

**Date :** May 31, 2019

**CERTIFICATE OF ANALYSIS – GC PROFILING**

**SAMPLE IDENTIFICATION**

**Internal code :** 19E21-PTH01-1-SCC

**Customer identification :** Cedarwood Virginian - USA - C7010488R

**Type :** Essential oil

**Source :** *Juniperus virginiana*

**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 :** May 27, 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:** 1.5051 ± 0.0003 (20 °C)

*ISO 4724:2004 - OIL OF CEDARWOOD, VIRGINIAN*

Compound	Min. %	Max. %	Observed %	Complies?
Widdrol	2	5	2	Yes
α-Cedrol	16	25	19	Yes
Cuparene	1.5	7.0	1.6	Yes
cis-Thujopsene	10	25	24	Yes
α-Cedrene + β-funebrene	20	35	25	Yes
β-Cedrene + β-caryophyllene	4	8	5	Yes
<b>Refractive index</b>	1.5010	1.5100	1.5051	Yes

*CONCLUSION*

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

The oil complies with the ISO standard for Virginian cedarwood oil.

## ANALYSIS SUMMARY

Identification	DB-5 (%)	DB-WAX (%)	Classe
Unknown	0.01	0.01	Monoterpene
$\alpha$ -Pinene	0.05	0.05	Monoterpene
$\alpha$ -Fenchene	0.01*	0.01	Monoterpene
Camphene	[0.01]*		Monoterpene
Thuja-2,4(10)-diene	0.01	0.01	Monoterpene
$\alpha$ -Methylstyrene	tr	tr	Normonoterpene
$\Delta^3$ -Carene	0.01	0.01	Monoterpene
para-Cymene	0.01	0.01	Monoterpene
Limonene	0.02	0.02	Monoterpene
Terpinolene	0.01*	tr	Monoterpene
para-Cymenene	[0.01]*	0.01	Monoterpene
$\alpha$ -Campholenal	tr	0.18*	Monoterpenic aldehyde
Camphor	0.01*	0.06	Monoterpenic ketone
<i>trans</i> -Pinocarveol	[0.01]*	0.15*	Monoterpenic alcohol
Pinocamphone	0.01*	0.29*	Monoterpenic ketone
Citronellal	[0.01]*	[0.18]*	Monoterpenic aldehyde
Borneol	0.01	0.47*	Monoterpenic alcohol
Terpinen-4-ol	0.02	0.19*	Monoterpenic alcohol
para-Cymen-8-ol	0.03	0.01	Monoterpenic alcohol
$\alpha$ -Terpineol	0.03	[0.47]*	Monoterpenic alcohol
Myrtenol	0.02	0.04	Monoterpenic alcohol
Verbenone	0.04	0.68*	Monoterpenic ketone
Carvacrol methyl ether	0.03	[0.19]*	Monoterpenic ether
Bornyl acetate	0.01	0.68	Monoterpenic ester
Brasila-1,10-diene	0.05*	0.02	Sesquiterpene
Carvacrol	[0.05]*	0.08	Monoterpenic alcohol
$\alpha$ -Terpinyl acetate	0.09*	[1.13]	Monoterpenic ester
African-1-ene	[0.09]*	0.10	Sesquiterpene
Cyclosativene II	0.26	[0.18]*	Sesquiterpene
2-epi- $\alpha$ -Funebrene	0.53	[0.29]*	Sesquiterpene
$\alpha$ -Duprezianene	0.58	0.44	Sesquiterpene
Isolongifolene	0.08	0.07	Sesquiterpene
$\beta$ -Elemene	0.58*	1.06*	Sesquiterpene
$\alpha$ -Funebrene	[0.58]*	0.12*	Sesquiterpene
7-epi-Sesquithujene	[0.58]*	0.20	Sesquiterpene
Unknown	0.33*	0.33*	Sesquiterpene
$\alpha$ -Chamipinene	[0.33]*	[0.12]*	Sesquiterpene
$\alpha$ -Cedrene	24.66*	23.60	Sesquiterpene
$\beta$ -Funebrene	[24.66]*	[0.33]*	Sesquiterpene
$\beta$ -Cedrene	4.70*	3.91	Sesquiterpene
$\beta$ -Caryophyllene	[4.70]*	[1.06]*	Sesquiterpene
$\beta$ -Duprezianene	[4.70]*	0.09	Sesquiterpene
<i>cis</i> -Thujopsene	23.62	23.46	Sesquiterpene
( <i>Z</i> )- $\beta$ -Farnesene?	0.19	0.07	Sesquiterpene
Isobazzanene	0.17*	0.14	Sesquiterpene
<i>trans</i> - $\alpha$ -Bergamotene	[0.17]*	[1.06]*	Sesquiterpene
Prezizaene	0.49*	0.14	Sesquiterpene
$\beta$ -Barbatene	[0.49]*	0.15	Sesquiterpene

7,8-Dehydro- $\alpha$ -acoradiene?	0.63*	0.15	Sesquiterpene
$\alpha$ -Himachalene	[0.63]*	0.37	Sesquiterpene
Cadina-4,11-diene	0.14	[0.15]*	Sesquiterpene
$\alpha$ -Humulene	0.20	0.10	Sesquiterpene
$\alpha$ -Acoradiene	0.32	0.66*	Sesquiterpene
( <i>E</i> )- $\beta$ -Farnesene	0.73*	[0.68]*	Sesquiterpene
9-epi- $\beta$ -Caryophyllene	[0.73]*	[0.66]*	Sesquiterpene
$\beta$ -Acoradiene	[0.73]*	0.62*	Sesquiterpene
Thujopsene isomer	1.19	[0.62]*	Sesquiterpene
$\beta$ -Chamigrene	0.87*	1.13	Sesquiterpene
Unknown	[0.87]*		Sesquiterpene
$\gamma$ -Himachalene	0.46	[0.68]*	Sesquiterpene
Unknown	0.88*	0.34	Sesquiterpene
ar-Curcumene	[0.88]*	0.60*	Sesquiterpene
Valencene	0.59	1.04*	Sesquiterpene
Pseudowiddrene	2.05	[1.04]*	Sesquiterpene
$\alpha$ -Chamigrene	[2.05]	2.25*	Sesquiterpene
$\beta$ -Himachalene	1.81*	0.81	Sesquiterpene
$\alpha$ -Cuprenene	[1.81]*	[2.25]*	Sesquiterpene
Cuparene	1.59	1.46	Sesquiterpene
1,2-Dihydrocuparene	0.19	0.14*	Sesquiterpene
$\alpha$ -Alaskene	0.25	[1.04]*	Sesquiterpene
$\alpha$ -Dehydro-ar-himachalene	0.83*	0.06*	Sesquiterpene
Unknown	[0.83]*	0.34	Sesquiterpene
1,4-Dihydrocuparene	[0.83]*	0.43	Sesquiterpene
7-epi- $\alpha$ -Selinene	0.24*	0.26*	Sesquiterpene
$\beta$ -Curcumene	[0.24]*	[0.14]*	Sesquiterpene
$\delta$ -Cadinene	0.14*	[0.26]*	Sesquiterpene
$\gamma$ -Dehydro-ar-himachalene	[0.14]*	0.02	Sesquiterpene
$\beta$ -Sesquiphellandrene	0.65	[0.60]*	Sesquiterpene
$\gamma$ -Cuprenene	0.58	[0.60]*	Sesquiterpene
( <i>E</i> )- $\gamma$ -Bisabolene	0.19*	[0.26]*	Sesquiterpene
ar-Himachalene	[0.19]*	0.08	Sesquiterpene
$\delta$ -Cuprenene epimer I	0.43*	0.11	Sesquiterpene
Unknown	[0.43]*	0.12	Oxygenated sesquiterpene
$\delta$ -Cuprenene epimer II	[0.43]	0.11	Sesquiterpene
8,14-Cedranoxide	0.06*	[0.06]*	Sesquiterpenic ether
Unknown	[0.06]*	0.19	Oxygenated sesquiterpene
Unknown	0.14	0.28*	Oxygenated sesquiterpene
Caryophyllenyl alcohol	0.14	0.19	Sesquiterpenic alcohol
Caryophyllene oxide	0.07	0.03	Sesquiterpenic ether
allo-Cedrol	0.38	[0.28]*	Sesquiterpenic alcohol
Widdrol	19.12*	1.70*	Sesquiterpenic alcohol
$\alpha$ -Cedrol	[19.12]*	18.52	Sesquiterpenic alcohol
epi-Cedrol	0.45*	0.25	Sesquiterpenic alcohol
$\beta$ -Himachalene oxide	[0.45]*	0.02	Sesquiterpenic ether
Unknown	0.31	0.03	Oxygenated sesquiterpene
Unknown	0.13*	[1.70]*	Oxygenated sesquiterpene
2-epi- $\alpha$ -Cedren-3-one	[0.13]*		Sesquiterpenic ketone
$\alpha$ -Acorenol	0.45	0.35	Sesquiterpenic alcohol
$\beta$ -Acorenol	0.46	0.42	Sesquiterpenic alcohol
Unknown	0.22*	0.11	Oxygenated sesquiterpene

Unknown	[0.22]*	0.21*	Oxygenated sesquiterpene
Unknown	0.69		Oxygenated sesquiterpene
Unknown	0.22*		Oxygenated sesquiterpene
Himachalol	[0.22]*	0.11	Sesquiterpenic alcohol
Unknown	0.28	0.04	Oxygenated sesquiterpene
Unknown	0.20	0.38*	Oxygenated sesquiterpene
Cedrenol analog	0.34	0.16	Sesquiterpenic alcohol
Cedr-8-en-13-ol	0.34	0.15	Sesquiterpenic alcohol
α-Bisabolol	0.14*	[0.38]*	Sesquiterpenic alcohol
α-Cedrenol	[0.14]*	0.08	Sesquiterpenic alcohol
Unknown	0.26*		Oxygenated sesquiterpene
Mayurone?	[0.26]*	0.10	Norsesquiterpenic ketone
Thujopsenal	0.25	[0.21]*	Sesquiterpenic aldehyde
Unknown	0.07	0.05	Oxygenated sesquiterpene
Thujopsenal analog	0.07	0.22	Sesquiterpenic aldehyde
Unknown	0.05		Oxygenated sesquiterpene
Cuparenal	0.04		Sesquiterpenic aldehyde
Unknown	0.12*		Oxygenated sesquiterpene
Cedryl acetate?	[0.12]*	0.13	Sesquiterpenic ester
Unknown	0.05	0.05	Oxygenated sesquiterpene
Unknown	0.07	0.05	Oxygenated sesquiterpene
Unknown	0.12*	0.05	Oxygenated sesquiterpene
Unknown	[0.12]*	0.09	Oxygenated sesquiterpene
Nootkatone analog	0.01	0.02	Sesquiterpenic ketone
<b>Total identified</b>	<b>94.99%</b>	<b>90.58%</b>	

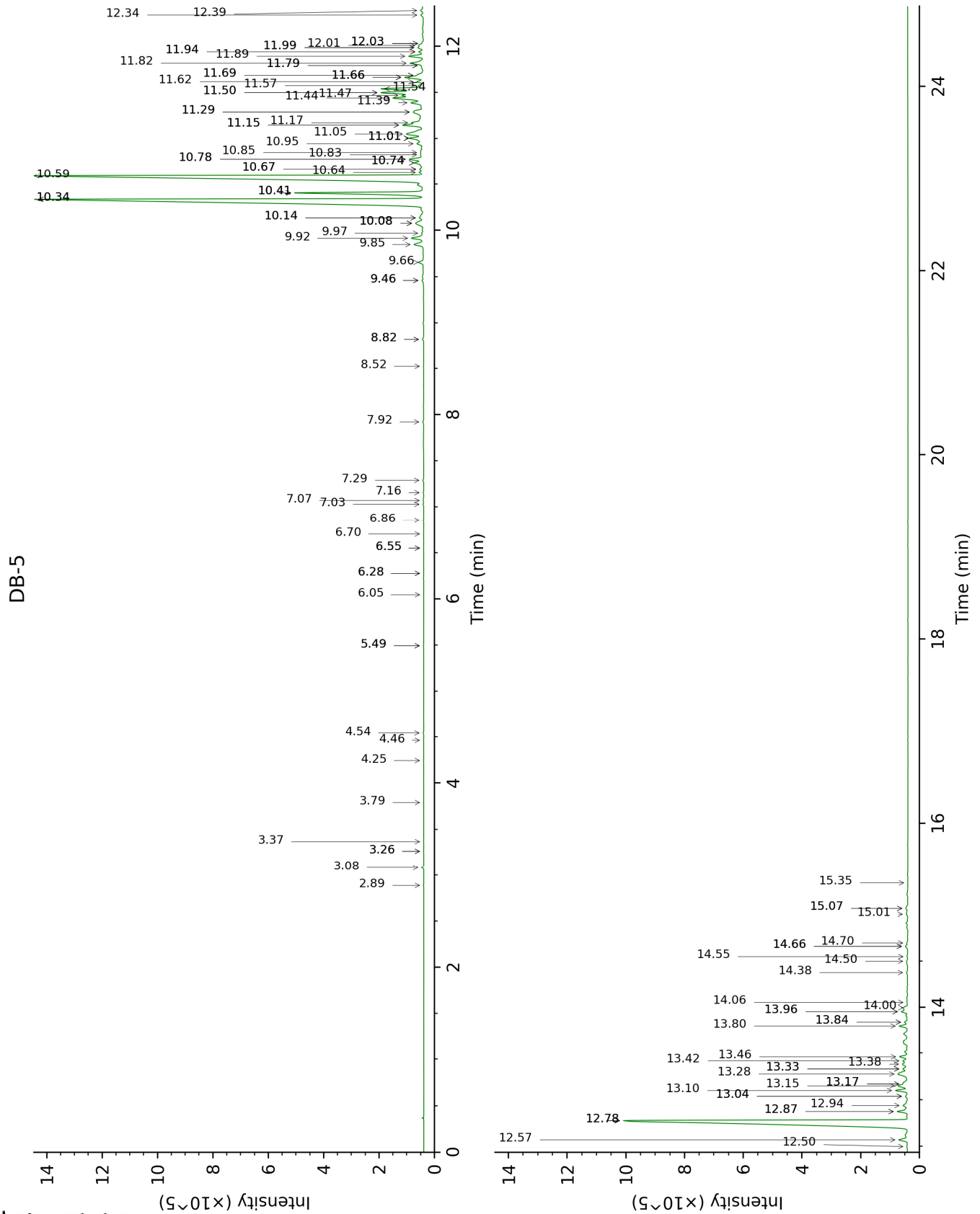
\*: Two or more compounds are coeluting on this column

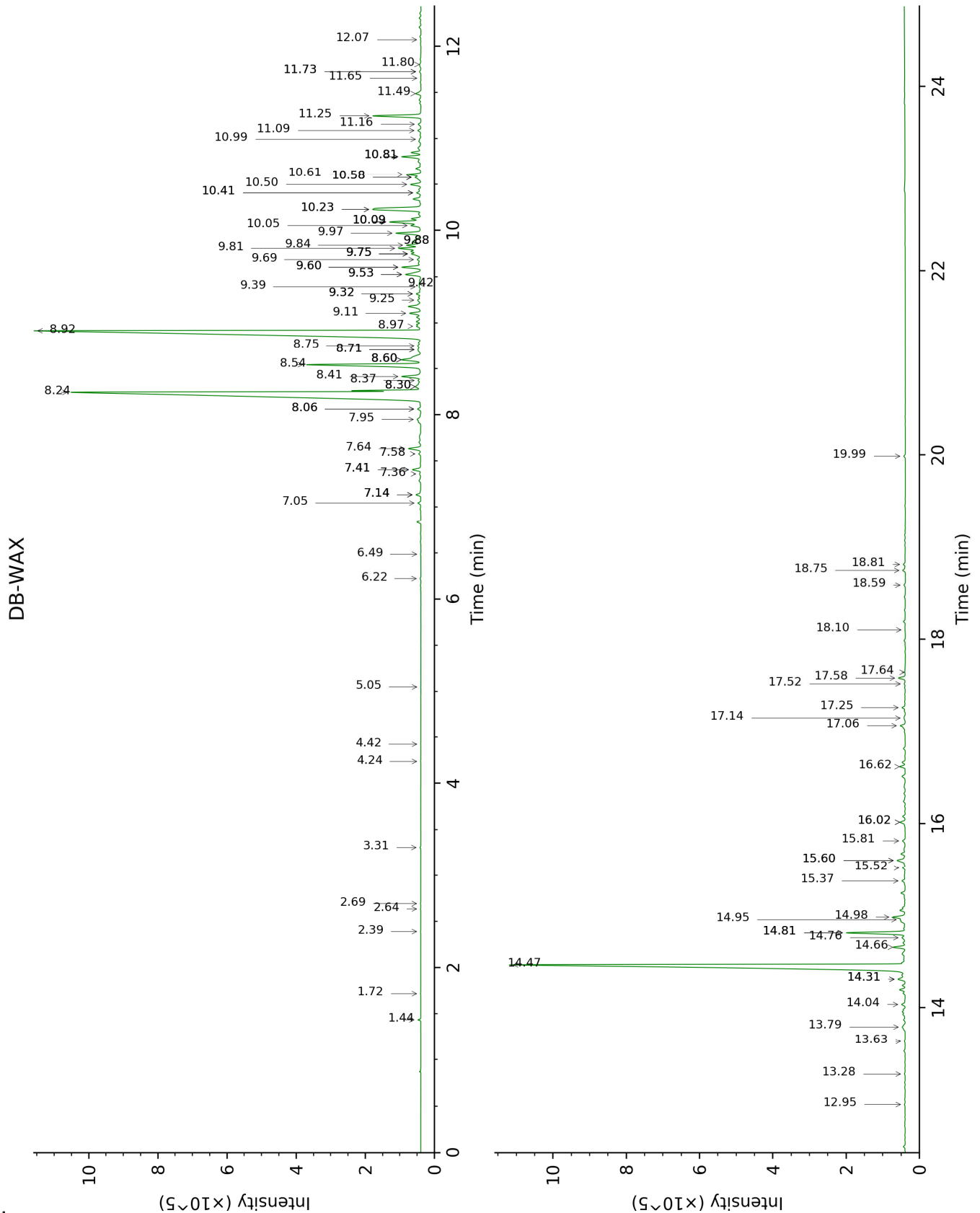
[xx]: Duplicate percentage due to coelutions, not taken account in the identified total

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	%
Unknown [m/z 105, 79 (80), 91 (78), 77 (69), 78 (56), 93 (46), 120 (44)... 136 (4)]	2.89	917	0.01	2.64	1108	0.01
$\alpha$ -Pinene	3.08	930	0.05	1.44	993	0.05
$\alpha$ -Fenchene	3.26*	942	0.01	1.72	1022	0.01
Camphene	3.26*	942	[0.01]			
Thuja-2,4(10)-diene	3.37	948	0.01	2.39	1087	0.01
$\alpha$ -Methylstyrene	3.79	976	tr	5.05	1289	tr
$\Delta$ 3-Carene	4.24	1006	0.01	2.69	1112	0.01
para-Cymene	4.46	1020	0.01	4.24	1230	0.01
Limonene	4.54	1025	0.02	3.31	1160	0.02
Terpinolene	5.49*	1085	0.01	4.42	1243	tr
para-Cymenene	5.49*	1085	[0.01]	6.49	1388	0.01
$\alpha$ -Campholenal	6.05	1120	tr	7.14*	1436	0.18
Camphor	6.28*	1135	0.01	7.36	1452	0.06
<i>trans</i> -Pinocarveol	6.28*	1135	[0.01]	9.32*	1602	0.15
Pinocamphone	6.55*	1153	0.01	7.41*	1456	0.29
Citronellal	6.55*	1153	[0.01]	7.14*	1436	[0.18]
Borneol	6.70	1163	0.01	9.88*	1648	0.47
Terpinen-4-ol	6.86	1173	0.02	8.71*	1555	0.19
para-Cymen-8-ol	7.03	1184	0.03	11.66	1796	0.01
$\alpha$ -Terpineol	7.07	1187	0.03	9.88*	1648	[0.47]
Myrtenol	7.16	1193	0.02	11.00	1740	0.04
Verbenone	7.29	1201	0.04	9.75*†	1637	0.68
Carvacrol methyl ether	7.92	1245	0.03	8.71*	1555	[0.19]
Bornyl acetate	8.52	1286	0.01	8.42	1532	0.68
Brasila-1,10-diene	8.82*	1307	0.05	6.22	1369	0.02
Carvacrol	8.82*	1307	[0.05]	15.52	2157	0.08
$\alpha$ -Terpinyl acetate	9.46*	1347	0.09	9.84†	1645	[1.13]
African-1-ene	9.46*	1347	[0.09]	7.05	1429	0.10
Cyclosativene II	9.66	1361	0.26	7.14*	1436	[0.18]
2-epi- $\alpha$ -Funebrene	9.85	1375	0.53	7.41*	1456	[0.29]
$\alpha$ -Duprezianene	9.92	1380	0.58	7.64	1473	0.44
Isolongifolene	9.97	1384	0.08	7.58	1469	0.07
$\beta$ -Elemene	10.08*	1391	0.58	8.60*†	1546	1.06
$\alpha$ -Funebrene	10.08*	1391	[0.58]	8.06*	1505	0.12
7-epi-Sesquithujene	10.08*	1391	[0.58]	7.95	1496	0.20
Unknown [m/z 107, 91 (86), 93 (83), 79 (81), 162 (74), 41 (73), 133 (72)... 204 (13)]	10.14*	1395	0.33	8.30*	1524	0.33
$\alpha$ -Chamipinene	10.14*	1395	[0.33]	8.06*	1505	[0.12]
$\alpha$ -Cedrene	10.34*	1410	24.66	8.24	1519	23.60
$\beta$ -Funebrene	10.34*	1410	[24.66]	8.30*	1524	[0.33]

β-Cedrene	10.41*	1415	4.70	8.54	1542	3.91
β-Caryophyllene	10.41*	1415	[4.70]	8.60*†	1546	[1.06]
β-Duprezianene	10.41*	1415	[4.70]	8.37	1529	0.09
cis-Thujopsene	10.59	1429	23.62	8.92	1571	23.46
(Z)-β-Farnesene?	10.64	1432	0.19	9.39	1608	0.07
Isobazzanene	10.67*	1435	0.17	8.75	1558	0.14
trans-α-Bergamotene	10.67*	1435	[0.17]	8.60*†	1546	[1.06]
Prezizaene	10.74*	1440	0.49	8.97	1575	0.14
β-Barbatene	10.74*	1440	[0.49]	9.25	1597	0.15
7,8-Dehydro-α-acoradiene?	10.78*	1443	0.63	9.69	1632	0.15
α-Himachalene	10.78*	1443	[0.63]	9.11	1586	0.37
Cadina-4,11-diene	10.83	1446	0.14	9.32*	1602	[0.15]
α-Humulene	10.85	1448	0.20	9.42	1611	0.10
α-Acoradiene	10.95	1455	0.32	9.53*	1619	0.66
(E)-β-Farnesene	11.01*	1460	0.73	9.75*†	1637	[0.68]
9-epi-β-Caryophyllene	11.01*	1460	[0.73]	9.53*	1619	[0.66]
β-Acoradiene	11.01*	1460	[0.73]	9.60*	1626	0.62
Thujopsene isomer	11.05	1463	1.19	9.60*	1626	[0.62]
β-Chamigrene	11.15*	1470	0.87	9.81†	1642	1.13
Unknown [m/z 91, 105 (93), 161 (77), 93 (73), 119 (71), 133 (69)... 204 (31)]	11.15*	1470	[0.87]			
γ-Himachalene	11.17	1472	0.46	9.75*†	1637	[0.68]
Unknown [m/z 189, 91 (95), 105 (93), 133 (84), 119 (75), 41 (59), 93 (46)... 204 (33)]	11.29*	1481	0.88	10.06	1662	0.34
ar-Curcumene	11.29*	1481	[0.88]	10.81*	1724	0.60
Valencene	11.39	1488	0.59	10.09*	1665	1.04
Pseudowiddrene	11.44†	1492	2.05	10.09*	1665	[1.04]
α-Chamigrene	11.47†	1494	[2.05]	10.23*	1676	2.25
β-Himachalene	11.50*	1497	1.81	9.97	1656	0.81
α-Cuprenene	11.50*	1497	[1.81]	10.23*	1676	[2.25]
Cuparene	11.54	1500	1.59	11.25	1762	1.46
1,2-Dihydrocuparene	11.58	1502	0.19	10.41*	1691	0.14
α-Alaskene	11.62	1506	0.25	10.09*	1665	[1.04]
α-Dehydro-arhimachalene	11.66*	1509	0.83	11.73*	1802	0.06
Unknown [m/z 121, 123 (45), 91 (24), 107 (24), 122 (24), 95 (23)... 204 (11)]	11.66*	1509	[0.83]	10.50	1698	0.34
1,4-Dihydrocuparene	11.66*	1509	[0.83]	10.61	1708	0.43
7-epi-α-Selinene	11.69*	1511	0.24	10.58*	1705	0.26
β-Curcumene	11.69*	1511	[0.24]	10.41*	1691	[0.14]

δ-Cadinene	11.79*	1519	0.14	10.58*	1705	[0.26]
γ-Dehydro-ar-himachalene	11.79*	1519	[0.14]	12.07	1833	0.02
β-Sesquiphellandrene	11.82	1521	0.65	10.81*	1724	[0.60]
γ-Cuprenene	11.89	1527	0.58	10.81*	1724	[0.60]
(E)-γ-Bisabolene	11.94*	1531	0.19	10.58*	1705	[0.26]
ar-Himachalene	11.94*	1531	[0.19]	11.80	1809	0.08
δ-Cuprenene epimer I	11.99*†	1535	0.43	11.09	1748	0.11
Unknown [m/z 43, 95 (81), 207 (61), 41 (55), 55 (50)... 222 (3)]	11.99*†	1535	[0.43]	14.04	2012	0.12
δ-Cuprenene epimer II	12.01†	1536	[0.43]	11.16	1754	0.11
8,14-Cedranoxide	12.03*	1538	0.06	11.73*	1802	[0.06]
Unknown [m/z 106, 41 (86), 43 (84), 149 (75), 69 (75), 91 (63), 93 (61)... 220 (1)]	12.03*	1538	[0.06]	11.49	1782	0.19
Unknown [m/z 95, 191 (52), 107 (50), 121 (32), 81 (31)...]	12.34	1562	0.14	14.31*	2038	0.28
Caryophyllenyl alcohol	12.39	1566	0.14	13.79	1989	0.19
Caryophyllene oxide	12.50	1575	0.07	12.95	1912	0.03
allo-Cedrol	12.57	1580	0.38	14.31*	2038	[0.28]
Widdrol	12.78*	1597	19.12	14.81*	2087	1.70
α-Cedrol	12.78*	1597	[19.12]	14.47	2053	18.52
epi-Cedrol	12.87*	1604	0.45	14.95	2100	0.25
β-Himachalene oxide	12.87*	1604	[0.45]	13.28	1942	0.02
Unknown [m/z 138, 110 (77), 137 (75), 107 (62), 91 (61), 93 (60), 109 (57)... 220 (34)]	12.94	1610	0.31	13.63	1974	0.03
Unknown [m/z 107, 41 (86), 123 (85), 82 (79), 95 (77), 93 (76), 91 (73), 69 (71)... 220 (13)]	13.04*	1618	0.13	14.81*	2087	[1.70]
2-epi-α-Cedren-3-one	13.04*	1618	[0.13]			
α-Acorenol	13.10	1623	0.45	14.66	2072	0.35
β-Acorenol	13.15	1627	0.46	14.98	2103	0.42
Unknown [m/z 132, 175 (22), 119 (18), 91 (18), 157 (18)... 219 (10)]	13.17*	1629	0.22	15.81	2186	0.11

Unknown [m/z 105, 93 (78), 95 (75), 131 (72), 119 (71), 132 (70), 91 (67), 120 (49)... 202 (39), 220 (9)]	13.17*	1629	[0.22]	16.02*	2207	0.21
Unknown [m/z 132, 91 (24), 119 (22), 105 (21), 133 (17), 117 (16)... 219 (3)]	13.28	1638	0.69			
Unknown [m/z 123, 81 (77), 95 (77), 107 (72), 41 (72), 93 (66), 55 (64)... 220? (13)]	13.33*	1642	0.22			
Himachalol	13.33*	1642	[0.22]	15.37	2142	0.11
Unknown [m/z 41, 91 (96), 79 (88), 69 (82), 123 (80), 93 (80)... 220 (8)]	13.38	1646	0.28	17.52	2365	0.04
Unknown [m/z 43, 81 (84), 41 (64), 67 (62), 95 (58), 79 (58)... 204 (48), 220 (2)]	13.42	1649	0.20	15.60*	2165	0.38
Cedrenol analog	13.46	1653	0.34	16.62	2269	0.16
Cedr-8-en-13-ol	13.80	1681	0.34	17.06	2316	0.15
$\alpha$ -Bisabolol	13.84*	1684	0.14	15.60*	2165	[0.38]
$\alpha$ -Cedrenol	13.84*	1684	[0.14]	17.14	2325	0.08
Unknown [m/z 91, 105 (87), 123 (74), 135 (70), 107 (60), 79 (59)... 220 (13)]	13.96*	1694	0.26			
Mayurone?	13.96*	1694	[0.26]	17.25	2337	0.10
Thujopsenal	14.00	1697	0.25	16.02*	2207	[0.21]
Unknown [m/z 105, 69 (77), 91 (66), 119 (65), 111 (56), 107 (45), 55 (45)... 220? (2)]	14.06	1702	0.07	17.64	2379	0.05
Thujopsenal analog	14.38	1730	0.07	17.58	2372	0.22
Unknown [m/z 105, 91 (83), 79 (78), 135 (67), 107 (56), 67 (53)... 220 (9)]	14.50	1741	0.05			
Cuparenal	14.55	1745	0.04			
Unknown [m/z 105, 69 (79), 111 (66), 119 (60), 91 (50), 55 (41)... 203 (11), 220 (1)]	14.66*	1755	0.12			
Cedryl acetate?	14.66*	1755	[0.12]	14.76	2082	0.13
Unknown [m/z 91,	14.70	1758	0.05	18.59	2483	0.05

105 (74), 93 (67), 79 (59), 133 (54), 41 (47), 107 (46)...						
Unknown [m/z 189, 91 (48), 133 (40), 105 (40), 41 (34), 187 (34)... 220 (5)]	15.01	1785	0.07	18.81	2509	0.05
Unknown [m/z 148, 141 (99), 91 (74), 105 (52), 41 (42), 121 (42), 133 (37)... 218 (32)]	15.07*	1790	0.12	19.99	2646	0.05
Unknown [m/z 121, 136 (53), 91 (22), 93 (19), 79 (15), 105 (13)... 220 (3)]	15.07*	1790	[0.12]	18.75	2501	0.09
Nootkatone analog	15.35	1815	0.01	18.10	2429	0.02
<b>Total identified</b>		<b>94.99%</b>			<b>90.58%</b>	
<b>Total reported</b>		<b>96.84%</b>			<b>92.05%</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