



# **Differences in Coffee Essence Due To Geography**

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## **ABSTRACT**

Coffee beans from 3 different countries, Columbia, Brazil, and Mexico were obtained and roasted to the same level of roast. Aqueous essences were produced using the system Integrated Extraction System. As expected, there are differences in the characteristics and quantity of the volatiles from each sample. Using the Columbian as a reference, the Mexican beans had on average 4% more aroma and the Brazilian had 14% more volatiles.

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## **INTRODUCTION**

It is well known that agricultural commodities vary based on geography. This can be due to many factors, such as climate, soil, elevation, agricultural practices, harvest and post-harvest treatments/storage, pesticides/herbicides, and others. The differences vary depending on the product and processing involved. A product like coffee is especially difficult to measure the differences due to the extra step of roasting in order to obtain brewable coffee beans. As a means of minimizing the controllable affects, Sensus worked with a coffee procurer and roaster to provide samples treated as identically as possible and then roasted to the same roast level. From these, identical processing procedures were conducted to yield aqueous essences that as best as could be controlled, reflected only the geographical differences of the coffee beans (i.e. climate, elevation, horticultural practices, but not storage, roasted and similar controllable variables).

## **MATERIALS AND METHODS**

Coffee samples were acquired from Sensus' current supplier from Brazil, Columbia, and Mexico with as many controllable variables eliminated as possible. The products were all roasted to the same level of roast and processed under typical conditions at Sensus, LLC. Essences were analyzed by GC-MS.

A Gerstel MultiPurposeSampler (MPS-2) (Baltimore, MD) was used with a 2-cm 3-phase (divinylbenene, Carboxen, Polydimethylsiloxane) for sample preparation. A 10-min incubation followed by a 40-min exposure was used to capture the volatiles on the fiber for injection into the GC. The sample was stirred using a 3x12mm stirbar in the 20mL vial. The fiber was desorbed for 5-min in the GC injector for 5 min. An Agilent 7890A gas chromatograph (Palo Alto, CA) was

used for the analysis. Analysis was performed in the splitless mode with a helium flow rate of 1.25mL/min through a 60mx0.25mmx0.25µm RTX-5ms column. The initial oven temperature was 50°C immediately followed by a 4°C/min temperature ramp to 170°C which was followed by a 100°C/min ramp to 250°C and held for 5min in order to ensure no sample to sample contamination. The transfer line to the Leco TruTOF MS (St. Joseph, MN) was held at 240°C. Data was collected for 30-250 m/z at an acquisition rate of 10 spectra per sec. Identification was based on a combination of MS library matching along with reported retention indices. The samples were then prepared for analysis by pipetting 50µL into 4.9mL of water along with 50µL of internal standard (phenol-D6, 100 ppm). Peaks were identified and quantified as relative to the Columbian sample.

## **RESULTS AND DISCUSSION**

The overall GC-MS "fingerprint" shows that the 3 essences are very similar (Figure 1). One can see that some of the early eluting compounds are larger in the Brazilian coffee (Figure 2), while the later eluting compounds are less different (Figure 3). As one can see, there are no "stand-out" differences (e.g. missing peaks or additional peaks) and the major differences are in the relative amounts of the various volatile compounds

Figure 1. Overall "fingerprint" of different coffee essences by GC-MS.

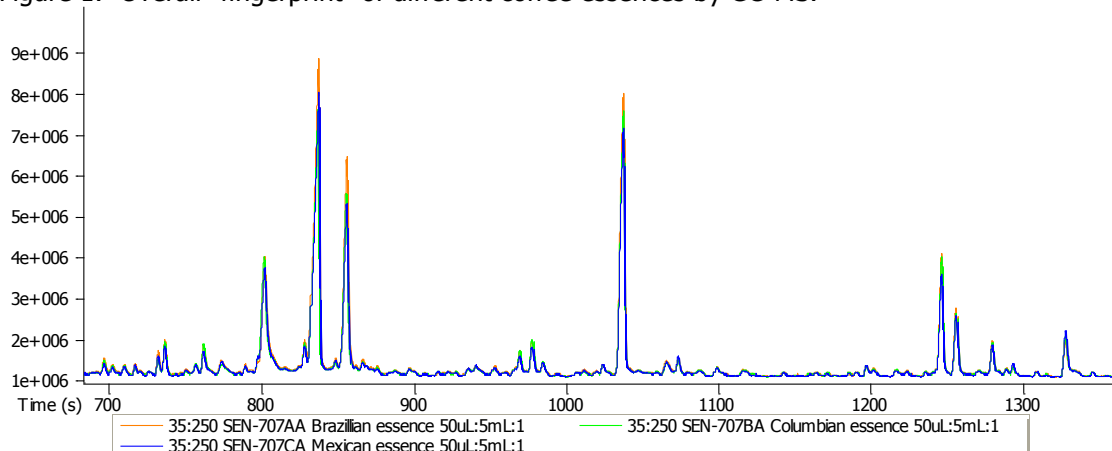
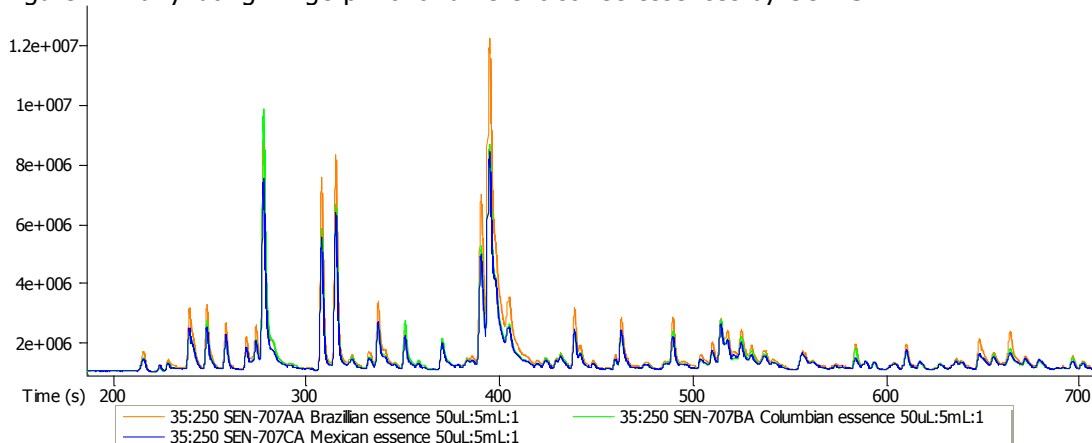
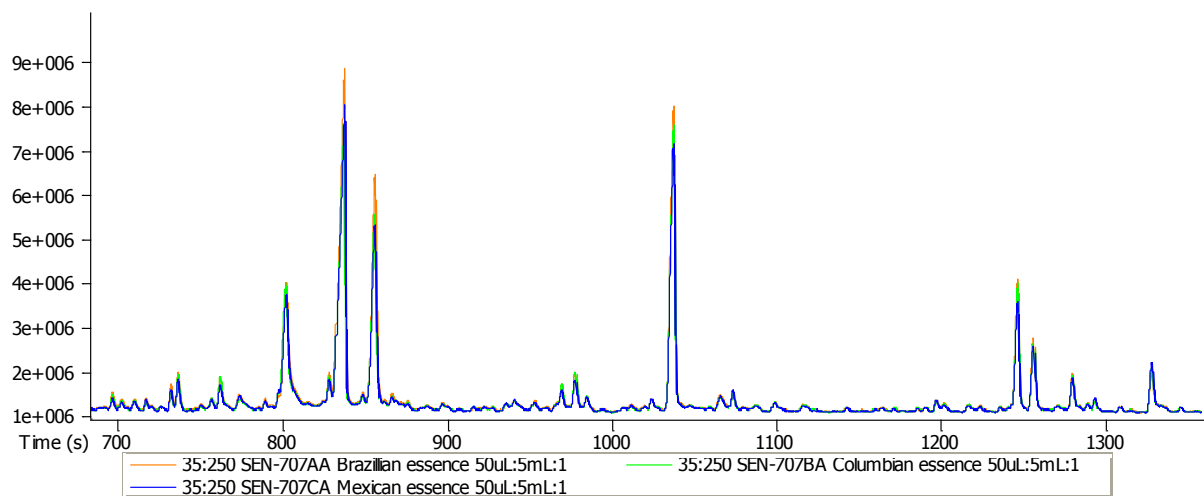


Figure 2. Early eluting "fingerprint" of different coffee essences by GC-MS.



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Figure 3. Later eluting "fingerprint" of different coffee essences by GC-MS.



There will be some variability in the GC-MS response to each compound based on many factors including processing variability, sampling variability, instrument variability, integration variability, and others. A convenient method to analyze the aromas is to set one sample as a reference and then compare the other samples to it. Therefore the reference sample is defined as being 100% and the others in relation to that. For this analysis, 145 peaks were used for comparison. The peaks are listed in Table 1, along with their relative abundances. Peaks are identified by peak number and retention index. The average response is 118 for the Brazilian grown coffee and 104 for the Mexican grown coffee, meaning that the total relative volatile differences are fairly minor, and differ mostly in the ratio of various compounds more so than overall abundance.

Table 1. Relative concentration of Brazilian and Mexican coffee essences to Columbian.

Peak #	Ret. Ind.	Brazilian	Mexican
1	427	117	93
2	430	155	97
3	455	130	139
4	468	145	104
5	502	161	113
6	502	145	119
7	508	106	97
8	558	124	113
9	590	150	113
10	599	126	102
11	602	141	96
12	608	92	77
13	653	132	103
14	663	133	102
15	676	110	88
16	689	137	93
17	696	142	113
18	700	114	75

19	701	141	93
20	709	82	73
21	715	68	79
22	725	83	105
23	736	74	84
24	739	162	135
25	742	148	100
26	743	156	106
27	746	150	106
28	748	138	98
29	749	103	122
30	754	178	112
31	767	138	102
32	770	130	98
33	775	101	97
34	777	94	91
35	783	150	111
36	786	148	103
37	786	104	95
38	791	106	122
39	801	164	126
40	802	134	118
41	804	78	79
42	809	114	94
43	815	150	102
44	816	78	80
45	818	130	94
46	820	167	122
47	821	144	103
48	826	163	130
49	830	153	120
50	832	137	109
51	832	92	95
52	834	142	112
53	835	136	109
54	838	112	75
55	841	127	92
56	841	95	59
57	842	91	88
58	845	136	113
59	845	117	92
60	848	157	118
61	856	105	96
62	857	150	114
63	857	160	128
64	860	88	97
65	873	105	52
66	875	119	136

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67	878	131	132
68	885	129	114
69	888	137	121
70	892	86	127
71	898	93	92
72	902	116	96
73	908	180	106
74	909	104	116
75	912	108	91
76	916	177	56
77	916	162	143
78	919	173	139
79	923	112	137
80	923	125	138
81	929	123	131
82	931	111	74
83	934	101	89
84	938	85	77
85	941	126	134
86	948	135	132
87	951	102	96
88	957	149	146
89	960	85	89
90	963	107	92
91	963	92	62
92	968	119	124
93	969	169	178
94	976	114	110
95	980	55	117
96	980	94	109
97	981	129	118
98	982	100	100
99	995	105	100
100	997	121	103
101	999	129	124
102	1004	121	128
103	1006	83	104
104	1007	127	128
105	1008	122	107
106	1010	121	127
107	1012	120	100
108	1013	109	82
109	1015	93	72
110	1017	159	42
111	1017	93	102
112	1027	104	102
113	1046	111	129
114	1052	115	122

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115	1052	151	145
116	1060	95	91
117	1060	86	75
118	1063	92	85
119	1067	89	101
120	1085	101	118
121	1090	101	96
122	1090	123	116
123	1090	120	121
124	1091	105	104
125	1105	116	120
126	1107	103	132
127	1119	92	97
128	1127	98	93
129	1149	106	107
130	1173	77	61
131	1182	101	92
132	1185	85	81
133	1187	102	93
134	1191	103	106
135	1203	104	103
136	1207	101	100
137	1225	93	113
138	1226	85	128
139	1229	99	97
140	1234	96	106
141	1282	91	86
142	1285	94	94
143	1286	93	95
144	1294	96	99
145	1608	113	97
Average		118	104