

**Date :** January 07, 2019

**CERTIFICATE OF ANALYSIS – GC PROFILING**

**SAMPLE IDENTIFICATION**

**Internal code :** 18L20-PTH08-1-DM

**Customer identification :** Organic Vetiver - Haiti - V8010386R

**Type :** Essential oil

**Source :** *Vetiveria zizanioides* ct. Haiti

**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 :** December 21, 2018

Checked and approved by :

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

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*PHYSICOCHEMICAL DATA*

**Physical aspect:** Viscous yellow liquid

**Refractive index:** 1.5243 ± 0.0003 (20 °C)

*ISO 4716:2013 - ESSENTIAL OIL OF VETIVER - HAITI*

<b>Compound</b>	<b>Min. %</b>	<b>Max. %</b>	<b>Observed %</b>	<b>Complies?</b>
(E)-Isovalencenol	10	16	11	Yes
α-Vetivone	2	4	4	Yes
Khusimol	9	15	12	Yes
β-Vetivone	2	4	2	Yes
β-Vetivenene	0.7	3.0	1.9	Yes
<b>Refractive index</b>	1.5160	1.5270	1.5243	Yes

*CONCLUSION*

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

## ANALYSIS SUMMARY

Identification	DB-5 (%)	DB-WAX (%)	Classe
α-Pinene	tr	tr	Monoterpene
Limonene	tr	tr	Monoterpene
Coumaran	0.03	0.53	Simple phenolic
4-Vinylguaiaicol	0.02	0.13	Simple phenolic
α-Cubebene	0.03	0.02	Sesquiterpene
Unknown	0.11		Norsesquiterpene
Cyclosativene I	0.07*	0.06	Sesquiterpene
12-Norisoziza-5-ene	[0.07]*	0.05	Norsesquiterpene
α-Ylangene	0.16	0.14	Sesquiterpene
2-Norzizaene?	0.05		Norsesquiterpene
6-epi-Nigritene	0.06	0.06	Norsesquiterpene
Nigritene	0.06	0.10*	Norsesquiterpene
β-Elemene	0.05	0.13*	Sesquiterpene
Cyperene	0.03	0.05	Sesquiterpene
Acora-3,7(14)-diene	0.23*	0.16	Sesquiterpene
β-Funebrene	[0.23]*	[0.10]*	Sesquiterpene
Aristolene	0.02	0.01	Sesquiterpene
β-Caryophyllene	0.22*	[0.13]*	Sesquiterpene
β-Cedrene	[0.22]*	0.10	Sesquiterpene
β-Copaene	0.09	0.07	Sesquiterpene
6,9-Guaiadiene	0.55*	0.13	Sesquiterpene
Prezizaene	[0.55]*	0.36	Sesquiterpene
Khusimene	0.55	0.43	Sesquiterpene
Unknown	0.39	0.37	Sesquiterpene
Unknown	0.15		Sesquiterpene
Unknown	0.22	0.30	Sesquiterpene
Unknown	0.42	0.60*	Sesquiterpene
α-Amorphene	1.48	1.47	Sesquiterpene
α-Vetispirene	0.49*	0.81*	Sesquiterpene
cis-Eudesma-6,11-diene	[0.49]*	0.49	Sesquiterpene
β-Vetispirene	0.89	0.87	Sesquiterpene
δ-Selinene	0.65*	0.50	Sesquiterpene
γ-Amorphene	[0.65]*	0.13	Sesquiterpene
Bicyclosesquiphellandrene?	0.55	[0.60]*	Sesquiterpene
Eudesma-2,4(15),11-triene	0.12	0.32*	Sesquiterpene
Unknown	0.25		Sesquiterpene
δ-Amorphene	0.93	0.88	Sesquiterpene
γ-Cadinene	0.18	0.12	Sesquiterpene
Nootkatene	0.12	0.13	Sesquiterpene
Spirovetiva-1(10),7(11)-diene	0.98	[0.81]*	Sesquiterpene
δ-Cadinene	0.41	0.21	Sesquiterpene
γ-Vetivenene	0.41	[0.32]*	Sesquiterpene
11,12,13-trinor-trans-Eudesm-5-en-7-one	0.15		Terpenic ketone
α-Calacorene	0.30	0.20	Sesquiterpene
α-Elemol	2.34*	0.62	Sesquiterpenic alcohol
β-Vetivenene	[2.34]*	1.94	Sesquiterpene
cis-Eudesm-6-en-11-ol	1.88		Sesquiterpenic alcohol

Unknown	0.47		Oxygenated sesquiterpene
Unknown	0.84		Oxygenated sesquiterpene
Unknown	1.08	1.07	Sesquiterpene
Unknown	1.04*	0.23	Oxygenated sesquiterpene
Khusimone?	[1.04]*		Norsesquiterpenic ketone
Unknown	0.26	1.42	Oxygenated sesquiterpene
Unknown	0.18	0.20	Oxygenated sesquiterpene
Unknown	1.06	0.60	Sesquiterpene
Selin-6-en-4 $\alpha$ -ol?	1.94	1.58	Sesquiterpenic alcohol
Rosifoliol	1.58	0.52	Sesquiterpenic alcohol
Unknown	1.04		Unknown
Unknown	0.92		Unknown
Unknown	0.83	0.68	Oxygenated sesquiterpene
Unknown	0.68	1.37	Sesquiterpenic alcohol
Unknown	3.73*		Oxygenated sesquiterpene
Cyclocopacamphan-12-ol, epimer A	[3.73]*	1.34	Sesquiterpenic alcohol
Cyclocopacamphan-12-ol, epimer B	1.52	1.85	Sesquiterpenic alcohol
Unknown	1.35		Oxygenated sesquiterpene
Zizanone analog	0.62		Sesquiterpenic ketone
Zizanol	1.08	0.69	Sesquiterpenic alcohol
Khusiol	2.19*	1.78	Sesquiterpenic alcohol
epi-Zizanone	[2.19]*	0.65	Sesquiterpenic ketone
Zizanal?	0.61	0.44	Sesquiterpenic aldehyde
Unknown	1.62		Oxygenated sesquiterpene
Unknown	1.29	1.16	Oxygenated sesquiterpene
Unknown	0.53		Oxygenated sesquiterpene
Vetiselinenol	3.59*	0.87	Sesquiterpenic alcohol
$\alpha$ -Vetivol?	[3.59]*	4.07	Sesquiterpenic alcohol
Unknown	1.00		Oxygenated sesquiterpene
Oplopanone	0.18	11.46*	Sesquiterpenic alcohol
Khusimol	12.07	9.49*	Sesquiterpenic alcohol
Unknown	2.58		Oxygenated sesquiterpene
10-epi-Acora-3,11-dien-15-al?	0.70		Sesquiterpenic aldehyde
Unknown	0.21		Oxygenated sesquiterpene
$\beta$ -Costol	0.66	0.78	Sesquiterpenic alcohol
( <i>E</i> )-Isovalencenol	11.28	[11.46]*	Sesquiterpenic alcohol
Nootkatone	2.04*	[9.49]*	Sesquiterpenic ketone
Unknown	[2.04]*	2.21	Oxygenated sesquiterpene
Unknown	1.55		Oxygenated sesquiterpene
( <i>Z</i> )-Isovalencenal	1.01	3.60	Sesquiterpenic aldehyde
$\beta$ -Vetivone	2.02	3.14	Sesquiterpenic ketone
Zizanoic acid	2.13	1.46	Sesquiterpenic acid
( <i>E</i> )-Isovalencenal	1.12	1.22	Sesquiterpenic aldehyde
$\alpha$ -Vetivone	4.20	4.38	Sesquiterpenic ketone
$\beta$ -Cyclodihydrocostunolide?	0.07		Sesquiterpenic lactone
<b>Total identified</b>	<b>69.45%</b>	<b>61.14%</b>	

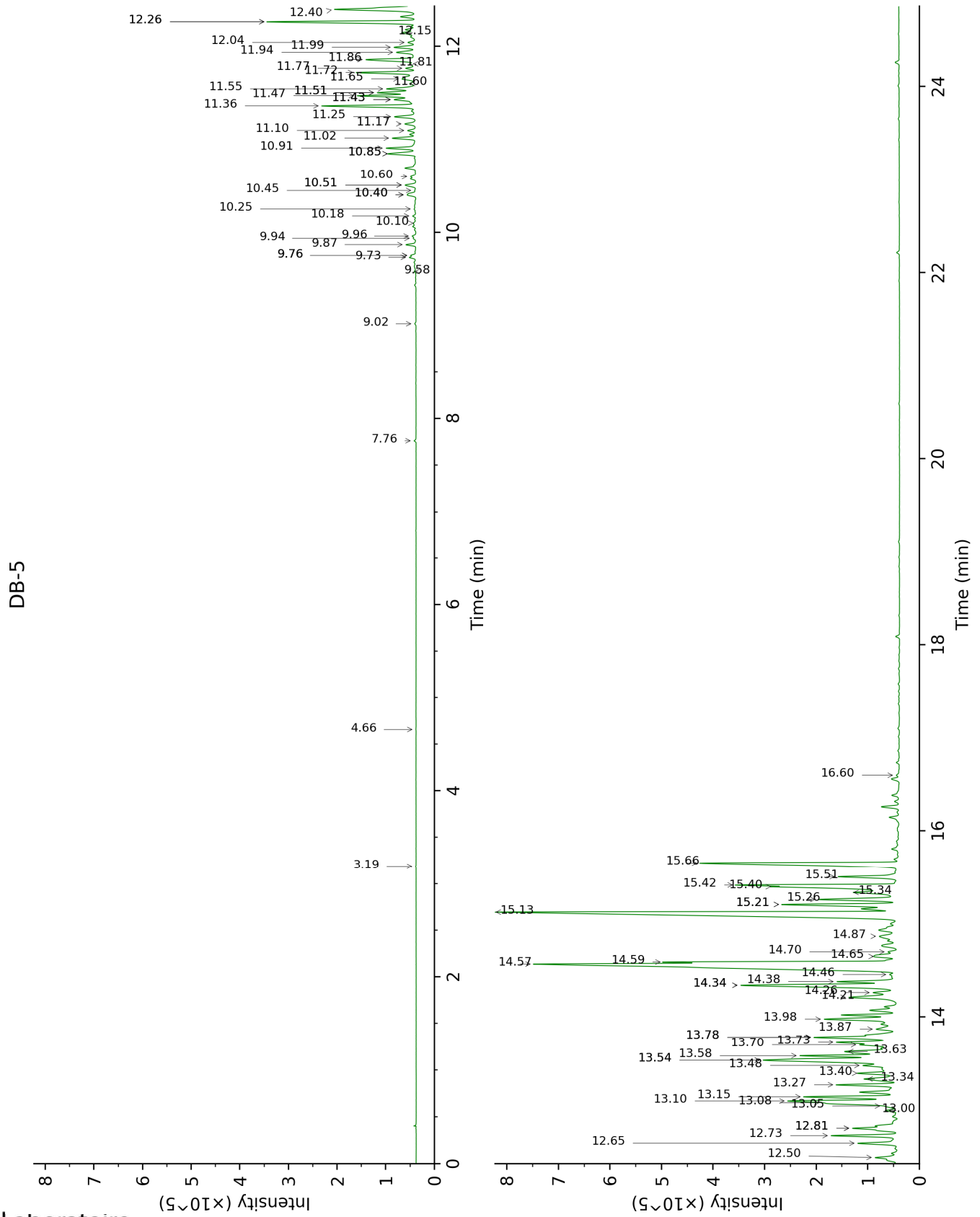
\*: Two or more compounds are coeluting on this column

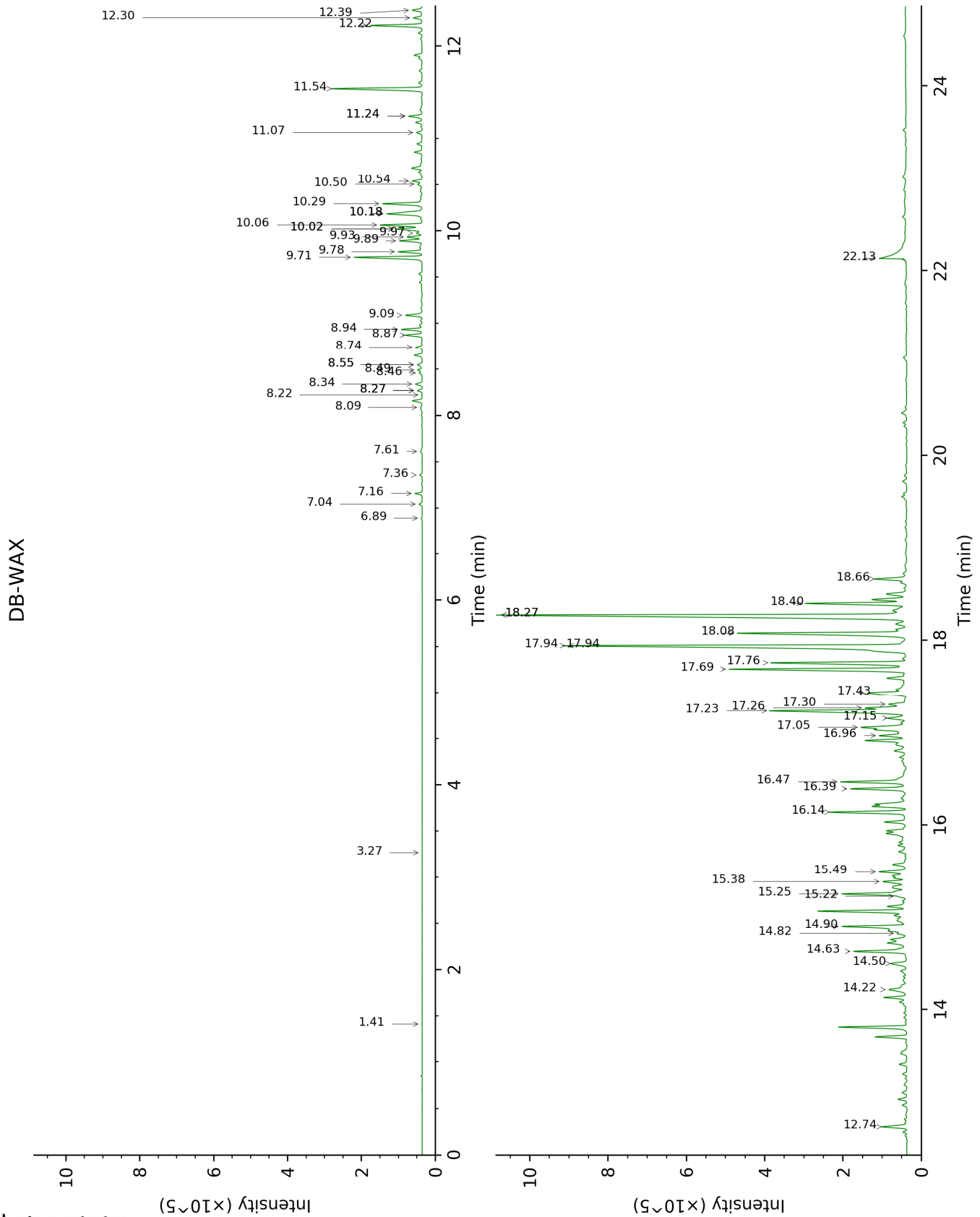
[xx]: Duplicate percentage due to coelutions, not taken account in the identified total

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	%
α-Pinene	3.19	929	tr	1.41	990	tr
Limonene	4.66	1024	tr	3.27	1156	tr
Coumaran	7.76	1225	0.03	17.15	2328	0.53
4-Vinylguaiaicol	9.02	1305	0.02	15.22	2128	0.13
α-Cubebene	9.58	1345	0.03	6.89	1420	0.02
Unknown [m/z 145, 188 (95), 117 (91), 173 (80), 91 (65), 131 (64)]	9.73	1356	0.11			
Cyclosativene I	9.76*	1358	0.07	7.04	1431	0.06
12-Norisoziza-5-ene	9.76*	1358	[0.07]	7.36	1454	0.05
α-Ylangene	9.87	1366	0.16	7.16	1440	0.14
2-Norzizaene?	9.94	1371	0.05			
6-epi-Nigritene	9.96	1372	0.06	8.09	1509	0.06
Nigritene	10.10	1382	0.06	8.27*	1523	0.10
β-Elemene	10.18	1388	0.05	8.55*	1544	0.13
Cyperene	10.25	1393	0.03	7.61	1473	0.05
Acora-3,7(14)-diene	10.40*	1404	0.23	8.34	1528	0.16
β-Funebrene	10.40*	1404	[0.23]	8.27*	1523	[0.10]
Aristolene	10.45	1407	0.02	8.22	1519	0.01
β-Caryophyllene	10.51*	1412	0.22	8.55*	1544	[0.13]
β-Cedrene	10.51*	1412	[0.22]	8.49	1540	0.10
β-Copaene	10.60	1419	0.09	8.46	1538	0.07
6,9-Guaiadiene	10.85*	1438	0.55	8.74	1559	0.13
Prezizaene	10.85*	1438	[0.55]	8.87	1569	0.36
Khusimene	10.91	1442	0.55	8.94	1574	0.43
Unknown [m/z 105, 161 (78), 93 (70), 133 (67), 91 (66), 204 (63), 119 (41)]	11.02	1450	0.39	9.09	1586	0.37
Unknown [m/z 119, 190 (99), 175 (95), 105 (71), 91 (59), 120 (57)... 204 (2)]	11.10	1456	0.15			
Unknown [m/z 119, 120 (31), 83 (23), 105 (22), 91 (21), 81 (18)... 202 (9)]	11.17	1462	0.22	9.93	1654	0.30
Unknown [m/z 145, 202 (85), 159 (64), 187 (39), 131 (35), 117 (34)]	11.25	1467	0.42	10.02*	1661	0.60
α-Amorphene	11.36	1476	1.48	9.72	1636	1.47
α-Vetispirene	11.43*	1481	0.49	10.18*	1674	0.81
cis-Eudesma-6,11-diene	11.43*	1481	[0.49]	9.89	1650	0.49
β-Vetispirene	11.47	1484	0.89	10.29	1683	0.87
δ-Selinene	11.50*	1487	0.65	9.78	1641	0.50
γ-Amorphene	11.50*	1487	[0.65]	9.98	1657	0.13
Bicyclosesquiphellandrene?	11.55	1490	0.55	10.02*	1661	[0.60]
Eudesma-2,4(15),11-triene	11.60	1494	0.12	11.24*	1762	0.32
Unknown [m/z 131, 145 (59), 202 (55), 187 (31), 91 (26), 159 (24)]	11.65	1498	0.25			



δ-Amorphene	11.72	1503	0.93	10.06	1664	0.88
γ-Cadinene	11.77	1506	0.18	10.50	1700	0.12
Nootkatene	11.81	1510	0.12	11.07	1748	0.13
Spirovetiva-1(10),7(11)-diene	11.86	1514	0.98	10.18*	1674	[0.81]
δ-Cadinene	11.94	1520	0.41	10.54	1703	0.21
γ-Vetivenene	11.99	1524	0.41	11.24*	1762	[0.32]
11,12,13-trinor-trans-Eudesm-5-en-7-one	12.04	1528	0.15			
α-Calacorene	12.15	1536	0.30	12.30	1855	0.20
α-Elemol	12.26*	1546	2.34	14.22	2031	0.62
β-Vetivenene	12.26*	1546	[2.34]	11.54	1788	1.94
cis-Eudesm-6-en-11-ol	12.40	1556	1.88			
Unknown [m/z 81, 200 (55), 143 (36), 93 (33), 91 (32), 185 (31), 129 (27), 128 (21)...]	12.50	1564	0.47			
Unknown [m/z 59, 43 (56), 205 (47), 91 (41), 220 (32), 105 (30), 147 (21)]	12.65	1576	0.84			
Unknown [m/z 202, 187 (63), 145 (43), 159 (34), 131 (29), 91 (22), 117 (20)]	12.73	1583	1.08	12.22	1847	1.07
Unknown [m/z 161, 119 (78), 105 (75), 120 (72), 43 (64)... 218 (4)]	12.81*	1589	1.04	12.39	1862	0.23
Khusimone?	12.81*	1589	[1.04]			
Unknown [m/z 43, 81 (97), 135 (71), 95 (62), 204 (61), 71 (59), 207 (56)... 222 (3)]	13.00	1604	0.26	14.63	2070	1.42
Unknown [m/z 179, 161 (66), 119 (44), 95 (38), 105 (35)... 204 (24), 222 (1)]	13.05	1608	0.18	14.82	2089	0.20
Unknown [m/z 187, 202 (86), 145 (25), 131 (19), 105 (16), 188 (15)]	13.08	1611	1.06	12.74	1893	0.60
Selin-6-en-4α-ol?	13.10	1612	1.94	14.90	2096	1.58
Rosifolol	13.15	1616	1.58	14.50	2058	0.52
Unknown [m/z 145, 59 (97), 161 (87), 218 (76), 43 (76), 179 (63)...]	13.27	1627	1.04			
Unknown [m/z 43, 91 (87), 71 (83), 93 (77), 95 (75), 135 (74)...]	13.34	1632	0.92			
Unknown [m/z 121, 107 (69), 93 (64), 79 (60), 177 (59), 136 (58), 91 (57), 41 (56)... 220 (21)]	13.40	1637	0.83	15.49	2155	0.68
Unknown cadinol analog II [m/z 95, 121 (73), 43 (57), 79 (43), 161 (43), 109 (40)... 204 (35), 222 (2)]	13.48	1644	0.68	15.25	2131	1.37

Unknown [m/z 161, 59 (67), 95 (45), 93 (40), 105 (40), 149 (39), 81 (39), 43 (38), 204 (37)... 220 (5)]	13.54*	1649	3.73			
Cyclocopacamphan-12-ol, epimer A	13.54*	1649	[3.73]	16.39	2247	1.34
Cyclocopacamphan-12-ol, epimer B	13.58	1653	1.52	16.47	2255	1.85
Unknown [m/z 84, 119 (77), 41 (72), 81 (68), 95 (68), 93 (68), 109 (63)... 222 (17)]	13.63	1656	1.35			
Zizanone analog	13.70	1662	0.62			
Zizanol	13.73	1664	1.08	16.96	2307	0.69
Khusiol	13.78*	1669	2.19	16.14	2221	1.78
epi-Zizanone	13.78*	1669	[2.19]	15.38	2144	0.65
Zizanal?	13.87	1677	0.61	17.30	2344	0.44
Unknown [m/z 189, 43 (91), 81 (89), 105 (81), 91 (74), 93 (74), 133 (67), 41 (67)... 222 (37)]	13.98	1686	1.62			
Unknown [m/z 189, 159 (82), 133 (44), 91 (29), 105 (29), 205 (25)... 220 (13)]	14.21	1705	1.29	17.05	2317	1.16
Unknown [m/z 204, 189 (99), 43 (83), 161 (75), 105 (55), 91 (44), 119 (33)... 220 (13)]	14.26	1709	0.53			
Vetiselinenol	14.34*	1716	3.59	17.26	2339	0.87
$\alpha$ -Vetivol?	14.34*	1716	[3.59]	17.69	2385	4.07
Unknown [m/z 136, 121 (98), 137 (90), 119 (68), 107 (55), 135 (55)... 202 (30), 220 (27)]	14.38	1720	1.00			
Oplopanone	14.46	1726	0.18	18.27*	2450	11.46
Khusimol	14.57	1736	12.07	17.94*	2413	9.49
Unknown [m/z 189, 187 (29), 159 (23), 43 (20), 133 (16)...]	14.59	1738	2.58			
10-epi-Acora-3,11-dien-15-al?	14.65	1743	0.70			
Unknown [m/z 91, 105 (89), 79 (84), 93 (77), 107 (67), 189 (64), 145 (62), 119 (61)... 220 (16)...]	14.70	1747	0.21			
$\beta$ -Costol	14.87	1762	0.66	18.66	2494	0.78
(E)-Isovalencenol	15.13	1784	11.28	18.27*	2450	[11.46]
Nootkatone	15.21*	1792	2.04	17.94*	2413	[9.49]
Unknown [m/z 120, 121 (93), 93 (85), 105 (74), 119 (68), 91 (58), 123 (49)... 220 (8)]	15.21*	1792	[2.04]	18.40	2464	2.21
Unknown [m/z 189, 91 (46),	15.26	1796	1.55			

95 (45), 105 (42), 220 (42)]						
(Z)-Isovalencenal	15.34	1803	1.01	17.23	2336	3.60
β-Vetivone	15.40	1808	2.02	17.76	2393	3.14
Zizanoic acid	15.42	1810	2.13	22.13	2918	1.46
(E)-Isovalencenal	15.51	1818	1.12	17.43	2357	1.22
α-Vetivone	15.66	1832	4.20	18.08	2428	4.38
β-Cyclodihydrocostunolide?	16.60	1918	0.07			
<b>Total identified</b>		<b>69.45%</b>			<b>61.14%</b>	
<b>Total reported</b>		<b>88.49%</b>			<b>70.76%</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

R.T.: Retention time (minutes)

R.I.: Retention index