

Date : April 08, 2021

CERTIFICATE OF ANALYSIS – GC PROFILING

SAMPLE IDENTIFICATION

**Internal code** : 21C30-PTH01

**Customer identification** : Vetiver - Haiti - V30109208R

**Type** : Essential oil

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

**Customer** : Plant Therapy

ANALYSIS

**Method**: PC-MAT-014  - 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** : April 07, 2021

Checked and approved by :

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

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*PHYSICOCHEMICAL DATA*

**Physical aspect:** Dark orange viscous liquid

**Refractive index:** 1.5243 ± 0.0003 (20 °C; method PC-MAT-016)

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

<b>Compound</b>	<b>Min. %</b>	<b>Max. %</b>	<b>Observed %</b>	<b>Complies?</b>
β-Vetivenene	0.7	3.0	2.3	Yes
β-Vetivone	2	4	3	Yes
Khusimol	9	15	10	Yes
α-Vetivone	2	4	4	Yes
(E)-Isovalencenol	10	16	10	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 – CONSOLIDATED CONTENTS

New readers of similar reports are encouraged to read table footnotes at least once.

Identification	%	Class
Ethanol	0.02	Aliphatic alcohol
$\alpha$ -Pinene	0.01	Monoterpene
$\alpha$ -Cubebene	0.02	Sesquiterpene
Unknown	0.01	Norsesquiterpene
Cyclosativene I	0.09	Sesquiterpene
12-Norisoziza-5-ene	0.05	Norsesquiterpene
$\alpha$ -Ylangene	0.13	Sesquiterpene
$\alpha$ -Copaene	0.01	Sesquiterpene
2-Norzizaene?	0.03	Norsesquiterpene
6-epi-Nigritene	0.05	Norsesquiterpene
Nigritene	0.03	Norsesquiterpene
$\beta$ -Elemene	0.02	Sesquiterpene
Cyperene	0.05	Sesquiterpene
Acora-3,7(14)-diene	0.12	Sesquiterpene
$\alpha$ -Cedrene	0.02	Sesquiterpene
Aristolene	0.01	Sesquiterpene
$\beta$ -Caryophyllene	0.14	Sesquiterpene
$\beta$ -Copaene	0.01	Sesquiterpene
Prezizaene	0.32	Sesquiterpene
6,9-Guaiadiene	0.13	Sesquiterpene
Khusimene	0.50	Sesquiterpene
Selina-4(15),7-diene	0.33	Sesquiterpene
Unknown	0.13	Sesquiterpene
Unknown	0.22	Sesquiterpene
Unknown	0.40	Sesquiterpene
$\alpha$ -Amorphene	1.40	Sesquiterpene
Unknown	0.08	Unknown
$\alpha$ -Vetispirene	0.57	Sesquiterpene
$\beta$ -Vetispirene	1.08	Sesquiterpene
$\delta$ -Selinene	0.44	Sesquiterpene
$\gamma$ -Amorphene	0.12	Sesquiterpene
Bicyclosesquiphellandrene?	0.54	Sesquiterpene
Eudesma-2,4(15),11-triene	0.29	Sesquiterpene
Unknown	0.17	Sesquiterpene
$\delta$ -Guaiene	0.77	Sesquiterpene
$\gamma$ -Cadinene	0.29	Sesquiterpene
Nootkatene	0.08	Sesquiterpene
Spirovetiva-1(10),7(11)-diene	0.88	Sesquiterpene
$\delta$ -Cadinene	0.38	Sesquiterpene
$\gamma$ -Vetivenene	0.26	Sesquiterpene
11,12,13-trinor- <i>trans</i> -Eudesm-5-en-7-one	0.28	Terpenic ketone
Selina-4(15),7(11)-diene	0.15	Sesquiterpene
Selina-3,7(11)-diene	0.17	Sesquiterpene
$\beta$ -Vetivenene	2.33	Sesquiterpene
$\alpha$ -Elemol	0.56	Sesquiterpenic alcohol

<i>cis</i> -Eudesm-6-en-11-ol	1.53	Sesquiterpenic alcohol
Unknown	0.43	Oxygenated sesquiterpene
Gynuradienol?	0.74	Sesquiterpenic alcohol
Unknown	0.89	Sesquiterpene
Khusimone	1.22	Norsesquiterpenic ketone
Unknown	0.19	Oxygenated sesquiterpene
Junenol	0.70	Sesquiterpenic alcohol
Selin-6-en-4 $\alpha$ -ol isomer	1.69	Sesquiterpenic alcohol
Unknown	0.44	Sesquiterpene
Unknown	0.87	Oxygenated sesquiterpene
Unknown	1.24	Unknown
Unknown	1.22	Unknown
Unknown	0.22	Oxygenated sesquiterpene
Cyclocopacamphan-12-ol, epimer A	1.45	Sesquiterpenic alcohol
Unknown	1.70	Sesquiterpenic alcohol
Unknown	0.71	Oxygenated sesquiterpene
Cyclocopacamphan-12-ol, epimer B	1.69	Sesquiterpenic alcohol
Unknown	1.63	Oxygenated sesquiterpene
Zizanone analog	0.72	Sesquiterpenic ketone
Zizanol	1.06	Sesquiterpenic alcohol
Khusiol	1.60	Sesquiterpenic alcohol
epi-Zizanone	0.61	Sesquiterpenic ketone
Zizanal	0.41	Sesquiterpenic aldehyde
Unknown	1.53	Oxygenated sesquiterpene
$\alpha$ -Costal?	0.90	Sesquiterpenic aldehyde
Unknown	1.46	Oxygenated sesquiterpene
Unknown	0.47	Oxygenated sesquiterpene
Vetiselinenol	3.89	Sesquiterpenic alcohol
$\alpha$ -Vetivol?	0.89	Sesquiterpenic alcohol
Oplopanone	0.27	Sesquiterpenic alcohol
Unknown	0.04	Oxygenated sesquiterpene
Khusimol	9.52	Sesquiterpenic alcohol
Unknown	3.64	Oxygenated sesquiterpene
10-epi-Acora-3,11-dien-15-al?	0.70	Sesquiterpenic aldehyde
( <i>E</i> )-Isovalencenol	10.32	Sesquiterpenic alcohol
Unknown	1.80	Oxygenated sesquiterpene
Unknown	1.34	Oxygenated sesquiterpene
Unknown	0.12	Oxygenated sesquiterpene
( <i>Z</i> )-Isovalencenal	0.64	Sesquiterpenic aldehyde
$\beta$ -Vetivone	3.02	Sesquiterpenic ketone
Zizanoic acid	1.30	Sesquiterpenic acid
( <i>E</i> )-Isovalencenal	1.08	Sesquiterpenic aldehyde
$\alpha$ -Vetivone	4.15	Sesquiterpenic ketone
( <i>E</i> )-Isovalencenyl acetate?	0.02	Sesquiterpenic ester
Isovalencenal isomer II?	0.18	Sesquiterpenic aldehyde
Isovalencenal isomer I?	0.28	Sesquiterpenic aldehyde
$\beta$ -Cyclodihydrocostunolide?	0.16	Sesquiterpenic lactone
<b>Consolidated total</b>	<b>84.35%</b>	

Note: no correction factor was applied

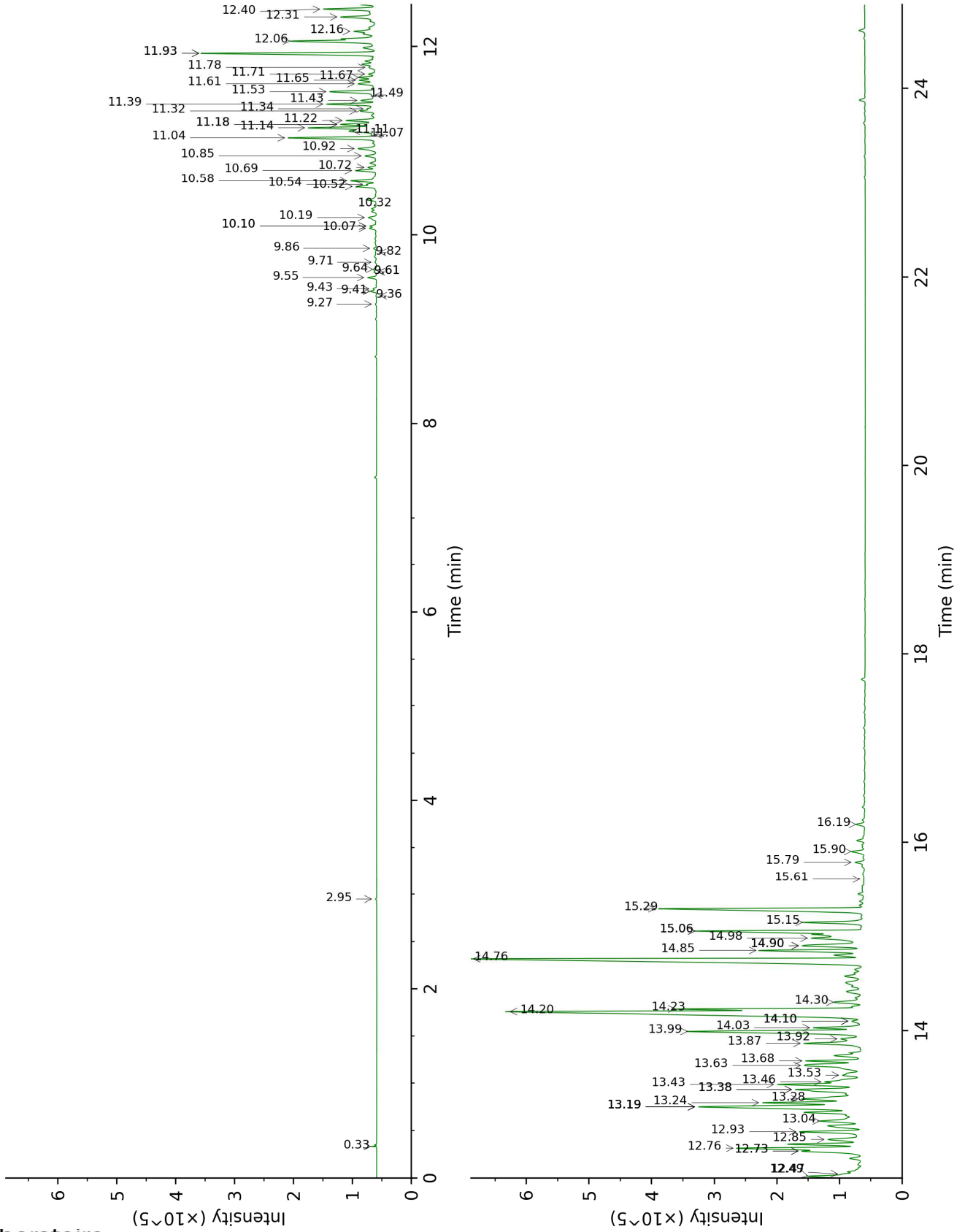
**About "consolidated" data:** The table above presents the breakdown of the sample volatile constituents after applying an algorithm to collapse data acquired from the multi-columns system of PhytoChemia into a single set of consolidated contents. In case of discrepancies

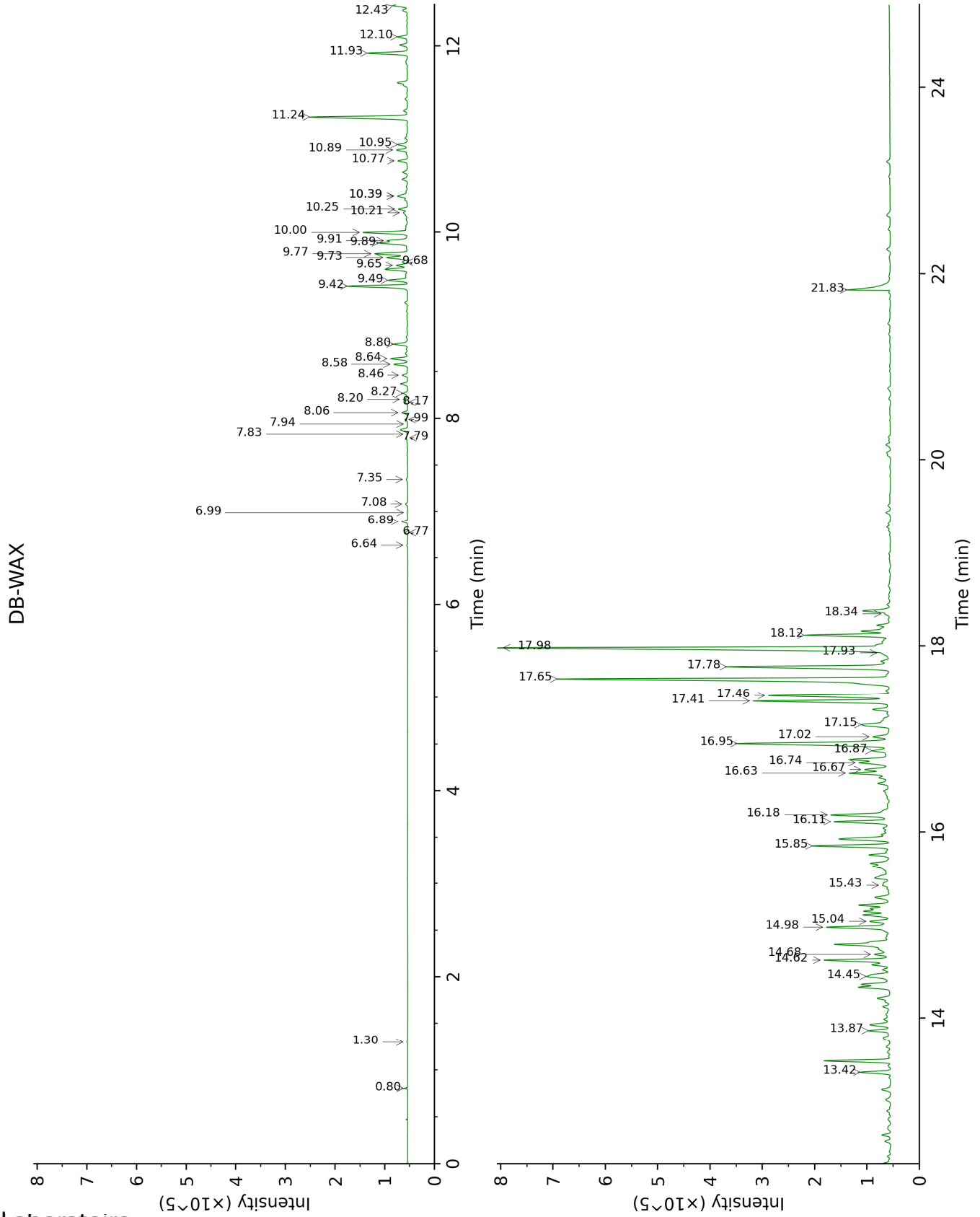
between columns, the algorithm is set to prioritize data from the most standard DB-5 column, and smallest values so as to avoid overestimating individual content. This process is semi-automatic. Advanced users are invited to consult the "Full analysis data" table after the chromatograms in this report to access the full untreated data and perform their own calculations if needed.

**Unknowns:** Unknown compounds' mass spectral data is presented in the "Full analysis data" table. The occurrence of unknown compounds is to be expected in many samples, and does not denote particular problems unless noted otherwise in the conclusion.

This page was intentionally left blank. The following pages present the complete data of the analysis.

DB-5







FULL ANALYSIS DATA

Identification	Column DB-5			Column DB-WAX		
	R.T	R.I	%	R.T	R.I	%
Ethanol	0.33	499	0.02	0.80	908	0.03
α-Pinene	2.95	931	0.01	1.30	993	0.01
α-Cubebene	9.27	1348	0.02	6.64	1421	0.02
Unknown [m/z 145, 188 (95), 117 (91), 173 (80), 91 (65), 131 (64)]	9.36	1354	0.01			
Cyclosativene I	9.41	1358	0.09	6.77	1431	0.05
12-Norisoziza-5-ene	9.43	1359	0.05	7.08	1455	0.05
α-Ylangene	9.55	1368	0.13	6.89	1440	0.13
α-Copaene	9.61*	1372	0.04	6.99	1448	0.01
2-Norzizaene?	9.61*	1372	[0.04]			
6-epi-Nigritene	9.64	1374	0.05	7.79	1508	0.06
Nigritene	9.71	1379	0.03	7.99	1523	0.07
β-Elemene	9.82	1387	0.02	8.27	1545	0.12
Cyperene	9.86	1390	0.05	7.35	1474	0.05
Acora-3,7(14)-diene	10.07	1405	0.12	8.06	1529	0.14
α-Cedrene	10.10*	1406	0.10	7.83	1511	0.02
Aristolene	10.10*	1406	[0.10]	7.94	1519	0.01
β-Caryophyllene	10.19	1413	0.14	8.20	1540	0.10
β-Copaene	10.32	1423	0.01	8.17	1538	0.06
Prezizaene	10.52	1438	0.32	8.58	1570	0.32
6,9-Guaiadiene	10.54	1440	0.13	8.46	1560	0.12
Khusimene	10.58	1442	0.50	8.64	1574	0.38
Selina-4(15),7-diene	10.69	1451	0.33	8.80	1587	0.33
Unknown [m/z 119, 190 (99), 175 (95), 105 (71), 91 (59), 120 (57)... 204 (2)]	10.72	1454	0.13			
Unknown [m/z 119, 120 (31), 83 (23), 105 (22), 91 (21), 81 (18)... 202 (9)]	10.85	1463	0.22	9.65	1655	0.25
Unknown [m/z 145, 202 (85), 159 (64), 187 (39), 131 (35), 117 (34)]	10.92	1468	0.40	9.73	1662	0.53
α-Amorphene	11.04	1477	1.40	9.42	1637	1.39
Unknown [m/z 160, 145 (78), 91 (37), 108 (31), 105 (28)...]	11.07	1479	0.08			
α-Vetispirene	11.11	1482	0.57	9.89†	1675	1.12
β-Vetispirene	11.14	1485	1.08	10.00	1684	1.01
δ-Selinene	11.18*	1487	0.59	9.49	1642	0.44
γ-Amorphene	11.18*	1487	[0.59]	9.68	1658	0.12
Bicyclosesquiphellandrene?	11.22	1490	0.54			
Eudesma-2,4(15),11-triene	11.32	1498	0.29	10.95	1764	0.26
Unknown [m/z 131, 145 (59), 202 (55), 187 (31), 91 (26), 159 (24)]	11.34	1500	0.17			
δ-Guaiene	11.39	1504	0.77	9.77	1665	0.76
γ-Cadinene	11.43	1506	0.29	10.21	1701	0.15

Nootkatene	11.49	1511	0.08	10.77	1749	0.23
Spirovetiva-1(10),7(11)-diene	11.52	1514	0.88	9.91†	1677	[1.12]
δ-Cadinene	11.61	1520	0.38	10.25	1705	0.21
γ-Vetivenene	11.65	1523	0.26	10.89	1759	0.25
11,12,13-trinor-trans-Eudesm-5-en-7-one	11.67	1526	0.28			
Selina-4(15),7(11)-diene	11.71	1528	0.15	10.39*	1716	0.30
Selina-3,7(11)-diene	11.78	1534	0.17	10.39*	1716	[0.30]
β-Vetivenene	11.93*	1546	2.75	11.24	1790	2.33
α-Elemol	11.93*	1546	[2.75]	13.87	2029	0.56
cis-Eudesm-6-en-11-ol	12.06	1556	1.53			
Unknown [m/z 81, 200 (55), 143 (36), 93 (33), 91 (32), 185 (31), 129 (27), 128 (21)...]	12.16	1564	0.43			
Gynuradienol?	12.31	1576	0.74			
Unknown [m/z 202, 187 (63), 145 (43), 159 (34), 131 (29), 91 (22), 117 (20)]	12.40	1582	0.89	11.92	1850	0.91
Khusimone	12.47	1588	1.22			
Unknown [m/z 161, 119 (78), 105 (75), 120 (72), 43 (64)... 218 (4)]	12.49	1589	0.19	12.10	1865	0.23
Junenol	12.73*†	1609	3.39	13.42	1986	0.70
Selin-6-en-4α-ol isomer	12.73*†	1609	[3.39]	14.62	2103	1.69
Unknown [m/z 187, 202 (86), 145 (25), 131 (19), 105 (16), 188 (15)]	12.76†	1611	[3.39]	12.43	1895	0.44
Unknown [m/z 59, 149 (94), 43 (82), 205 (65)... 220 (6)]	12.85	1619	0.87			
Unknown [m/z 145, 59 (97), 161 (87), 218 (76), 43 (76), 179 (63)...]	12.93	1626	1.24			
Unknown [m/z 43, 91 (87), 71 (83), 93 (77), 95 (75), 135 (74)...]	13.04	1635	1.22			
Unknown [m/z 202, 187 (89), 121 (45), 105 (42), 93 (40), 95 (38)...]	13.19*	1647	3.99	15.42	2184	0.22
Cyclocopacamphan-12-ol, epimer A	13.19*	1647	[3.99]	16.11	2255	1.45
Unknown cadinol analog II [m/z 95, 121 (73), 43 (57), 79 (43), 161 (43), 109 (40)... 204 (35), 222 (2)]	13.19*	1647	[3.99]	14.98	2138	1.70
Unknown [m/z 161, 59 (67), 95 (45), 93 (40), 105 (40), 149 (39), 81 (39), 43 (38), 204 (37)... 220 (5)]	13.19*	1647	[3.99]	14.45	2086	0.71
Cyclocopacamphan-12-ol, epimer B	13.24	1651	1.69	16.18	2262	1.70

Unknown [m/z 84, 119 (77), 41 (72), 81 (68), 95 (68), 93 (68), 109 (63)... 222 (17)]	13.28	1654	1.63			
Zizanone analog	13.38*	1662	1.78			
Zizanol	13.38*	1662	[1.78]	16.63	2309	1.06
Khusiol	13.43	1667	1.60	15.85	2228	1.88
epi-Zizanone	13.46	1669	0.61	15.04	2144	0.56
Zizanal	13.53	1675	0.41	17.02	2351	0.60
Unknown [m/z 189, 43 (91), 81 (89), 105 (81), 91 (74), 93 (74), 133 (67), 41 (67)... 222 (37)]	13.63	1683	1.53			
α-Costal?	13.68	1687	0.90	14.68	2109	0.43
Unknown [m/z 189, 159 (82), 133 (44), 91 (29), 105 (29), 205 (25)... 220 (13)]	13.87	1703	1.46	16.74	2321	0.87
Unknown [m/z 204, 189 (99), 43 (83), 161 (75), 105 (55), 91 (44), 119 (33)... 220 (13)]	13.92	1707	0.47			
Vetiselinenol	13.99	1714	3.89	16.95	2343	4.77
α-Vetivol?	14.03	1718	0.89	17.41	2393	3.28
Oplopanone	14.10*	1724	0.31	17.93	2451	0.27
Unknown [m/z 136, 121 (98), 137 (90), 119 (68), 107 (55), 135 (55)... 202 (30), 220 (27)]	14.10*	1724	[0.31]			
Khusimol	14.20†	1732	13.16	17.65	2420	9.52
Unknown [m/z 189, 187 (29), 159 (23), 43 (20), 133 (16)...]	14.23†	1735	[13.16]			
10-epi-Acora-3,11-dien-15-al?	14.30	1741	0.70			
(E)-Isovalencenol	14.76	1781	10.32	17.98	2457	10.37
Unknown [m/z 120, 121 (93), 93 (85), 105 (74), 119 (68), 91 (58), 123 (49)... 220 (8)]	14.85	1788	1.80	18.12	2472	1.94
Unknown [m/z 189, 91 (46), 95 (45), 105 (42), 220 (42)]	14.90*	1793	1.46			
Unknown [m/z 202, 187 (91), 93 (70), 91 (69), 105 (67)...]	14.90*	1793	[1.46]	18.34	2498	0.12
(Z)-Isovalencenal	14.98†	1800	4.97	16.87	2335	0.64
β-Vetivone	15.06*†	1806	[4.97]	17.46	2399	3.02
Zizanoic acid	15.06*†	1806	[4.97]	21.83	2923	1.30
(E)-Isovalencenal	15.15	1815	1.08	17.15	2365	1.04
α-Vetivone	15.29	1828	4.15	17.78	2434	4.33
(E)-Isovalencenyl acetate?	15.61	1857	0.02	16.67	2313	0.73
Isovalencenal isomer II?	15.79	1873	0.18			
Isovalencenal isomer I?	15.90	1884	0.28			

$\beta$ - Cyclodihydrocostunolide?	16.19	1910	0.16	
<b>Total identified</b>		<b>72.05%</b>		<b>60.54%</b>
<b>Total reported</b>		<b>84.79%</b>		<b>68.47%</b>

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

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

†: Peaks apexes were resolved, but peaks overlapped and were summed for analysis

Note: no correction factor was applied

R.T.: Retention time (minutes)

R.I.: Retention index