohol
Isoleptospermone	0.04	0.04	Sesquiterpenic ketone
1-epi-Cubenol	0.34*	0.36	Sesquiterpenic alcohol
Leptospermone	[0.34]*	0.02	Sesquiterpenic ketone
$\gamma$ -Eudesmol	[0.34]*	0.06*	Sesquiterpenic alcohol
$\tau$ -Cadinol	0.22*	[0.06]*	Sesquiterpenic alcohol
$\tau$ -Muurolol	[0.22]*	0.08	Sesquiterpenic alcohol
$\alpha$ -Muurolol	0.05	0.05	Sesquiterpenic alcohol
$\beta$ -Eudesmol	0.04	0.04	Sesquiterpenic alcohol
$\alpha$ -Eudesmol	0.04	0.05	Sesquiterpenic alcohol
$\alpha$ -Cadinol	0.12	0.13	Sesquiterpenic alcohol
Unknown	0.02	0.03	Oxygenated sesquiterpene
Cadalene	0.04	0.14	Sesquiterpene
Shyobunol	0.04	0.07	Sesquiterpenic alcohol
Unknown	0.01		Unknown
Unknown	0.02		Oxygenated sesquiterpene
<b>Total identified</b>	<b>98.16%</b>	<b>97.85%</b>	

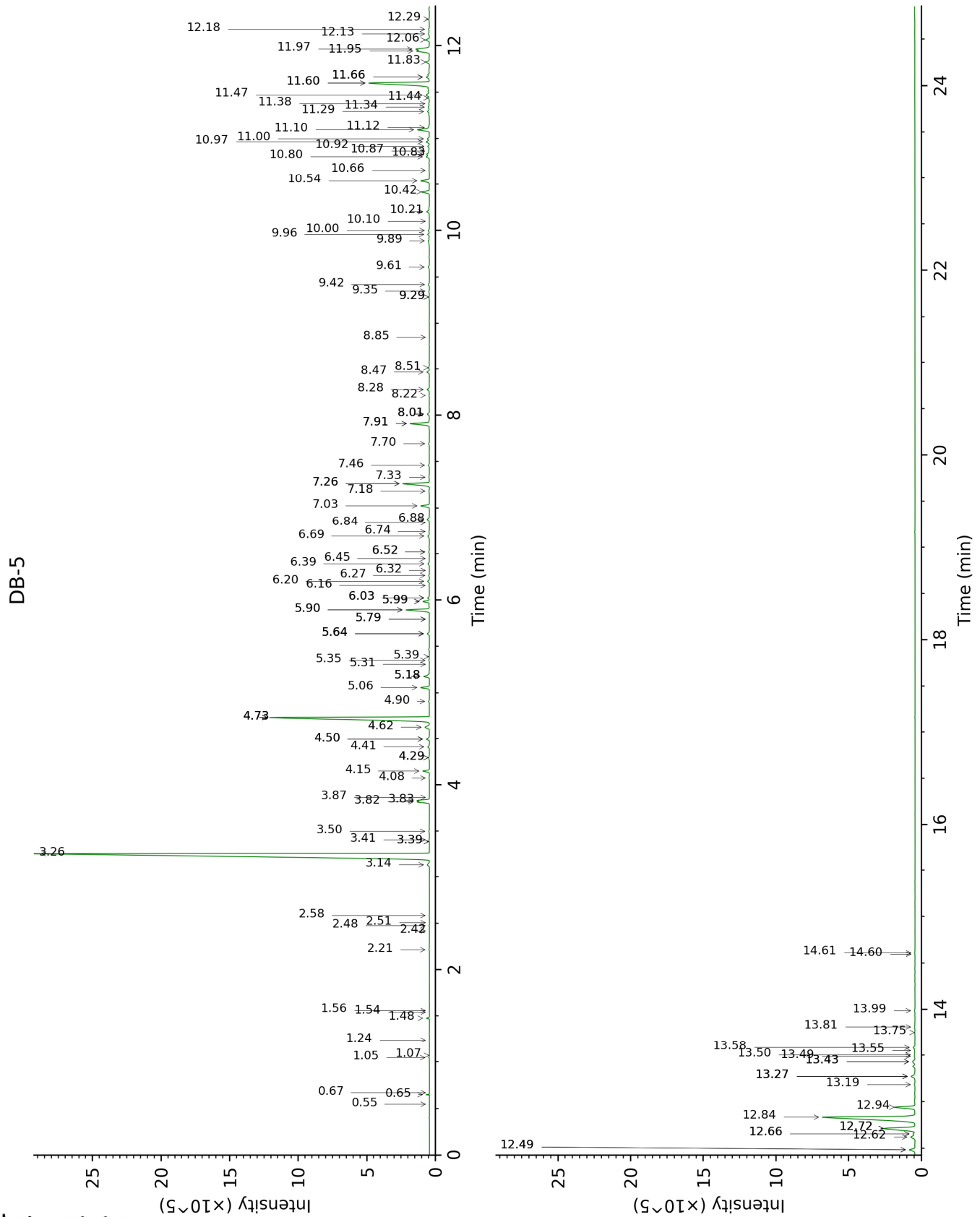
\*: Two or more compounds are coeluting on this column

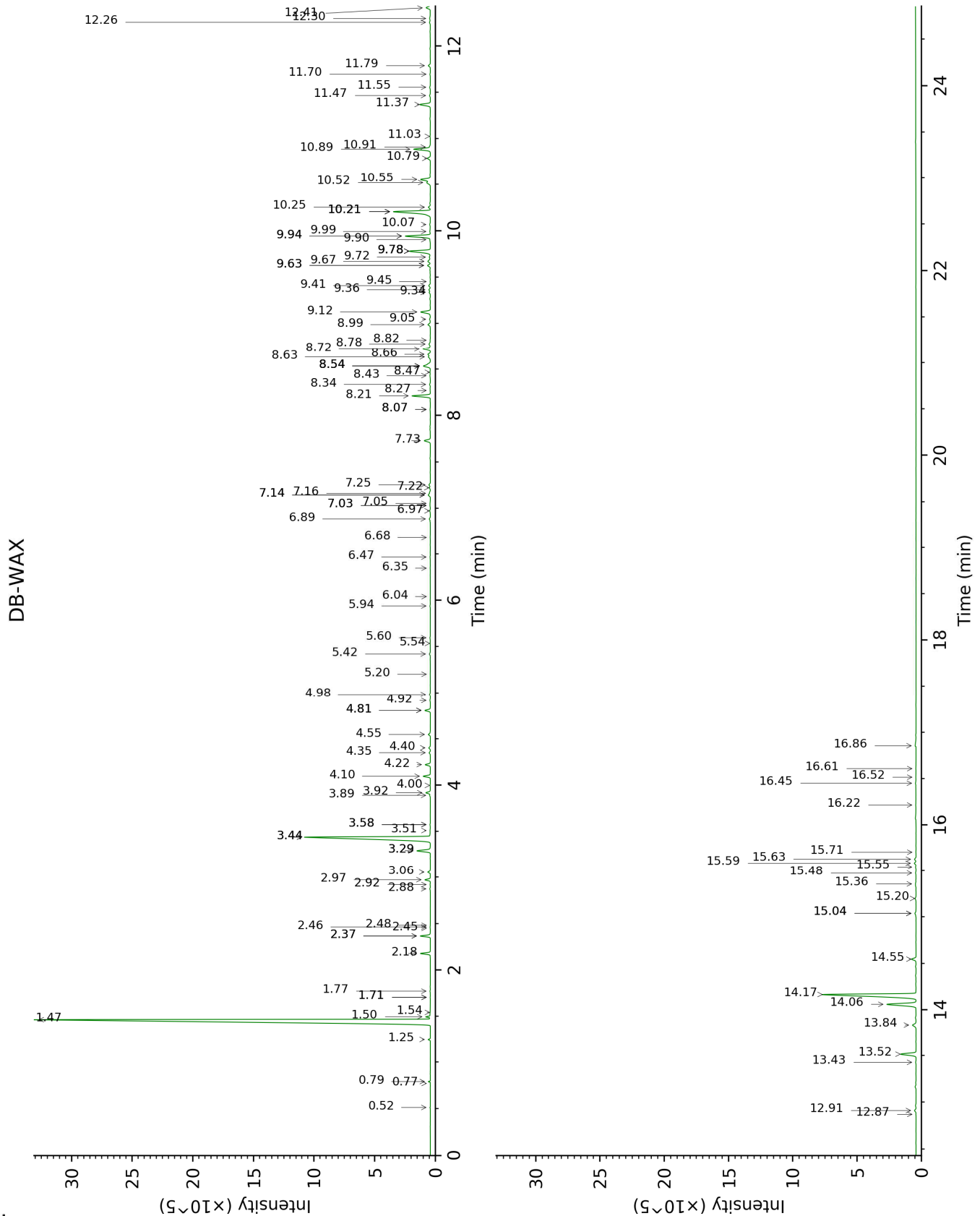
[xx]: Duplicate percentage due to coelutions, not taken account in the identified total

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

Note: no correction factor was applied

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FULL ANALYSIS DATA

Identification	Column DB-5			Column DB-WAX		
	R.T	R.I	%	R.T	R.I	%
2-Methyl-3-buten-2-ol	0.55	608	tr	1.71*	1020	0.01
Isovaleral	0.65	641	0.07	0.79	888	0.07
2-Methylbutyral	0.67	648	tr	0.77	881	0.01
Isoamyl alcohol	1.05	731	0.02	3.58*	1180	0.03
2-Methylbutanol	1.07	734	tr	3.58*	1180	[0.03]
Toluene	1.24	757	0.01	1.54	1004	0.02
2,4-Dimethyl-3-pentanone	1.48	789	0.10	1.25	964	0.10
Hexanal	1.54	798	tr			
Octane	1.56	800	tr	0.52	782	0.01
(3Z)-Hexenol	2.22	855	0.03	5.94	1350	0.03
Hexanol	2.42	871	0.01	5.54	1321	0.01
Isoamyl acetate	2.48	876	0.01	2.46	1094	0.02
2-Methylbutyl acetate	2.51	879	0.01	2.45	1093	tr
Styrene	2.58	885	0.02	4.00	1211	0.02
α-Thujene	3.14	925	0.17	1.50†	1000	[44.07]
α-Pinene	3.26	933	43.75	1.46†	996	44.07
Unknown [m/z 91, 92 (47), 65 (11)... 134 (1)]	3.39*	941	0.01	2.48	1095	tr
α-Fenchene	3.39*	941	[0.01]	1.71*	1020	[0.01]
Camphene	3.41	943	0.02	1.77	1026	0.02
Thuja-2,4(10)-diene	3.50	949	0.04	2.37*	1085	0.65
Sabinene	3.82†	970	1.27	2.37*	1085	[0.65]
β-Pinene	3.83†	971	[1.27]	2.18	1066	0.64
Isoamyl propionate	3.87	973	0.01	3.29*	1158	1.09
6-Methyl-5-hepten-2-one	4.08	987	0.02	5.20	1298	0.01
Myrcene	4.15	992	0.36	2.97	1133	0.36
α-Phellandrene	4.29*	1001	0.07	2.88	1126	0.04
Pseudolimonene	4.29*	1001	[0.07]	2.92	1129	0.02
(3Z)-Hexenyl acetate	4.41	1008	0.10	4.98	1281	0.07
α-Terpinene	4.50*	1014	0.21	3.06	1140	0.18
Isoamyl isobutyrate	4.50*	1014	[0.21]	3.51	1175	0.03
para-Cymene	4.62	1022	0.37	4.22	1227	0.36
Limonene	4.73*	1028	14.57	3.29*	1158	[1.09]
β-Phellandrene	4.73*	1028	[14.57]	3.44*	1169	13.49
1,8-Cineole	4.73*	1028	[14.57]	3.44*	1169	[13.49]
(Z)-β-Ocimene	4.90	1039	0.05	3.89	1203	0.04
(E)-β-Ocimene	5.06	1049	0.50	4.10	1218	0.49
γ-Terpinene	5.18*	1057	0.39	3.92	1205	0.33
Isoamyl butyrate	5.18*	1057	[0.39]	4.35	1236	0.09

<i>cis</i> -Sabinene hydrate	5.31	1065	0.01	7.03*	1429	0.03
Unknown [m/z 79, 93 (60), 43 (40), 94 (35), 137 (33), 77 (26), 91 (20), 152 (18)]	5.35	1068	0.03	4.92	1276	0.03
<i>cis</i> -Linalool oxide (fur.)	5.39	1070	0.01	6.68	1403	0.02
Terpinolene	5.64*	1086	0.16	4.40	1240	0.11
<i>trans</i> -Linalool oxide (fur.)	5.64*	1086	[0.16]	7.03*	1429	[0.03]
para-Cymenene	5.64*	1086	[0.16]	6.47	1388	0.04
<i>trans</i> -Sabinene hydrate	5.80*	1096	0.01	8.07*	1506	0.04
Rosefuran	5.80*	1096	[0.01]	6.04	1357	0.01
Linalool	5.90*	1102	1.53	8.21	1518	1.37
Isoamyl 2-methylbutyrate	5.90*	1102	[1.53]	4.55	1250	0.16
Isoamyl isovalerate	5.99*	1108	0.38	4.81*	1269	0.40
Amyl isovalerate	5.99*	1108	[0.38]	4.81*	1269	[0.40]
<i>cis</i> -Rose oxide	6.02*	1110	0.11	5.42	1313	0.08
endo-Fenchol	6.02*	1110	[0.11]	8.47	1537	0.03
<i>cis</i> -para-Menth-2-en-1-ol	6.16	1119	0.02	8.27	1522	0.02
α-Campholenal	6.20	1122	0.11	7.14*†	1438	0.26
<i>trans</i> -Rose oxide	6.27	1126	0.04	5.60	1326	0.04
Nopinone	6.32	1130	0.01	8.34	1527	0.06
<i>trans</i> -Pinocarveol	6.39	1134	0.10	9.34	1605	0.09
<i>cis</i> -Verbenol	6.45	1138	0.01	9.45	1614	0.01
Unknown [m/z 109, 43 (73), 71 (54), 124 (51), 69 (37), 41 (35)...152 (5)]	6.52*	1142	0.05			
Unknown [m/z 109, 124 (45), 119 (41), 43 (35), 91 (28), 95 (25)...]	6.52*	1142	[0.05]	6.97	1425	0.05
Citronellal	6.69	1154	0.12	7.14*†	1438	[0.26]
Pinocarvone	6.74	1157	0.03	8.07*	1506	[0.04]
Borneol	6.84	1163	0.01	9.94*	1654	2.03
δ-Terpineol	6.88	1166	0.16	9.63*	1628	0.23
Terpinen-4-ol	7.02	1175	0.55	8.72	1557	0.61
para-Cymen-8-ol	7.18	1185	0.05	11.70	1800	0.03
α-Terpineol	7.26*	1191	1.93	9.94*	1654	[2.03]
Myrtenal	7.26*	1191	[1.93]	8.82	1564	0.02
Myrtenol	7.33	1195	0.04	11.03	1743	0.02
Verbenone	7.46	1204	0.07	9.72	1635	0.09
<i>trans</i> -Carveol	7.70	1219	0.05	11.56	1788	0.06
Citronellol	7.91*	1234	1.31	10.89	1732	1.36
Hexyl 2-	7.91*	1234	[1.31]	6.35	1379	0.02

methylbutyrate?						
Carvone	8.01*	1241	0.14	10.21*	1675	3.70
Neral	8.01*	1241	[0.14]	9.63*	1628	[0.23]
Isoamyl hexanoate	8.22	1255	0.03	7.05	1431	0.03
Geraniol	8.28	1259	0.17	11.79	1808	0.16
Geranial	8.47	1272	0.16	10.25	1678	0.16
(2E)-Decenol	8.51	1275	0.06	11.47	1780	0.07
Unknown [m/z 43, 93 (66), 91 (44), 41 (38), 69 (35)... 152? (1)]	8.85	1298	0.01			
Myrtenyl acetate	9.28*	1324	0.04	9.78*	1640	1.94
Methyl geranate	9.28*	1324	[0.04]	9.90	1650	0.04
Citronellic acid	9.35	1328	0.05	16.22	2228	0.04
Bicycloelemene	9.42	1333	0.08	7.16†	1439	[0.26]
α-Cubebene	9.61	1346	0.10	6.89	1418	0.09
Geranic acid	9.89	1366	0.13	16.86	2295	0.14
α-Copaene	9.96	1371	0.12	7.25	1446	0.11
7-Cubebene	10.00	1374	0.08	7.22	1443	0.07
cis-β-Elemene	10.10	1381	0.01	8.43	1534	0.05
β-Elemene	10.20	1389	0.19	8.63	1550	0.19
α-Gurjunene	10.42	1404	0.53	7.73	1481	0.52
β-Caryophyllene	10.54	1413	0.60	8.54*	1542	0.81
β-Gurjunene	10.66	1422	0.02	8.54*	1542	[0.81]
Aromadendrene	10.80	1433	0.22	8.66	1552	0.21
trans-α-Bergamotene	10.83	1435	0.21	8.54*	1542	[0.81]
Cadina-3,5-diene isomer I?	10.87	1437	0.07			
6,9-Guaiadiene	10.92	1441	0.11	8.78	1561	0.13
Cadina-3,5-diene ?	10.97	1445	0.22	8.99	1577	0.21
α-Humulene	11.00	1447	0.14	9.41	1610	0.14
allo-Aromadendrene	11.10	1455	0.85	9.12	1588	0.86
Valerena-4,7(11)-diene	11.12	1456	0.06	9.05	1582	0.06
trans-Cadina-1(6),4-diene	11.29	1469	0.14	9.36	1607	0.12
γ-Murolene	11.34	1473	0.10	9.78*	1640	[1.94]
Germacrene D	11.38	1476	0.04	9.99	1658	0.07
β-Selinene	11.44	1480	0.05	10.07	1664	0.05
allo-Aromadendrene	11.47	1482	0.27	9.67	1632	0.24
Bicyclogermacrene	11.60*†	1492	5.53	10.21*	1675	[3.70]
Viridiflorene	11.60*†	1492	[5.53]	9.78*	1640	[1.94]
Unknown [m/z 93, 105 (63), 119 (60), 91 (58), 107 (55), 41 (51), 69 (44), 79 (44), 202 (43)]	11.66*	1497	0.23			
α-Murolene	11.66*	1497	[0.23]	10.21*	1675	[3.70]
γ-Cadinene	11.83	1509	0.23	10.52	1701	0.36

<i>trans</i> -Calamenene	11.94†	1519	1.84	11.37	1772	0.91
δ-Cadinene	11.97†	1520	[1.84]	10.55	1703	0.86
<i>trans</i> -Cadina-1,4-diene	12.06	1528	0.25	10.79	1723	0.25
α-Cadinene	12.13	1533	0.08	10.91	1733	0.05
α-Calacorene	12.18	1537	0.06	12.26	1849	0.08
Isocaryophyllene epoxide B	12.29	1546	0.05	12.30	1853	0.09
Unknown [m/z 161, 109 (98), 82 (93), 43 (72), 105 (68), 93 (59), 69 (56), 119 (55)... 222 (7)]	12.49*	1561	0.42	13.43	1956	0.04
Palustrol	12.49*	1561	[0.42]	12.41	1863	0.38
Spathulenol	12.62	1572	0.37	14.55	2061	0.37
Caryophyllene oxide	12.66*	1575	0.13	12.91	1908	0.13
Caryophyllene oxide isomer	12.66*	1575	[0.13]	12.87	1904	0.01
Globulol	12.72*	1579	2.83	14.06	2015	2.76
Unknown [m/z 109, 43 (95), 81 (81), 93 (76), 69 (75), 95 (74), 107 (71)... 204 (22), 220 (6)]	12.72*	1579	[2.83]			
Viridiflorol	12.84	1589	9.81	14.17	2025	9.51
Ledol	12.94	1597	1.38	13.52	1964	1.31
Isoleptospermone	13.18	1617	0.04	16.52	2260	0.04
1-epi-Cubenol	13.27*	1624	0.34	13.84	1993	0.36
Leptospermone	13.27*	1624	[0.34]	15.71	2176	0.02
γ-Eudesmol	13.27*	1624	[0.34]	15.04*	2110	0.06
τ-Cadinol	13.43*	1637	0.22	15.04*	2110	[0.06]
τ-Muurolol	13.43*	1637	[0.22]	15.20	2126	0.08
α-Muurolol	13.49	1642	0.05	15.36	2141	0.05
β-Eudesmol	13.50	1643	0.04	15.55	2160	0.04
α-Eudesmol	13.55	1647	0.04	15.48	2153	0.05
α-Cadinol	13.58	1650	0.12	15.63	2168	0.13
Unknown [m/z 159, 118 (33), 91 (30), 131 (30)... 220? (4)]	13.75	1664	0.02	16.61	2269	0.03
Cadalene	13.81	1669	0.04	15.59	2164	0.14
Shyobunol	13.99	1683	0.04	16.45	2253	0.07
Unknown [m/z 43, 139 (66), 178 (44), 81 (41), 95 (41), 121 (35)...]	14.60	1735	0.01			
Unknown [m/z 43, 194 (68), 136 (63), 81 (63), 177 (56),	14.61	1736	0.02			

223 (51)... 238 (3)]		
<b>Total identified</b>	<b>98.16%</b>	<b>97.85%</b>
<b>Total reported</b>	<b>98.25%</b>	<b>98.00%</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