

**Date :** February 01, 2021

**CERTIFICATE OF ANALYSIS – GC PROFILING**

*SAMPLE IDENTIFICATION*

**Internal code :** 21A29-PTH01


**Customer identification :** Bergamot (Bergapten Free) - B301102011R

**Type :** Essential oil

**Source :** *Citrus aurantium* var. *bergamia*

**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 :** January 31, 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:** Clear liquid

**Refractive index:** 1.4631 ± 0.0003 (20 °C; method PC-MAT-016)

NFT 75-215:2009 - OIL OF BERGAMOT - ITALY

Compound	Min. %	Max. %	Observed %	Complies?
β-Pinene	5.5	9.5	7.0	Yes
Limonene	30	45	39	Yes
γ-Terpinene	6	10	6	Yes
Linalool	3	15	11	Yes
Linalyl acetate	22	36	31	Yes
Geranial	0.25	0.50	0.09	No
β-Bisabolene	0.3	0.6	0	No
<b>Refractive index</b>	1.4650	1.4700	1.4631	No

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
Tricyclene	0.01	Monoterpene
$\alpha$ -Thujene	0.10	Monoterpene
$\alpha$ -Pinene	1.24	Monoterpene
Camphene	0.03	Monoterpene
Thuja-2,4(10)-diene	0.01	Monoterpene
Sabinene	0.97	Monoterpene
$\beta$ -Pinene	6.97	Monoterpene
Myrcene	0.86	Monoterpene
$\alpha$ -Phellandrene	0.01	Monoterpene
Octanal	0.08	Aliphatic aldehyde
$\Delta^3$ -Carene	0.04	Monoterpene
$\alpha$ -Terpinene	0.04	Monoterpene
para-Cymene	0.48	Monoterpene
Limonene	38.95	Monoterpene
$\beta$ -Phellandrene	0.30	Monoterpene
(Z)- $\beta$ -Ocimene	0.02	Monoterpene
(E)- $\beta$ -Ocimene	0.05	Monoterpene
$\gamma$ -Terpinene	5.85	Monoterpene
cis-Sabinene hydrate	0.03	Monoterpenic alcohol
cis-Linalool oxide (fur.)	0.04	Monoterpenic alcohol
Octanol	0.02	Aliphatic alcohol
Terpinolene	0.07	Monoterpene
trans-Linalool oxide (fur.)	0.04	Monoterpenic alcohol
trans-Sabinene hydrate	0.01	Monoterpenic alcohol
Linalool	11.00	Monoterpenic alcohol
Nonanal	0.04	Aliphatic aldehyde
trans-para-Mentha-2,8-dien-1-ol	0.02	Monoterpenic alcohol
cis-Limonene oxide	0.02	Monoterpenic ether
trans-Limonene oxide	0.01	Monoterpenic ether
Camphor	0.03	Monoterpenic ketone
Citronellal	0.01	Monoterpenic aldehyde
Borneol	0.01	Monoterpenic alcohol
Terpinen-4-ol	0.02	Monoterpenic alcohol
$\alpha$ -Terpineol	0.04	Monoterpenic alcohol
Octyl acetate	0.14	Aliphatic ester
Nerol	0.01	Monoterpenic alcohol
Neral	0.09	Monoterpenic aldehyde
Linalyl acetate	30.67	Monoterpenic ester
Geranial	0.09	Monoterpenic aldehyde
(trans?)-Linalool oxide acetate (fur.)?	0.17	Monoterpenic ester
Bornyl acetate	0.01	Monoterpenic ester
Hodiendiol derivative	0.04	Oxygenated monoterpene
Unknown	0.03	Monoterpenic ester
Unknown	0.02	Oxygenated monoterpene
Neryl acetate	0.39	Monoterpenic ester

Geranyl acetate	0.38	Monoterpenic ester
$\beta$ -Caryophyllene	0.08	Sesquiterpene
<i>cis</i> - $\alpha$ -Bergamotene	0.09	Sesquiterpene
<i>trans</i> - $\alpha$ -Bergamotene	0.02	Sesquiterpene
$\beta$ -Bisabolene	0.02	Sesquiterpene
Caryophyllene oxide	0.01	Sesquiterpenic ether
<b>Consolidated total</b>	<b>99.65%</b>	

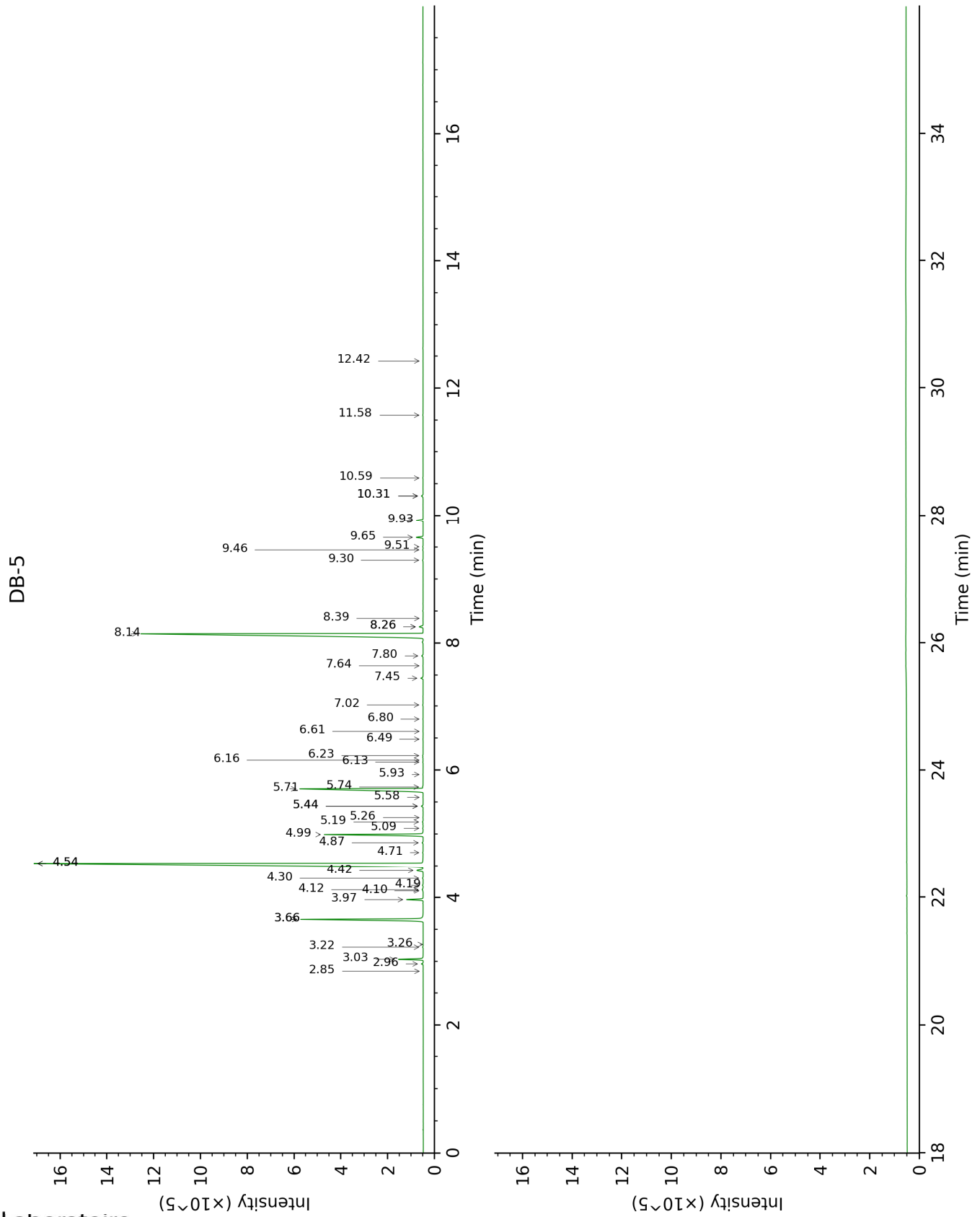
tr: The compound has been detected below 0.005% of total signal.

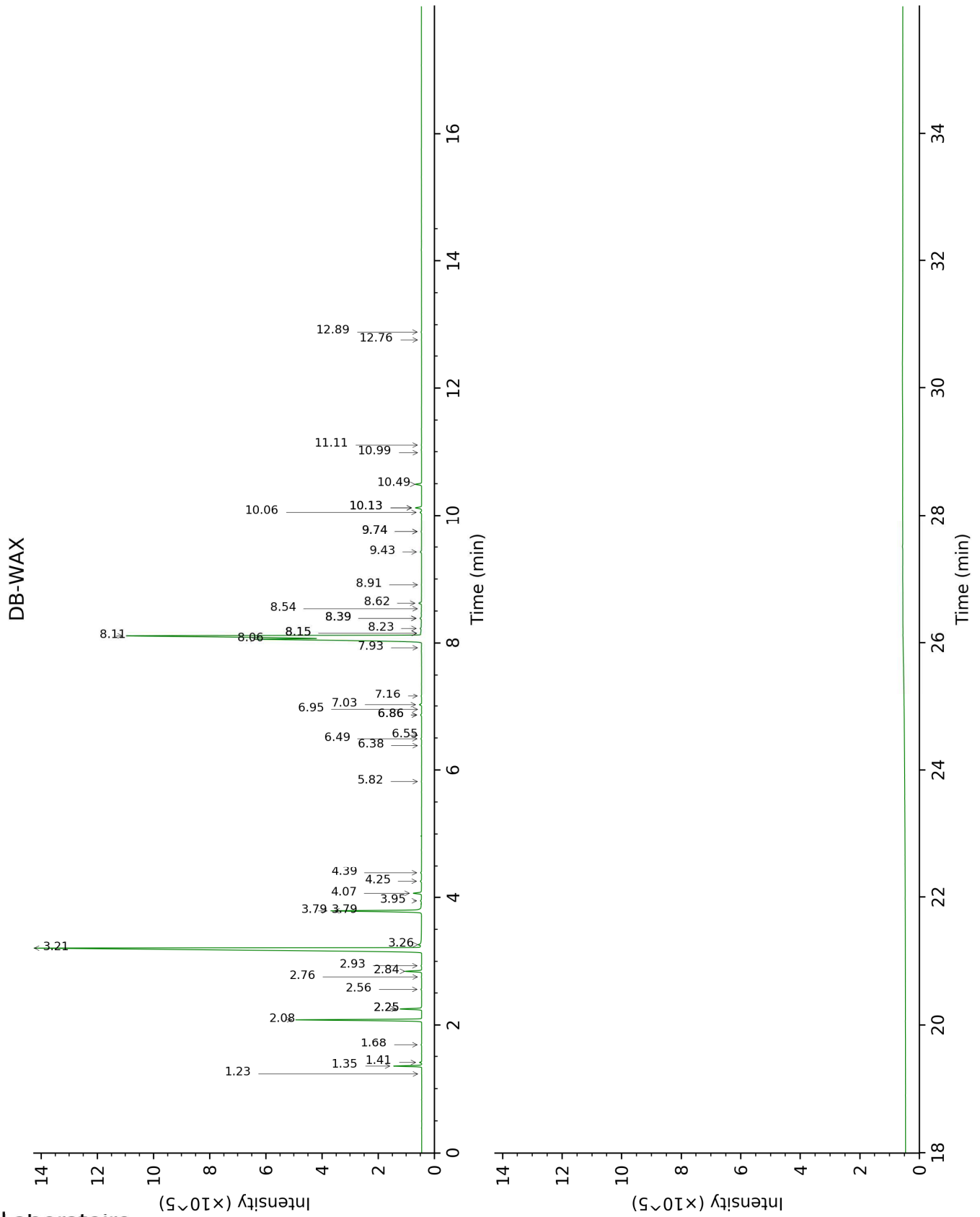
Note: no correction factor was applied

**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.

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FULL ANALYSIS DATA

Identification	Column DB-5			Column DB-WAX		
	R.T	R.I	%	R.T	R.I	%
Tricyclene	2.84	918	0.01	1.23	971	tr
$\alpha$ -Thujene	2.96	925	0.10	1.41	1000	0.10
$\alpha$ -Pinene	3.03	930	1.24	1.35	991	1.25
Camphene	3.22	943	0.03	1.68	1027	0.03
Thuja-2,4(10)-diene	3.26	945	0.01	2.26*	1084	1.10
Sabinene	3.66*	971	7.94	2.26*	1084	[1.10]
$\beta$ -Pinene	3.66*	971	[7.94]	2.08	1067	6.97
Myrcene	3.97	992	0.86	2.84	1134	0.87
$\alpha$ -Phellandrene	4.10	1001	0.01	2.76	1127	0.02
Octanal	4.12	1002	0.08	4.39	1251	0.05
$\Delta$ 3-Carene	4.19	1006	0.04	2.56	1112	0.04
$\alpha$ -Terpinene	4.30	1013	0.04	2.93	1140	0.04
para-Cymene	4.42	1021	0.48	4.06	1228	0.48
Limonene	4.54*	1028	39.24	3.21	1162	38.95
$\beta$ -Phellandrene	4.54*	1028	[39.24]	3.26	1166	0.30
(Z)- $\beta$ -Ocimene	4.71	1039	0.02	3.79*	1208	5.72
(E)- $\beta$ -Ocimene	4.86	1049	0.05	3.95	1219	0.06
$\gamma$ -Terpinene	4.99	1057	5.85	3.79*	1208	[5.72]
cis-Sabinene hydrate	5.09	1063	0.03	6.86*	1430	0.07
cis-Linalool oxide (fur.)	5.19	1069	0.04	6.49	1402	0.04
Octanol	5.26	1074	0.02	8.15*	1527	0.11
Terpinolene	5.44*	1085	0.11	4.25	1242	0.07
trans-Linalool oxide (fur.)	5.44*	1085	[0.11]	6.86*	1430	[0.07]
trans-Sabinene hydrate	5.58	1094	0.01	7.93	1510	0.01
Linalool	5.71	1102	11.00	8.06†	1520	41.67
Nonanal	5.74	1104	0.04	5.82	1354	0.02
trans-para-Mentha-2,8-dien-1-ol	5.93	1117	0.02	8.91	1587	0.02
cis-Limonene oxide	6.13	1129	0.02	6.38	1395	0.02
trans-Limonene oxide	6.16	1131	0.01	6.55	1406	0.02
Camphor	6.23	1136	0.03	7.16	1452	0.04
Citronellal	6.49	1153	0.01	6.95	1437	0.01
Borneol	6.61	1161	0.01	9.74*	1654	0.04
Terpinen-4-ol	6.80	1173	0.02	8.54	1557	0.01
$\alpha$ -Terpineol	7.02	1188	0.04	9.74*	1654	[0.04]
Octyl acetate	7.45	1217	0.14	7.03	1442	0.13
Nerol	7.64	1230	0.01	10.99	1757	0.01
Neral	7.80	1241	0.09	9.43	1628	0.09
Linalyl acetate	8.14†	1265	31.01	8.11†	1524	[41.67]
Geranial	8.26*†	1272	[31.01]	10.06	1679	0.09



( <i>trans?</i> )-Linalool oxide acetate (fur.)?	8.26*†	1272	[31.01]	8.62	1564	0.17
Bornyl acetate	8.39	1282	0.01	8.23	1533	0.11
Hodiendiol derivative	9.30	1340	0.04	12.89	1925	0.03
Unknown [m/z 43, 121 (52), 93 (48), 79 (33), 41 (30), 136 (26), 81 (25)...]	9.46	1352	0.03			
Unknown [m/z 43, 79 (46), 71 (30), 94 (25), 41 (23), 81 (21)... 197 (0)]	9.51	1355	0.02	11.11	1767	0.03
Neryl acetate	9.66	1366	0.39	10.13*	1685	0.40
Geranyl acetate	9.93	1385	0.38	10.50	1715	0.38
β-Caryophyllene	10.31*	1413	0.11	8.39*	1546	0.10
<i>cis</i> -α-Bergamotene	10.31*	1413	[0.11]	8.15*	1527	[0.11]
<i>trans</i> -α-Bergamotene	10.59	1434	0.02	8.39*	1546	[0.10]
β-Bisabolene	11.58	1507	0.02	10.13*	1685	[0.40]
Caryophyllene oxide	12.42	1574	0.01	12.76	1913	0.02
<b>Total identified</b>		<b>99.61%</b>			<b>99.63%</b>	
<b>Total reported</b>		<b>99.66%</b>			<b>99.66%</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

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