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Original Article

Content of Some Elements in the Bestselling Brands of Green Tea on the Iranian market

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Abstract

Background: Tea is one of most frequently consumed beverages in the world. Only in Iran, around 12000 tons of tea is annually used. Besides, green tea, which is made from *Camellia sinensis* leaves and buds, is very popular among people. Although teas have health benefits, since they may be much drunk, they may pose a threat to consumers' health because of absorbing various ions in their leaves. Unfortunately, there are a limited number of studies on the health effects of green teas.

Methods: It was a cross-sectional study performed in 2021. In this research, the concentrations of ions: fluoride (F), chloride (Cl), nitrate (NO_3), sulfate (SO_4), and phosphate (PO_4) in the six bestselling green tea brands, both loose and bag, in Iran were detected by means of ion chromatography.

Results: The highest amounts of F, Cl, NO_3, SO_4, and PO_4 in the brands were found to be, respectively, in 0.27310, 0.62103, 0.83533, 1.28067, and 1.1037 mg/L. The concentrations of the ions in the both loose and bag tea samples were different significantly. Also, the content of F in the all samples was lower than those acceptable levels suggested by different organizations.

Conclusion: It was found that the concentration of the ions was by far lower than those have been introduced as the standard levels. Nonetheless, the water used for tea infusion may contain high levels of these compounds and its volume drunk every day is also very important.

Keywords: Various ions, Risk assessment, Green tea, Fluoride concentration, Iranian market

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Introduction

Tea is the second most common beverage across the world.[1] It contains essential minerals, which are beneficial to human health. Approximately 18-20 billion tea cups are consumed daily.[2] In addition to be consumed as a hot beverage, it is known as a medicinal herb with many properties.[3-5] Tea is commonly made through pouring hot or boiling water over cured leaves of the Camellia sinensis and is presented to the market as follows: black, green and oolong. Reports have shown that drinking green tea is proper for heart health, especially patients suffering from high triglycerides. Green tea contains polyphenols, which have anti-cancer effects.[6] The tea plant can absorb huge quantities of essential elements for the body, as well as heavy metals, from soil and accumulate them in leaves.[4] Of course, tea processing can affect its ingredients. Moreover, high concentrations of aluminum (Al) have been reported in tea, which may be linked to Alzheimer's disease.[5] The conditions of cultivation, processing and infusion of tea affect elements in infused tea. Of course, the amount of tea consumed is effective.[7] The Iranian people consume approximately 5% of the world's total consumption (12 000 tons).[8] To date, a few studies have been conducted to determine the content of various ions in tea distributed on the Iranian markets.[7,8] Therefore, in view of high annual per capita consumption of tea in Iran (1.5 kg), it is essential to control the quality of this beverage.[9] Thus, in this study, the contents of: Al, as well as ions: fluoride (F), chloride (Cl), nitrate (NO_3), sulfate (SO_4), and phosphate (PO_4) in the bestselling green tea brands in Iran were determined. Furthermore, the exposure to F and its health risk assessment were measured.

Materials and Methods

Sample Selection and Preparation

Based on previous studies and p = 52.8%, d = 0.082 and confidence level = 95%, the sample size was calculated to be 108.[10] The samples were selected as follows: nine packages of each green tea type, distributed in six cities in Iran,

were purchased. Next, the contents of each three packages were mixed well and finally a 1-g sample was prepared to perform the experiments.[7] Therefore, considering six types (six brands) of green tea studied in the cities, 108 samples were collected. The six brands were number 1, 2, 3, 4, 5 and 6. Furthermore, bag and loose tea samples were shown by A and B, respectively.

In order to dry the samples, they were placed in oven at a temperature of 60 °C for 4 h. The samples were kept in a desiccator before testing. In each stage, 1 g of the dried tea was added to 100 mL of boiling water (100°C) in a Teflon teapot. So as to prevent evaporation, the teapot's door was covered with glass. It should be noted that the temperature of the teapot was kept at 80°C over infusion.

Composition Measurement

Elements

At the end of each infusion period, a 1-mL aliquot was taken from each sample and diluted to 100 mL using ultrapure water. The samples were then filtered through a 0.45-µm membrane and prepared for the measurement of anion concentrations. The ion concentrations were determined by ion chromatography using a Metrohm 882 compact IC plus, Metrohm AG, Switzerland. Each sample was analyzed twice. Moreover, the content of F was detected as explained in the study of Malde.[11]

Daily F Intake and its Health Risk Assessment

Daily F intake was also assessed. To do this, daily F intake by consumption of 1-4 cups of the studied green teas, and also the expected F intake through consumption of 4 cups of the teas brewed with drinking water containing different F levels (0.1–7 mg/L) were determined. We assessed the exposure risk of F from tea ingestion, according to the equation 1[12]:

$$CDI = C \times \frac{DI}{BW} \quad (1)$$

here, *CDI* presents daily intake (mg/kg/d), *C* presents the F content in tea infusion (mg/L), *DI* presents the average daily intake rate of tea (L/d), and *BW* presents body weight (kg). In this study, default body weights were 20 and 70 kg, respectively, for children and adults. For both children and adults, the risks from F ingestions were calculated. Besides, it was assumed that 0.075 and 0.75 L tea/d were, respectively, consumed by children (< 15 years) and adults (> 35 years). The hazard quotient (HQ) was calculated to estimate F risks by means of the equation 2[12]:

$$HQ = \frac{CDI}{RfD} \quad (2)$$

where, *RfD* shows the dose of F (mg/kg/d). And, a HQ value > 1 represents a meaningful risk amount.[12]

Statistical Analysis

In this study, statistical Package for the Social Sciences (SPSS) version 16 using analysis of variance (ANOVA) was utilized to analyze the data; also, the Tukey's test was used to study the relationship between ion concentrations and tea brands. So as to compare F concentration in the tea samples studied, one-sample *t* test was used. Also, the Guidelines for Drinking-water Quality recommended by the World Health Organization (WHO)[13] were used to compare the ions contents reported in the current study with the standards, as well as for daily F intake thresholds for different age groups.

Results and Discussion

Anion Concentration in the Infused Tea Samples (Loose and Bag) and Their Relationship With Tea Brands

Inappropriate concentration ranges of ions in drinking water results in health problems. For instance, teeth and bones can be impacted by the content of fluoride in drinking water; concentration between 1 and 1.5 mg/L of fluoride can strengthen the enamel, but contents from 1.5 to 4 mg/L lead to dental fluorosis and skeletal fluorosis happens at higher contents 4–10 mg/L.[14] Usually, tea is drunk a short time after tea leaves are added to hot water.[12] Therefore, in this study, the concentrations of ions were determined after the tea samples were infused (Table 1). Based on Table 1, the highest concentrations of F, Cl, NO_3, SO4 and PO_4 were determined, respectively, in A6 (0.27310 mg/L), B2 (0.62103 mg/L), B4 (0.83533 mg/L), A6 (1.28067 mg/L), and A5 (1.1037 mg/L). There was a significant relationship between the kind of the bag tea samples and the content of each ion. Also, the concentrations of the ions in the loose tea samples were different significantly (Table 2). The average concentrations of chloride of the loose samples were higher than those of the bag tea samples, but the average contents of NO_3 and SO_4 in the bag tea samples were higher (Table 1). Also, there was a significant relationship between the Cl, NO_3, SO_4 and PO_4 contents of the loose and bag tea samples ($P < 0.05$). Apparently, the contents of theses parameters were extremely lower than the maximum allowable levels suggested by organizations like the WHO.[13] Moreover, other researchers such as Minca et al[15] and Balcerzak and Janiszewska[16] reported similar observations. In general, a difference in the amount of tea ions can be due to reasons like country of origin, harvesting and processing conditions of tea leaves, and addition of additives, perfumes and so on.[15]

F Concentration

Table 3 presents the results of daily intake by person (as mg/L) and it was assumed that a person consumes 1-4 cups of tea and water containing no F was used to infuse the tea. Since drinking water contains some F and people use water containing F to infuse tea, the daily F intake was estimated based on the number of tea cups and the different concentrations of the water were used for tea infusion (Table 4). In Table 5, the intakes were calculated with considering three parameters: the intake from the dry

Table 1. Concentrations of ions detected after the tea samples were infused

Ion	Brand	Sample Number		Mean		Min		Max		SD	
		A	B	A	B	A	B	A	B	A	B
F	6	3	3	0.27310	0.16140	0.193	0.098	0.326	0.223	0.070491	0.062767
	5	3	3	0.22913	0.10130	0.165	0.025	0.302	0.152	0.068995	0.066956
	4	3	3	0.07940	0.17133	0.055	0.150	0.116	0.187	0.032241	0.018985
	3	3	3	0.17910	0.16843	0.088	0.135	0.250	0.235	0.083009	0.057735
	2	3	3	0.10023	0.07337	0.078	0.034	0.125	0.124	0.024017	0.046467
	1	3	3	0.11370	0.24447	0.071	0.194	0.155	0.300	0.041770	0.053012
	Total	18	18	0.16244	0.15338	0.055	0.025	0.326	0.300	0.087548	0.72048
Cl	6	3	3	0.44600	0.13777	0.368	0.083	0.520	0.221	0.076079	0.073330
	5	3	3	0.28700	0.50000	0.178	0.392	0.448	0.631	0.142313	0.121149
	4	3	3	0.20930	0.55830	0.080	0.512	0.306	0.619	0.116543	0.054954
	3	3	3	0.40033	0.35600	0.188	0.195	0.589	0.511	0.201545	0.158085
	2	3	3	0.23303	0.62103	0.178	0.527	0.322	0.741	0.077507	0.109301
	1	3	3	0.58800	0.45257	0.386	0.367	0.734	0.529	0.180632	0.081660
	Total	18	18	0.36061	0.43761	0.080	0.083	0.734	0.741	0.180400	0.184716
NO_3	6	3	3	0.76107	0.24037	0.649	0.165	0.833	0.344	0.098346	0.093051
	5	3	3	0.23390	0.24307	0.168	0.218	0.317	0.269	0.076071	0.025511
	4	3	3	0.59637	0.83533	0.499	0.684	0.689	0.968	0.095088	0.142917
	3	3	3	0.33133	0.21627	0.276	0.172	0.385	0.269	0.054519	0.048927
	2	3	3	0.31670	0.24437	0.089	0.157	0.439	0.332	0.197379	0.087500
	1	3	3	0.66267	0.30483	0.515	0.265	0.811	0.355	0.148001	0.046044
	Total	18	18	0.48367	0.34737	0.089	0.157	0.833	0.968	0.227796	0.236885
SO_4	6	3	3	1.28067	0.41133	1.054	0.322	1.511	0.543	0.228522	0.116423
	5	3	3	0.64770	0.20953	0.545	0.144	0.791	0.267	0.127927	0.061896
	4	3	3	0.33600	0.14977	0.254	0.098	0.465	0.206	0.113080	0.054307
	3	3	3	0.27113	0.58373	0.102	0.542	0.364	0.611	0.146374	0.036740
	2	3	3	0.38247	0.25140	0.293	0.219	0.445	0.277	0.079206	0.029460
	1	3	3	0.26770	0.51233	0.235	0.433	0.300	0.592	0.032451	0.079501
	Total	18	18	0.53094	0.35302	0.102	0.098	1.511	0.611	0.386382	0.174972
PO_4	6	3	3	0.79500	0.68770	0.718	0.588	0.911	0.826	0.102240	0.123678
	5	3	3	1.10370	0.53270	0.920	0.346	1.089	0.753	0.085049	0.205632
	4	3	3	0.25100	0.25603	0.198	0.212	0.321	0.328	0.063238	0.062922
	3	3	3	0.17723	0.41167	0.087	0.326	0.287	0.511	0.101421	0.093254
	2	3	3	0.55177	0.55783	0.189	0.468	1.200	0.617	0.562695	0.079004
	1	3	3	0.23940	0.70120	0.214	0.614	0.257	0.787	0.022536	0.086508
	Total	18	18	0.50413	0.52452	0.087	0.212	1.200	0.826	0.379684	0.187781

tea samples, the intake from water containing different amounts of F and the number tea cups.

The content of F in different tea samples ranged from 0.025 to 0.326 mg/L. And, the amount of F in tea bag samples averaged higher than that of the loose tea ones. There was a significant relationship between the bag and loose tea samples in terms of their content of F ($P < 0.05$) (Table 2). It should be noted that the content of F in all the samples was lower than the US allowable level for F in bottled water (1.4 mg/L) and the allowable level of F in China (1 mg/L).[17] Moreover, the WHO has suggested 2 and 4 mg/L of the allowable levels of F for children and adults, respectively.[14,18] In previous studies, it has been claimed that the concentration of F over processing is constant, even though processes of rolling and ball rolling cause its content to rise due to the separation of tea cells and tissues.[17,19] Of course, environmental conditions in the region in which tea is cultivated are effective and as tea plant ages the F concentration enhances.[20]

Cao et al reported that the F concentrations ranged between 0.95 and 1.41 mg/L in black tea sticks, 0.70 and 2.44 mg/L in black tea granules and 1.15 and 6.01 mg/L in black tea bags.[21] Also, Emekli stated that F contents in black tea and herbal tea after 5-minute infusion were 0.57-

Table 2. The Relationship Between Ion Concentrations (mg/L) and Tea Type

Ion		Tea type					
		Bag			Loose		
		df	F	*P* Value	*df*	F	*P* Value
F	Between groups	5	5.425	0.008	5	3.798	0.027
	Within groups	12			12		
	Total	17			17		
Cl	Between groups	5	3.185	0.046	5	8.039	0.002
	Within groups	12			12		
	Total	17			17		
NO_3	Between groups	5	9.584	0.001	5	24.917	0.001
	Within groups	12			12		
	Total	17			17		
SO_4	Between groups	5	25.255	0.001	5	19.231	0.001
	Within groups	12			12		
	Total	17			17		
PO_4	Between groups	5	6.024	0.005	5	6.167	0.005
	Within Groups	12			12		
	Total	17			17		

Table 3. Fluoride Daily Intake (mg/d) in Terms of Tea Cup Number Consumed

Tea Brand	1 Cup		2 Cups		3 Cups		4 Cups	
	A	B	A	B	A	B	A	B
1	0.011	0.024	0.022	0.048	0.034	0.073	0.045	0.097
2	0.010	0.007	0.020	0.014	0.030	0.022	0.040	0.029
3	0.017	0.016	0.035	0.033	0.053	0.050	0.071	0.067
4	0.007	0.017	0.015	0.034	0.023	0.051	0.031	0.068
5	0.022	0.010	0.045	0.020	0.068	0.030	0.091	0.040
6	0.027	0.016	0.054	0.032	0.081	0.048	0.109	0.064

Six tea brands: 1, 2, 3, 4, 5 and 6; A (bag tea samples) and B (loose tea samples).

Table 4. Fluoride Daily Intake (mg/d) Through Consuming Water Containing Different Concentrations of Fluoride

Cup Number	Fluoride Concentration of Water				
	<0.1 (mg/L)	0.1-0.5 (mg/L)	0.5–1.5 (mg/L)	1.5–4 (mg/L)	4–7 (mg/L)
1	C_1 < 0.01	C5 = 0.01-0.05	C_9 = 0.05-0.15	C_{13} = 0.15-0.4	C_{17} = 0.4-0.7
2	C_2 < 0.02	C6 = 0.02-0.1	C_{10} = 0.1-0.3	C_{14} = 0.3-0.8	C_{18} = 0.8-1.4
3	C_3 < 0.03	C_7 = 0.03-0.15	C_{11} = 0.15-0.45	C_{15} = 0.45-1.2	C_{19} = 1.2-2.1
4	C_4 < 0.04	C_8 = 0.04-0.2	C_{12} = 0.2-0.6	C_{16} = 0.6-1.6	C_{20} = 1.6-2.8

Each cup contains 100 mL of drinking water.

3.72 and 0.02-0.04 mg/L, respectively.[22]

The results given in Table 1 show that the highest daily intake of F in different bag and loose tea samples was for A6 (four cups) (average 0.109 mg/L). Thus, all the daily intakes of F in different tea samples were lower than those acceptable levels by different organizations. Of course, the water used for tea infusion may contain high levels of F. On the other hand, sample A6, for which four cups of tea and water containing 4-7 mg/L of F were used, was found to have the highest daily intake (2.909 mg/d), which exceeds the level allowable for children. Peng et al. suggested 1.5-4 and 1.5-2.5 mg/d of daily F intake, respectively, for children and adults.[17]

Health Risk Assessment for F in Tea Samples

Health risks caused by F accumulation due to tea consumption have been reported across the world. The observations of a study performed in Sichuan, China, for instance, showed that fluorosis was linked to high contents of F intake.[17,23] Also, another case of skeletal fluorosis was reported due to drinking instant tea.[24] It is therefore essential that health risks caused by F among tea consumers be assessed.[12] Table 6 presents the measurements of health risk assessment associated with the consumption of different brands of tea containing different amounts of F (1-4 cups; 100-400 mL) in children (20 kg) and adults (70 kg). The health risk of F in different

Table 5. Daily Fluoride Intake Through Consuming Different Tea Brands and Drinking Water Containing Different Levels of Fluoride

Cup Number	Tea Brand	Fluoride Concentration (mg/L)									
		<0.1		0.1-0.5		0.5–1.5		1.5–4		4–7	
		A	B	A	B	A	B	A	B	A	B
1	6	0.037	0.026	0.037- 0.077	0.026- 0.066	0.077-0.177	0.066-0.166	0.177-0.427	0.166- 0.416	0.427-0.727	0.416-0.716
	5	0.032	0.020	0.032-0.072	0.020- 0.060	0.072-0.172	0.060-0.160	0.172-0.422	0.160- 0.410	0.422-0.722	0.410-0.710
	4	0.017	0.027	0.017- 0.057	0.027- 0.067	0.057-0.157	0.067-0.167	0.157-0.407	0.167-0.417	0.407-0.707	0.417-0.717
	3	0.027	0.026	0.027- 0.067	0.026-0.066	0.067-0.167	0.066-0.166	0.167-0.417	0.166-0.416	0.417-0.717	0.416-0.716
	2	0.020	0.017	0.020- 0.060	0.017-0.057	0.060-0.160	0.057-0.157	0.160-0.410	0.157-0.407	0.410-0.710	0.407-0.707
	1	0.021	0.034	0.021- 0.061	0.034-0.074	0.061-0.161	0.074-0.174	0.161-0.411	0.174-0.424	0.411-0.711	0.424-0.724
2	6	0.074	0.052	0.074-0.154	0.052-0.132	0.154-0.354	0.132-0.332	0.354-0.854	0.332-0.832	0.854-1.454	0.832-1.432
	5	0.065	0.040	0.065-0.145	0.040-0.120	0.145-0.345	0.120-0.320	0.3450-0.845	0.320-0.820	0.845-1.445	0.820-1.420
	4	0.035	0.054	0.035-0.115	0.054-0.134	0.115-0.315	0.134-0.334	0.315-0.815	0.334-0.834	0.815-1.415	0.834-1.434
	3	0.055	0.053	0.055-0.135	0.053-0.133	0.135-0.335	0.133-0.333	0.335-0.835	0.333-0.833	0.835-1.435	0.833-1.433
	2	0.040	0.034	0.040-0.120	0.034-0.114	0.120-0.320	0.114-0.314	0.320-0.820	0.314-0.814	0.820-1.420	0.814-1.414
	1	0.042	0.068	0.042-0.122	0.068-0.148	0.122-0.322	0.148-0.348	0.322-0.822	0.348-0.848	0.822-1.422	0.848-1.448
3	6	0.111	0.078	0.111-0.231	0.078-0.198	0.231-0.531	0.198-0.498	0.531-1.281	0.498-1.248	1.281-2.181	1.248-2.148
	5	0.098	0.060	0.098-0.218	0.060-0.180	0.218-0.518	0.180-0.480	0.518-1.268	0.480-1.230	1.268-2.168	1.230-2.130
	4	0.053	0.081	0.053-0.173	0.081-0.201	0.173-0.473	0.201-0.501	0.473-1.223	0.501-1.251	1.223-2.123	1.251-2.151
	3	0.083	0.080	0.083-0.203	0.080-0.200	0.203-0.503	0.200-0.500	0.503-1.253	0.500-1.250	1.253-2.153	1.250-2.150
	2	0.060	0.052	0.060-0.180	0.052-0.172	0.180-0.480	0.172-0.472	0.480-1.230	0.472-1.222	1.230-2.130	1.222-2.122
	1	0.064	0.103	0.064-0.184	0.103-0.223	0.184-0.484	0.223-0.523	0.484-1.234	0.523-1.273	1.234-2.134	1.273-2.173
4	6	0.149	0.104	0.149-0.309	0.104-0.264	0.309-0.709	0.264-0.0664	0.709-1.709	0.664-1.664	1.709-2.909	1.664-2.864
	5	0.131	0.080	0.131-0.291	0.080-0.240	0.291-0.691	0.240-0.640	0.691-1.691	0.640-1.640	1.691-2.891	1.640-2.840
	4	0.071	0.108	0.071-0.231	0.108-0.268	0.231-0.631	0.268-0.668	0.631-1.631	0.668-1.668	1.631-2.831	1.668-2.868
	3	0.111	0.107	0.111-0.271	0.107-0.267	0.271-0.671	0.267-0.667	0.671-1.671	0.667-1.667	1.671-2.871	1.667-2.867
	2	0.080	0.069	0.080-0.240	0.069-0.229	0.240-0.640	0.229-0.629	0.640-1.640	0.629-1.629	1.640-2.840	1.629-2.829
	1	0.085	0.137	0.085-0.245	0.137-0.297	0.245-0.645	0.297-0.697	0.645-1.645	0.697-1.697	1.645-2.845	1.697-2.897

Six tea brands: 1, 2, 3, 4, 5 and 6; A (bag tea samples) and B (loose tea samples).

tea samples for children ranged between 0.017 and 2.909. The highest health risk in children was found to be 2.909, which was for the sample, in which four cups of tea were consumed and the water used for tea infusion contained 7 mg/L of F. Furthermore, the health risk of F in different tea samples for adults ranged from 0.004 to 0.831. Like for children, this sample had the highest health risk in adults (0.831). The findings of the study by Das et al. showed the amount of health risk caused by F in different brands of tea in adults was 0.01-0.65.[12] which does not accord with that of our study; in this research, water with different amounts of F (0.1-7 mg/L) was used for tea infusion. As can be indicated, the consumption of two cups of tea, infused with water containing F more than 7 mg/L, had health risk more than the standard limit and can result in health problems. Also, the consumption of three cups of tea and the use of water with 4 mg/L of F had health risk more than the standard limit. Therefore, an increase in the content of F of water used for tea infusion leads to a rise in health risk.

Conclusions

The results show that the average concentration of chloride of the loose samples were higher than those of the bag tea samples, but the average contents of NO_3 and SO_4 in the bag tea samples were higher. In general, it was found that the concentration of the ions was bay far lower than those have been introduced as the standard levels. Nonetheless, the water and, used for tea infusion and its volume drunk every day may contain high levels of these compounds. For example, the consumption of three cups of tea and the use of water with 4 mg/L of F had health risk more than the standard limit. Therefore, an increase in the content of F of water used for tea infusion leads to a rise in health risk. Therefore, it is suggested that a comprehensive study is needed to investigate more factors affecting the quality of green tea on the Iranian market.

Authors' Contributions

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Table 6. Amount of Health Risk of Fluoride in Different Tea Brands for Children and Adults

Cup Number	People	Tea Brand	Fluoride Concentration (mg/L)									
			0.1		0.5		1.5		4		7	
			A	B	A	B	A	B	A	B	A	B
1	Children	6	0.037	0.026	0.077	0.066	0.177	0.166	0.427	0.416	0.727	0.716
		5	0.032	0.020	0.072	0.060	0.172	0.16	0.422	0.41	0.722	0.710
		4	0.017	0.027	0.057	0.067	0.157	0.167	0.407	0.417	0.707	0.717
		3	0.027	0.026	0.067	0.066	0.167	0.166	0.417	0.416	0.717	0.716
		2	0.020	0.017	0.060	0.057	0.16	0.157	0.41	0.407	0.710	0.707
		1	0.021	0.034	0.061	0.074	0.161	0.174	0.411	0.424	0.711	0.724
	Adults	6	0.010	0.007	0.022	0.018	0.050	0.047	0.122	0.118	0.207	0.204
		5	0.009	0.005	0.020	0.017	0.049	0.045	0.120	0.117	0.206	0.202
		4	0.004	0.007	0.016	0.019	0.044	0.047	0.116	0.119	0.202	0.204
		3	0.007	0.007	0.019	0.018	0.047	0.047	0.119	0.118	0.204	0.204
		2	0.005	0.004	0.017	0.016	0.045	0.044	0.117	0.116	0.202	0.202
		1	0.006	0.009	0.017	0.021	0.046	0.049	0.117	0.121	0.203	0.206
2	Children	6	0.074	0.052	0.154	0.132	0.354	0.332	0.854	0.832	1.454	1.432
		5	0.065	0.040	0.145	0.120	0.345	0.32	0.845	0.82	1.445	1.420
		4	0.035	0.054	0.115	0.134	0.315	0.334	0.815	0.834	1.415	1.434
		3	0.055	0.053	0.135	0.133	0.335	0.333	0.835	0.833	1.435	1.433
		2	0.040	0.034	0.120	0.114	0.32	0.314	0.82	0.814	1.420	1.414
		1	0.042	0.068	0.122	0.148	0.322	0.348	0.822	0.848	1.422	1.448
	Adults	6	0.021	0.014	0.044	0.037	0.101	0.094	0.244	0.237	0.415	0.409
		5	0.018	0.011	0.041	0.034	0.098	0.091	0.241	0.234	0.412	0.405
		4	0.010	0.015	0.032	0.038	0.090	0.095	0.232	0.238	0.404	0.409
		3	0.015	0.015	0.038	0.038	0.095	0.095	0.238	0.238	0.410	0.409
		2	0.011	0.009	0.034	0.032	0.091	0.089	0.234	0.232	0.405	0.404
		1	0.012	0.019	0.034	0.042	0.092	0.099	0.234	0.242	0.406	0.413
3	Children	6	0.111	0.078	0.231	0.198	0.531	0.498	1.281	1.248	2.181	2.148
		5	0.098	0.060	0.218	0.180	0.518	0.48	1.268	1.23	2.168	2.130
		4	0.053	0.081	0.173	0.201	0.473	0.501	1.223	1.251	2.123	2.151
		3	0.083	0.080	0.203	0.200	0.503	0.5	1.253	1.25	2.153	2.150
		2	0.060	0.052	0.180	0.172	0.48	0.472	1.230	1.222	2.130	2.122
		1	0.064	0.103	0.184	0.223	0.484	0.523	1.234	1.273	2.134	2.173
	Adults	6	0.031	0.022	0.066	0.056	0.151	0.142	0.366	0.356	0.623	0.613
		5	0.028	0.017	0.062	0.051	0.148	0.137	0.362	0.351	0.619	0.608
		4	0.015	0.023	0.049	0.057	0.135	0.143	0.349	0.357	0.606	0.614
		3	0.023	0.022	0.058	0.057	0.143	0.142	0.358	0.357	0.615	0.614
		2	0.017	0.014	0.051	0.049	0.137	0.134	0.351	0.349	0.608	0.606
		1	0.018	0.029	0.052	0.063	0.138	0.149	0.352	0.363	0.609	0.620
4	Children	6	0.149	0.104	0.309	0.264	0.709	0.264	1.709	1.664	2.909	2.864
		5	0.131	0.080	0.291	0.240	0.691	0.64	1.691	1.64	2.891	2.840
		4	0.071	0.108	0.231	0.268	0.631	0.668	1.631	1.668	2.831	2.868
		3	0.111	0.107	0.271	0.267	0.671	0.667	1.671	1.667	2.871	2.867
		2	0.08	0.069	0.24	0.229	0.64	0.629	1.64	1.629	2.840	2.829
		1	0.085	0.137	0.245	0.297	0.645	0.697	1.645	1.697	2.845	2.897
	Adults	6	0.042	0.029	0.088	0.075	0.202	0.075	0.488	0.475	0.831	0.818
		5	0.037	0.022	0.083	0.068	0.197	0.182	0.483	0.468	0.826	0.811
		4	0.020	0.030	0.066	0.076	0.180	0.190	0.466	0.476	0.808	0.819
		3	0.031	0.030	0.077	0.076	0.191	0.190	0.477	0.476	0.820	0.819
		2	0.022	0.019	0.068	0.065	0.182	0.179	0.468	0.465	0.811	0.808
		1	0.024	0.039	0.070	0.084	0.184	0.199	0.470	0.484	0.812	0.827

1. Six tea brands: 1, 2, 3, 4, 5 and 6; A (bag tea samples) and B (loose tea samples).

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Competing Interests
The authors declare no conflict of interest.

Ethical Approval
The conducted study was not related to either human or animal use.

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