

**Date :** March 27, 2019

**CERTIFICATE OF ANALYSIS – GC PROFILING**

**SAMPLE IDENTIFICATION**

**Internal code :** 19C25-PTH02-1-SCC

**Customer identification :** Rhododendron - Nepal - RJ010188R

**Type :** Essential oil

**Source :** *Rhododendron anthopogon*

**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 26, 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:** Faintly yellow liquid

**Refractive index:**  $1.4793 \pm 0.0003$  (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	0.01	0.01	Aliphatic alcohol
Toluene	tr	0.25*	Simple phenolic
Octane	0.01	0.02	Alkane
5-Methyl-3-hexanone	0.03	0.03*	Aliphatic ketone
4-Methyl-3-hexanone	0.02	0.02	Aliphatic ketone
Ethyl 2-methylbutyrate	0.01	tr	Aliphatic ester
Ethyl isovalerate	tr	[0.03]*	Aliphatic ester
Styrene	tr	2.44*	Simple phenolic
Bornylene	0.01	tr	Monoterpene
Hashishene	0.02	33.53*	Monoterpene
Tricyclene	0.05	0.06	Monoterpene
$\alpha$ -Thujene	0.21	[0.25]*	Monoterpene
$\alpha$ -Pinene	33.41	[33.53]*	Monoterpene
$\alpha$ -Fenchene	0.34*	0.08	Monoterpene
Camphene	[0.34]*	0.27	Monoterpene
Thuja-2,4(10)-diene	0.02	0.12*	Monoterpene
6-Methyl-2-heptanone	0.01	3.68*	Aliphatic ketone
Sabinene	15.16*	[0.12]*	Monoterpene
$\beta$ -Pinene	[15.16]*	15.21	Monoterpene
Octen-3-ol	0.02	0.01	Aliphatic alcohol
Myrcene	1.09	1.09	Monoterpene
Pseudolimonene	0.03*	0.03	Monoterpene
$\alpha$ -Phellandrene	[0.03]*	0.03	Monoterpene
$\Delta^3$ -Carene	0.12	0.13	Monoterpene
$\alpha$ -Terpinene	0.11	0.11	Monoterpene
para-Cymene	0.79	0.80	Monoterpene
1,8-Cineole	12.87*	0.15*	Monoterpenic ether
$\beta$ -Phellandrene	[12.87]*	[0.15]*	Monoterpene
Limonene	[12.87]*	12.83	Monoterpene
(Z)- $\beta$ -Ocimene	3.36	[3.68]*	Monoterpene
2-Heptyl acetate	0.03	0.03	Aliphatic ester
(E)- $\beta$ -Ocimene	1.34	1.36	Monoterpene
$\gamma$ -Terpinene	2.69	[2.44]*	Monoterpene
cis-Linalool oxide (fur.)	0.01	0.01	Monoterpenic alcohol
Octanol	0.01	0.04	Aliphatic alcohol
$\alpha$ -Pinene oxide analog	0.01	0.03*	Monoterpenic ether
para-Cymenene	0.28*	0.01	Monoterpene
Terpinolene	[0.28]*	0.27	Monoterpene
$\alpha$ -Pinene oxide	0.02	[0.03]*	Monoterpenic ether
Linalool	0.25	0.29*	Monoterpenic alcohol
endo-Fenchol	0.04	3.01*	Monoterpenic alcohol
Octen-3-yl acetate	0.02	0.03	Aliphatic ester
allo-Ocimene	0.10	0.11	Monoterpene
trans-Pinocarveol	0.07	0.36*	Monoterpenic alcohol
Camphene hydrate	0.11	0.38*	Monoterpenic alcohol
Borneol	0.03	0.46*	Monoterpenic alcohol
Ethyl benzoate	0.01	0.18*	Phenolic ester
Terpinen-4-ol	0.19	0.20*	Monoterpenic alcohol

Methyl salicylate	0.03*	[6.78]*	Phenolic ester
para-Cymen-8-ol	[0.03]*	0.02	Monoterpenic alcohol
$\alpha$ -Terpineol	0.30	[0.46]*	Monoterpenic alcohol
Myrtenol	0.03	0.03	Monoterpenic alcohol
(3Z,5E)-2,6-Dimethylocta-3,5,7-trien-2-ol?	0.02	0.24	Monoterpenic alcohol
(3E,5E)-2,6-Dimethylocta-3,5,7-trien-2-ol	0.01	0.01	Monoterpenic alcohol
<i>trans</i> -Carveol	0.01	0.02	Monoterpenic alcohol
Citronellol	0.02	0.02	Monoterpenic alcohol
2-Nonyl acetate	0.01	0.02	Aliphatic ester
Unknown	0.04	0.18*	Unknown
<i>trans</i> -Ascaridole glycol	0.01	0.02	Monoterpenic alcohol
Unknown	0.01	0.18*	Oxygenated monoterpene
Bornyl acetate	0.12	0.12	Monoterpenic ester
2-Undecanone	0.02	0.04	Aliphatic ketone
Bicycloelemene	0.03	0.09*	Sesquiterpene
Unknown	0.25*	0.04	Sesquiterpene
$\alpha$ -Cubebene	[0.25]*	0.23	Sesquiterpene
Citronellyl acetate	0.13	0.15	Monoterpenic ester
Cyclosativene II	0.01	0.01	Sesquiterpene
$\alpha$ -Ylangene	0.09	[0.09]*	Sesquiterpene
$\alpha$ -Copaene	0.64	0.66	Sesquiterpene
$\beta$ -Bourbonene	0.18	[0.18]*	Sesquiterpene
$\beta$ -Cubebene	0.02	0.01	Sesquiterpene
7-epi-Sesquithujene	0.19*	0.04	Sesquiterpene
$\beta$ -Elemene	[0.19]*	[3.01]*	Sesquiterpene
$\alpha$ -Funebrene	0.06	0.08	Sesquiterpene
4-Phenyl-2-butyl acetate	0.02		Phenylbutanoid ester
$\alpha$ -Cedrene	0.28*	[0.29]*	Sesquiterpene
$\alpha$ -Gurjunene	[0.28]*	0.15	Sesquiterpene
$\beta$ -Caryophyllene	2.82	[3.01]*	Sesquiterpene
$\beta$ -Gurjunene	0.03	0.04	Sesquiterpene
$\beta$ -Copaene	0.20	0.19	Sesquiterpene
$\alpha$ -Maaliene	0.04	[0.20]*	Sesquiterpene
<i>trans</i> - $\alpha$ -Bergamotene	0.43*	[3.01]*	Sesquiterpene
Selina-5,11-diene	[0.43]*	0.08	Sesquiterpene
Aromadendrene	[0.43]*	[0.38]*	Sesquiterpene
<i>cis</i> -Muurolo-3,5-diene	0.05	0.03	Sesquiterpene
Unknown	0.17	0.17	Sesquiterpene
$\alpha$ -Humulene	0.51	0.43	Sesquiterpene
allo-Aromadendrene	0.44	0.47	Sesquiterpene
( <i>E</i> )- $\beta$ -Farnesene	0.56*	0.42	Sesquiterpene
<i>cis</i> -Muurolo-4(15),5-diene	[0.56]*	[0.18]*	Sesquiterpene
<i>trans</i> -Cadina-1(6),4-diene	0.40	[0.36]*	Sesquiterpene
$\gamma$ -Muurolole	1.28	1.31	Sesquiterpene
Germacrene D	0.35*	0.21	Sesquiterpene
$\alpha$ -Amorphene	[0.35]*	0.22	Sesquiterpene
$\beta$ -Selinene	0.72	0.78	Sesquiterpene
ar-Curcumene	0.05	0.32*	Sesquiterpene
$\alpha$ -Selinene	0.94*	0.59	Sesquiterpene
$\gamma$ -Amorphene	[0.94]*		Sesquiterpene

$\alpha$ -Muurolene	1.60	1.60	Sesquiterpene
$\beta$ -Curcumene	2.33*	0.33	Sesquiterpene
$\gamma$ -Cadinene	[2.33]*	6.78	Sesquiterpene
(3E,6E)- $\alpha$ -Farnesene	[2.33]*	0.10	Sesquiterpene
Zonarene	5.22*	[6.78]*	Sesquiterpene
$\delta$ -Cadinene	[5.22]*	[6.78]*	Sesquiterpene
<i>trans</i> -Cadina-1,4-diene	0.20	[0.32]*	Sesquiterpene
$\alpha$ -Cadinene	0.35	0.35	Sesquiterpene
$\alpha$ -Calacorene	0.09	0.08	Sesquiterpene
Isocaryophyllene epoxide B	0.05	0.03	Sesquiterpenic ether
$\beta$ -Calacorene	0.01	0.05*	Sesquiterpene
(E)-Nerolidol	0.10	0.17*	Sesquiterpenic alcohol
Germacrene D-4-ol	0.17*	0.14	Sesquiterpenic alcohol
Spathulenol	[0.17]*	0.13	Sesquiterpenic alcohol
Caryophyllene oxide	0.20*	[0.18]*	Sesquiterpenic ether
Caryophyllene oxide isomer	[0.20]*	[0.05]*	Sesquiterpenic ether
Unknown	0.04		Oxygenated sesquiterpene
Viridiflorol	0.03	0.05	Sesquiterpenic alcohol
Ledol?	0.09	0.08	Oxygenated sesquiterpene
Unknown	0.07		Oxygenated sesquiterpene
10-epi-Cubenol	0.13		Sesquiterpenic alcohol
1-epi-Cubenol	0.16	[0.17]*	Sesquiterpenic alcohol
$\gamma$ -Eudesmol	0.07	0.35*	Sesquiterpenic alcohol
$\tau$ -Muurolol	0.74*	0.33	Sesquiterpenic alcohol
$\tau$ -Cadinol	[0.74]*	[0.35]*	Sesquiterpenic alcohol
$\alpha$ -Muurolol	0.15	0.14	Sesquiterpenic alcohol
$\beta$ -Eudesmol	0.09	0.09	Sesquiterpenic alcohol
$\alpha$ -Cadinol	0.41	0.40	Sesquiterpenic alcohol
<i>cis</i> -Calamene-10-ol	0.03	0.03	Sesquiterpenic alcohol
<i>trans</i> -Calamene-10-ol	0.02	0.02	Sesquiterpenic alcohol
$\alpha$ -Bisabolol	0.10	0.09	Sesquiterpenic alcohol
Unknown	0.05		Oxygenated sesquiterpene
Unknown	0.03		Oxygenated sesquiterpene
Unknown	0.05	0.03	Oxygenated sesquiterpene
<b>Total identified</b>	<b>96.56%</b>	<b>96.44%</b>	

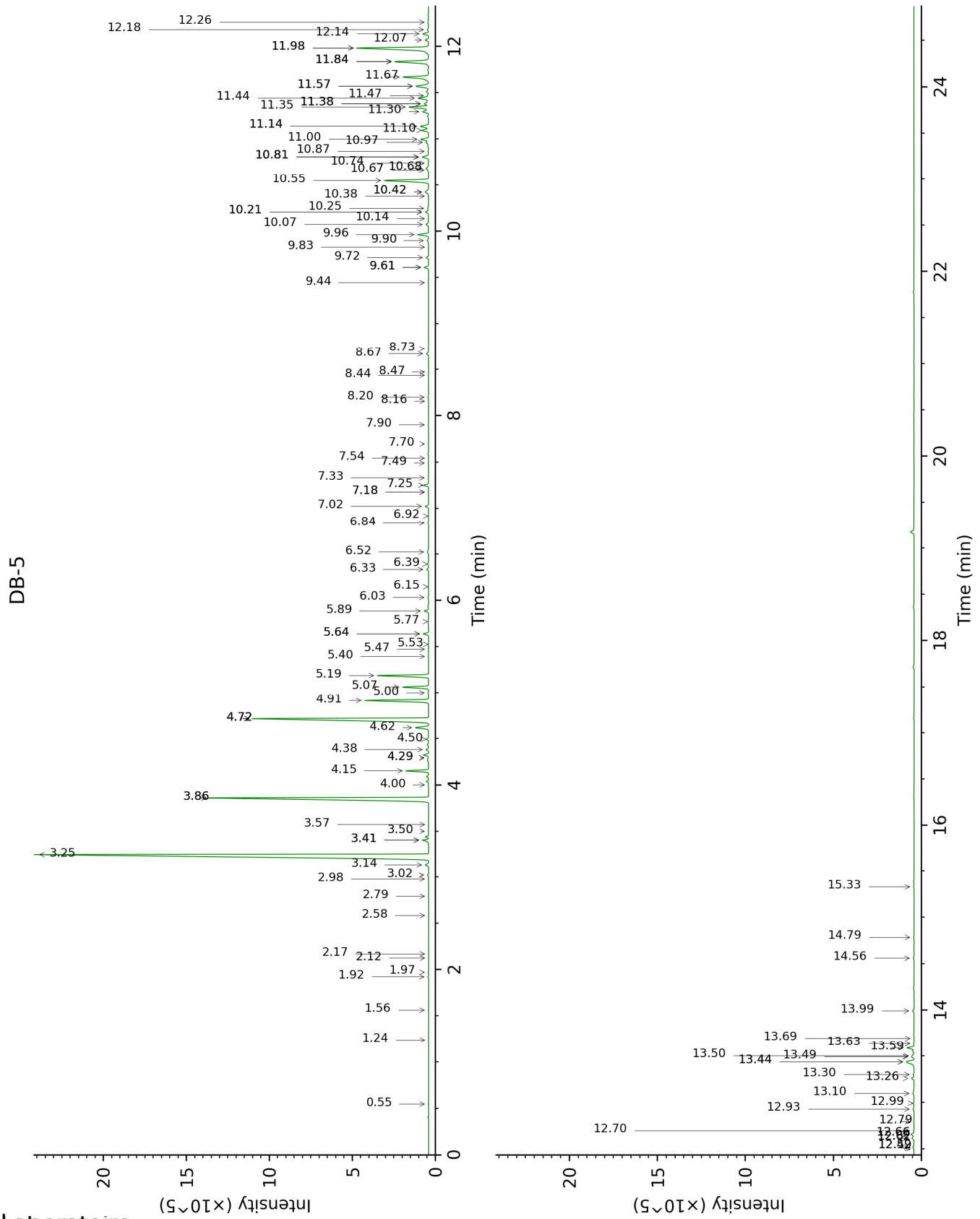
\*: Two or more compounds are coeluting on this column

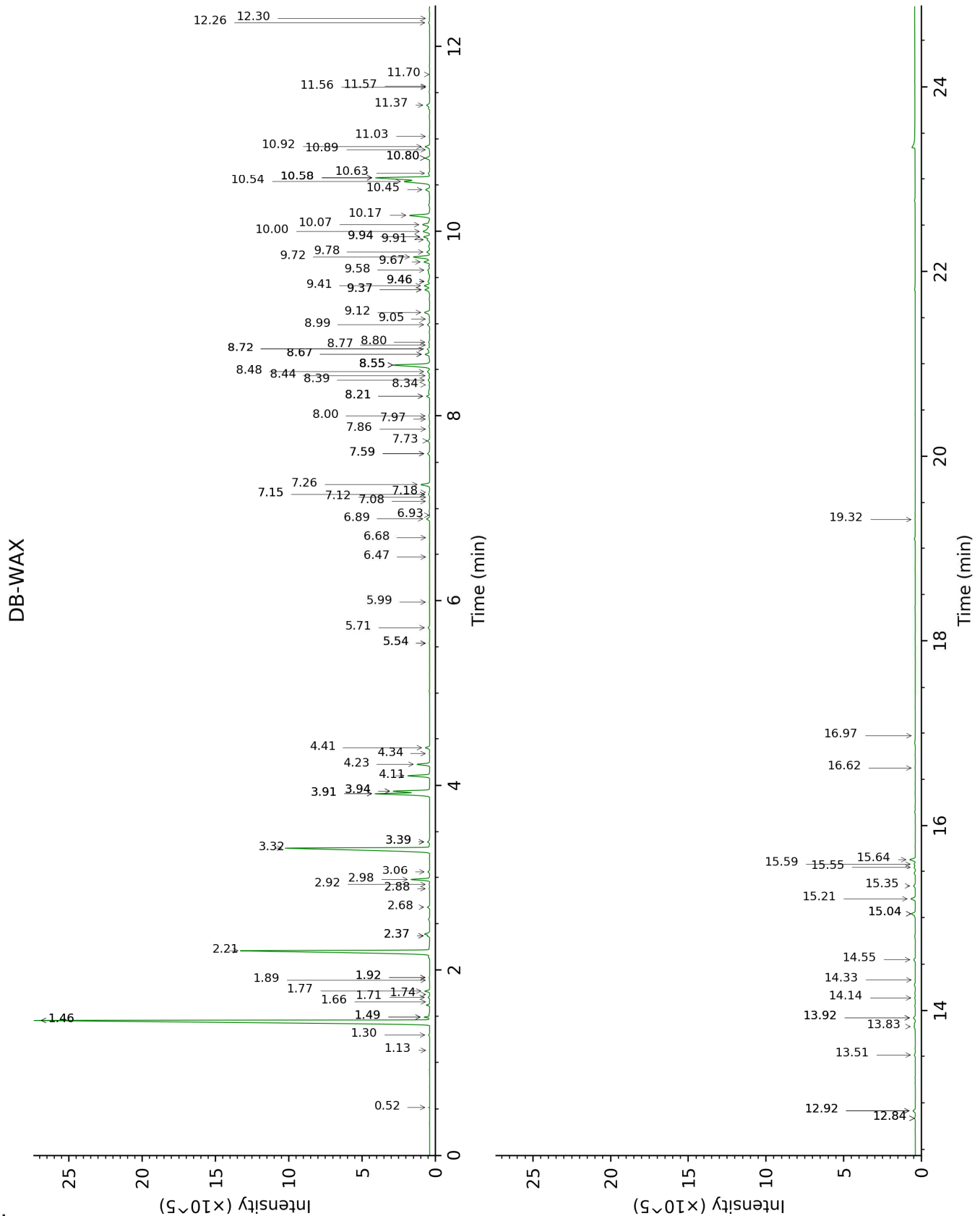
[xx]: Duplicate percentage due to coelutions, not taken account in the identified total

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	0.01	1.66	1015	0.01
Toluene	1.24	757	tr	1.49*	999	0.25
Octane	1.56	801	0.01	0.52	783	0.02
5-Methyl-3-hexanone	1.92	831	0.03	1.92*	1041	0.03
4-Methyl-3-hexanone	1.97	835	0.02	1.89	1038	0.02
Ethyl 2-methylbutyrate	2.12	847	0.01	1.74	1023	tr
Ethyl isovalerate	2.17	851	tr	1.92*	1041	[0.03]
Styrene	2.58	885	tr	3.94*	1207	2.44
Bornylene	2.79	902	0.01	1.13	944	tr
Hashishene	2.98	914	0.02	1.46*	996	33.53
Tricyclene	3.02	917	0.05	1.30	972	0.06
$\alpha$ -Thujene	3.14	925	0.21	1.49*	999	[0.25]
$\alpha$ -Pinene	3.25	932	33.41	1.46*	996	[33.53]
$\alpha$ -Fenchene	3.41*	942	0.34	1.71	1020	0.08
Camphene	3.41*	942	[0.34]	1.78	1027	0.27
Thuja-2,4(10)-diene	3.50	949	0.02	2.37*	1085	0.12
6-Methyl-2-heptanone	3.57	954	0.01	3.91*	1205	3.68
Sabinene	3.86*	972	15.16	2.37*	1085	[0.12]
$\beta$ -Pinene	3.86*	972	[15.16]	2.21	1069	15.21
Octen-3-ol	4.00	982	0.02	6.93	1422	0.01
Myrcene	4.15	992	1.09	2.98	1134	1.09
Pseudolimonene	4.29*	1001	0.03	2.92	1130	0.03
$\alpha$ -Phellandrene	4.29*	1001	[0.03]	2.88	1126	0.03
$\Delta^3$ -Carene	4.38	1007	0.12	2.68	1111	0.13
$\alpha$ -Terpinene	4.50	1014	0.11	3.06	1140	0.11
para-Cymene	4.62	1022	0.79	4.23	1227	0.80
1,8-Cineole	4.72*	1028	12.87	3.39*	1166	0.15
$\beta$ -Phellandrene	4.72*	1028	[12.87]	3.39*	1166	[0.15]
Limonene	4.72*	1028	[12.87]	3.32	1160	12.83
(Z)- $\beta$ -Ocimene	4.91	1040	3.36	3.91*	1205	[3.68]
2-Heptyl acetate	5.00	1046	0.03	4.34	1236	0.03
(E)- $\beta$ -Ocimene	5.06	1050	1.34	4.10	1218	1.36
$\gamma$ -Terpinene	5.19	1058	2.69	3.94*	1207	[2.44]
cis-Linalool oxide (fur.)	5.40	1071	0.01	6.68	1403	0.01
Octanol	5.47	1076	0.01	8.34	1527	0.04
$\alpha$ -Pinene oxide analog	5.53	1079	0.01	5.54*	1322	0.03
para-Cymenene	5.64*	1086	0.28	6.47	1388	0.01
Terpinolene	5.64*	1086	[0.28]	4.41	1240	0.27
$\alpha$ -Pinene oxide	5.77	1094	0.02	5.54*	1322	[0.03]
Linalool	5.89	1102	0.25	8.21*†	1518	0.29

endo-Fenchol	6.03	1111	0.04	8.55*	1544	3.01
Octen-3-yl acetate	6.15	1118	0.02	5.98	1353	0.03
allo-Ocimene	6.33	1130	0.10	5.71	1334	0.11
<i>trans</i> -Pinocarveol	6.39	1134	0.07	9.37*	1607	0.36
Camphene hydrate	6.52	1143	0.11	8.67*†	1552	0.38
Borneol	6.84	1163	0.03	9.94*	1653	0.46
Ethyl benzoate	6.92	1168	0.01	9.46*	1614	0.18
Terpinen-4-ol	7.02	1175	0.19	8.72*	1557	0.20
Methyl salicylate	7.18*	1185	0.03	10.58*†	1705	[6.78]
para-Cymen-8-ol	7.18*	1185	[0.03]	11.70	1800	0.02
α-Terpineol	7.25	1190	0.30	9.94*	1653	[0.46]
Myrtenol	7.33	1195	0.03	11.03	1744	0.03
(3 <i>Z</i> ,5 <i>E</i> )-2,6-Dimethylocta-3,5,7-trien-2-ol?	7.49	1205	0.02	11.37	1772	0.24
(3 <i>E</i> ,5 <i>E</i> )-2,6-Dimethylocta-3,5,7-trien-2-ol	7.54	1209	0.01	11.56	1788	0.01
<i>trans</i> -Carveol	7.70	1219	0.01	11.57	1789	0.02
Citronellol	7.90	1233	0.02	10.89	1732	0.02
2-Nonyl acetate	8.16	1251	0.01	7.18	1440	0.02
Unknown [m/z 68, 43 (71), 82 (59), 67 (52), 95 (24), 81 (24)...]	8.20	1254	0.04	7.59*	1471	0.18
<i>trans</i> -Ascaridole glycol	8.44	1270	0.01	14.33	2041	0.02
Unknown [m/z 41, 43 (84), 72 (81), 97 (90), 95 (60)... 150 (4)]	8.47	1272	0.01	12.92*	1908	0.18
Bornyl acetate	8.67	1286	0.12	8.39	1531	0.12
2-Undecanone	8.73	1290	0.02	8.77	1561	0.04
Bicycloelemene	9.44	1335	0.03	7.15*	1438	0.09
Unknown [m/z 95, 147 (61), 96 (39), 93 (37), 94 (37)... 204 (4)]	9.61*	1346	0.25	7.08	1433	0.04
α-Cubebene	9.61*	1346	[0.25]	6.89	1419	0.23
Citronellyl acetate	9.72	1354	0.13	9.58	1624	0.15
Cyclosativene II	9.83	1362	0.01	7.12	1436	0.01
α-Ylangene	9.90	1367	0.09	7.15*	1438	[0.09]
α-Copaene	9.96	1372	0.64	7.26	1446	0.66
β-Bourbonene	10.07	1379	0.18	7.59*	1471	[0.18]
β-Cubebene	10.14	1384	0.02	7.86	1490	0.01
7-epi-Sesquithujene	10.21*	1389	0.19	7.97	1499	0.04
β-Elemene	10.21*	1389	[0.19]	8.55*	1544	[3.01]

$\alpha$ -Funebrene	10.25	1392	0.06	8.00	1501	0.08
4-Phenyl-2-butyl acetate	10.38	1401	0.02			
$\alpha$ -Cedrene	10.42*	1404	0.28	8.21*†	1518	[0.29]
$\alpha$ -Gurjunene	10.42*	1404	[0.28]	7.73	1481	0.15
$\beta$ -Caryophyllene	10.55	1414	2.82	8.55*	1544	[3.01]
$\beta$ -Gurjunene	10.67	1422	0.03	8.44	1535	0.04
$\beta$ -Copaene	10.68	1424	0.20	8.48	1538	0.19
$\alpha$ -Maaliene	10.74	1428	0.04	8.72*	1557	[0.20]
<i>trans</i> - $\alpha$ -Bergamotene	10.81*	1433	0.43	8.55*	1544	[3.01]
Selina-5,11-diene	10.81*	1433	[0.43]	8.80	1563	0.08
Aromadendrene	10.81*	1433	[0.43]	8.67*†	1552	[0.38]
<i>cis</i> -Muuro-la-3,5-diene	10.87	1438	0.05	9.05	1582	0.03
Unknown [m/z 91, 161 (92), 105 (85), 119 (63), 133 (53), 79 (49), 204 (46)]	10.97	1445	0.17	8.99	1578	0.17
$\alpha$ -Humulene	11.00	1447	0.51	9.41	1611	0.43
allo-Aromadendrene	11.10	1454	0.44	9.12	1588	0.47
( <i>E</i> )- $\beta$ -Farnesene	11.14*	1458	0.56	9.67	1632	0.42
<i>cis</i> -Muuro-la-4(15),5-diene	11.14*	1458	[0.56]	9.46*	1614	[0.18]
<i>trans</i> -Cadin-1(6),4-diene	11.30	1470	0.40	9.37*	1607	[0.36]
$\gamma$ -Muuro-lene	11.35	1473	1.28	9.72	1636	1.31
Germacrene D	11.38*	1476	0.35	9.91	1651	0.21
$\alpha$ -Amorphene	11.38*	1476	[0.35]	9.78	1640	0.22
$\beta$ -Selinene	11.44	1480	0.72	10.00	1658	0.78
ar-Curcumene	11.47	1482	0.05	10.80*	1724	0.32
$\alpha$ -Selinene	11.57*	1490	0.94	10.07	1664	0.59
$\gamma$ -Amorphene	11.57*	1490	[0.94]			
$\alpha$ -Muuro-lene	11.67	1497	1.60	10.17	1672	1.60
$\beta$ -Curcumene	11.84*	1510	2.33	10.45	1694	0.33
$\gamma$ -Cadinene	11.84*	1510	[2.33]	10.54†	1702	6.78
(3 <i>E</i> ,6 <i>E</i> )- $\alpha$ -Farnesene	11.84*	1510	[2.33]	10.63	1710	0.10
Zonarene	11.98*	1522	5.22	10.58*†	1705	[6.78]
$\delta$ -Cadinene	11.98*	1522	[5.22]	10.58*†	1705	[6.78]
<i>trans</i> -Cadin-1,4-diene	12.07	1529	0.20	10.80*	1724	[0.32]
$\alpha$ -Cadinene	12.14	1534	0.35	10.92	1734	0.35
$\alpha$ -Calacorene	12.18	1537	0.09	12.26	1850	0.08
Isocaryophyllene epoxide B	12.26	1544	0.05	12.30	1854	0.03
$\beta$ -Calacorene	12.49	1562	0.01	12.84*	1901	0.05
( <i>E</i> )-Nerolidol	12.52	1564	0.10	13.92*	2002	0.17
Germacrene D-	12.62*	1572	0.17	13.83	1992	0.14

4-ol						
Spathulenol	12.62*	1572	[0.17]	14.55	2062	0.13
Caryophyllene oxide	12.66*	1575	0.20	12.92*	1908	[0.18]
Caryophyllene oxide isomer	12.66*	1575	[0.20]	12.84*	1901	[0.05]
Unknown [m/z 109, 43 (95), 81 (81), 93 (76), 69 (75), 95 (74), 107 (71)... 204 (22), 220 (6)]	12.70	1578	0.04			
Viridiflorol	12.79	1586	0.03	14.14	2022	0.05
Ledol?	12.93	1596	0.09	13.51	1963	0.08
Unknown [m/z 149, 43 (95), 93 (84), 177 (66), 109 (62), 67 (60)...220 (11)]	12.99	1601	0.07			
10-epi-Cubenol	13.10	1610	0.13			
1-epi-Cubenol	13.26	1623	0.16	13.92*	2002	[0.17]
γ-Eudesmol	13.30	1626	0.07	15.04*	2110	0.35
τ-Muurolol	13.44*	1638	0.74	15.21	2126	0.33
τ-Cadinol	13.44*	1638	[0.74]	15.04*	2110	[0.35]
α-Muurolol	13.49	1642	0.15	15.34	2140	0.14
β-Eudesmol	13.50	1643	0.09	15.59	2164	0.09
α-Cadinol	13.59	1650	0.41	15.64	2169	0.40
cis-Calamenen-10-ol	13.63	1654	0.03	16.62	2271	0.03
trans-Calamenen-10-ol	13.69	1659	0.02	16.97	2308	0.02
α-Bisabolol	13.99	1684	0.10	15.55	2161	0.09
Unknown [m/z 91, 175 (93), 105 (76), 79 (73), 133 (69), 107 (60)...218 (33)]	14.56	1732	0.05			
Unknown [m/z 91, 177 (75), 79 (68), 105 (65), 93 (62), 159 (60)...220 (16)]	14.78	1752	0.03			
Unknown [m/z 43, 41 (72), 95 (69), 81 (66), 67 (55), 55 (52), 79 (52), 69 (50)... 238 (1)]	15.33	1799	0.05	19.32	2570	0.03
<b>Total identified</b>		<b>96.56%</b>			<b>96.44%</b>	
<b>Total reported</b>		<b>97.02%</b>			<b>96.68%</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