Comparison of Tea Volatiles Due to Geographical Differences

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ABSTRACT

Tea (*Camellia sinensis*), like any other agricultural product, will vary based on geographic growing region. Sensus obtains its tea leaves from many countries, including Indonesia, Kenya, and Sri Lanka (formerly Ceylon) which results in different flavor profiles of tea essence. A study of the volatile differences of the essences was conducted. Twenty six compounds were semi-quantitated and reported here. Major differences were observed for some low molecular weight compounds with largely green aroma notes and also with eucalyptol which imparts a cool, fresh, camphorous note.

INTRODUCTION

Tea is a water infusion of the *Camellia sinensis* plant after it has been harvest and processed. The post harvest processing determines if the tea is considered white, green, oolong, or black tea. Tea is grown across the globe in many countries with China and India being the largest producers, followed by Kenya, Sri Lanka, and Indonesia. The different growing regions with the varying climatic conditions, coupled with differing horticultural practices, and differences in post harvest treatment result in black teas with differing aroma profiles. With this in mind, tea essences from Indonesia, Kenya, and Sri Lanka (Ceylon) were analyzed to determine the differences in the volatile profile.

MATERIALS AND METHODS

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. Samples were 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.
Calibrations of compounds were with standards from 4ppb to 4000ppb as needed by compound. Phenol-D6 was used as an internal standard. Tea essence samples from Indonesia, Kenya, and Sri Lanka(Ceylon) were analyzed by diluting the essence 100 fold with a 5mL total volume.

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RESULTS AND DISCUSSION

As would be expected, volatile analysis of teas from different geographical areas (along with the differences in horticultural practices and post harvest treatments) would yield teas with different aroma profiles. While most of the aroma compounds are present in each sample, the relative amounts change, resulting in a differing organoleptic response. Table 1 is a partial list of the aroma compounds found in the samples along with the determined concentrations. There are various differences that are immediately apparent. Pentanal and E-2-Pentenal both varied between the samples with the Kenyan tea having about twice as much as the Indonesian while the Ceylon tea contained about one quarter the amount. The Ceylon tea appeared to have significantly less hexanal than the other two teas. Likewise heptanal was also considerably less concentrated in the Ceylon tea. These early eluting lower molecular weight compounds seem to have been lost, perhaps during post harvest treatments. However, probably the biggest difference of the Ceylon tea is Eucalyptol. Almost 30 times as much as in the Indonesian and over 200 times as much as the Kenyan. With its distinctive aroma, it could impact the organoleptic properties. The aroma threshold for eucalyptol has been reported as 2-3200ppb.

Table1. Compounds and their concentrations(ppb) in tea essences from different geographic locations.

Peak #	Name	Ret. Ind.	Indonesia	Kenya	Ceylon
1	Pentanal	691	108,704	201,176	22,174
2	2-Pentenal, (E)-	747	3,440	9,439	852
3	3-Hexenal, (Z)-	795	104,982	125,773	87,916
4	Hexanal	796	255,168	375,995	3,024
5	2-Hexenal	849	51,129	99,251	11,865
6	1-Hexanol	861	727	404	675
7	4-Heptenal, (Z)-	896	1,853	3,341	309
8	Heptanal	898	1,071	2,299	235
9	Hexanoic acid, methyl ester	919	39	26	25
10	Benzaldehyde	962	2,376	1,711	1,283
11	5-Hepten-2-one, 6-methyl-	983	624	984	170
12	á-Myrcene	988	174	28	165
13	Octanal	1000	50	155	14
14	D-Limonene	1030	36	27	72
15	Eucalyptol	1034	31	4	925
16	1,6-Octadien-3-ol, 3,7-dimethyl-	1097	4,720	2,989	2,722
17	Nonanal	1101	69	486	119
18	2-Nonenal, (E)-	1158	34	141	20
19	Benzoic acid, 2-hydroxy-, methyl ester	1201	1,768	2,969	5,152
20	Decanal	1203	37	288	61
21	1-Cyclohexene-1-carboxaldehyde, 2,6,6-trimethyl-	1227	788	835	267
22	2,4-Decadienal	1314	279	670	20
23	Hexanoic acid, hexyl ester	1379	27	13	0
24	2-Buten-1-one, 1-(2,6,6-trimethyl-1,3-cyclohexadien-1-yl)-, (E)-	1389	22,664	16,318	39,194
25	3-Buten-2-one, 4-(2,6,6-trimethyl-2-cyclohexen-1-yl)-, (E)-	1440	588	545	86
26	5,9-Undecadien-2-one, 6,10-dimethyl-, (E)-	1462	164	1440	108

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