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A STUDY ON EVALUTION OF CONFORMITY OF BLACK TEAS PRODUCED IN TURKEY WITH TURKISH FOOD CODEX

TÜRKİYE'DE ÜRETİLEN SİYAH ÇAYLARIN TÜRK GIDA KODEKSİNE UYGUNLUĞUNUN BELİRLENMESİ ÜZERİNE BİR ARAŞTIRMA

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ABSTRACT: Tea is one of the most popular beverages consumed worldwide. Black tea has protective effect in cancer progression and heart diseases. Our aim was to determine the contents of ten different firm's black tea samples sold in Ankara local markets and to evaluate whether obtaining these results were within the Turkish Food Codex values or not. These contents were moisture, ash, ash solved in water, alcality of ash solved in water, ash unsolved in acid, water extract, crude cellulose, non-oxidation piece, dye and caffeine amounts. According to the data obtained in our research, the avarage values of ash, ash solved in water, alcality of ash solved in water, ash unsolved in acid, water extract, crude cellulose, non-oxidation piece and caffeine found in black tea samples were within the Turkish Food Codex values and dye was not found.

Key Words: Tea, quality criteria

ÖZET: Çay dünyada tüketilen en popüler içeceklerden birisidir. Siyah çay kanser gelişiminde ve kalp hastalıklarından koruyucu etkiye sahiptir. Araştırmamızda Ankara piyasasından sağlanan on farklı firmaya ait siyah çay örneklerinin rutubet, toplam kül, suda çözünen kül, suda çözünen külde alkalilik, asitte çözünmeyen kül, su ekstraktı, ham selüloz, okside olmamış parça, boya ve kafein içeriklerinin saptanması ve elde edilen sonuçların Türk Gıda Kodeksi değerlerine uygunluğunun değerlendirilmesi amaçlanmıştır. Araştırmamızda elde ettiğimiz sonuçlara göre rutubet, toplam kül, suda çözünen kül, suda çözünen külde alkalilik, asitte çözünmeyen kül, su ekstraktı, ham selüloz, okside olmamış parça, kafein'in ortalama miktarları Türk Gıda Kodeksi'nde belirtilen değerleri aşmamaktadır ve örneklerde boya bulunmamıştır.

Anahtar Kelimeler: Çay, kalite kriterleri

INTRODUCTION

The most popular non-alcoholic beverage in the world is tea prepared from leaves of *Camellia sinensis*. There are two major varieties, *sinensis* and *assamica* and tea is cultivated in more than 30 countries (1, 2, 3). Of the total amount of teas produced and consumed in the world, 78 % are black, 20 % are green and 2 % are oolong tea (4). Black tea is prepared from leaves that have been withered and undergone a polyphenol oxidase-catalysed oxidation of catechins prior to drying. In some populations tea also provides the greatest single source of polyphenolic antioxidants in the diet (5). Caffeine, total amino acids, water extract and moisture content are considered to be quality indicators for leaf teas and teabags. Caffeine plays a vital role in tea quality contributions, such as briskness and other taste characteristics, and has been considered as an important quality parameter for the evalution of tea quality (6).

There have been many reports on the beneficial effects of tea on human health. Many epidemiological studies have shown that regular consumption of tea is asssociated with reduced risk of several forms of cancer. Tea polyphenols produce their inhibitory actions due to various mechanisms at different stages of mutagenesis,

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carcinogenesis, invasion and metastasis of tumor cells (7,8). Tea can act on many cellular functions and impact positively on cancer and cardiovascular disease, and it is likely that tea can also be helpful in other pathologies. Many reports support this statement. It is reported that tea can improve gastrointestinal function, ethanol metabolism, kidneys, liver, pancreas, stomach injuries, protect skin and eyes, alleviate arthritis, allergies, diabetes, prevent infections, dental caries, and can improve other diseases that have an inflammation component. The beneficial effects of tea on neurological and psychological health have also been reported (9). Our aim was to determine the contents of ten different firm's black tea samples sold in Ankara local markets and to evaluate whether obtaining these results were within the Turkish Food Codex values or not. These contents were moisture, ash, ash solved in water, alcality of ash solved in water, ash unsolved in acid, water extract, crude cellulose, non-oxidation piece, dye and caffeine amounts.

MATERIALS and METHODS

Samples Collection

In this study, total of hundred black tea samples have been analyzed which ten different firms (A, B, C, D, E, F, G, H, I, J) provided that each firm has ten samples sold in Ankara local markets. Samples had different serial numbers. Black tea samples were granulated, were sift and were kept in glass jars.

Methods of Analysis

All reagents were of analytical grade. The methods used for tea samples preparation were based on Turkish Standard Institute method (TSI) (10, 11).

Gravimetric method for moisture analysis

Moisture determination of the tea samples was carried out in accordance with the TSI method. The black tea sample was dried in an oven at 103± 2 °C until the weight of the extract was constant. The loss on drying was measured by weight difference and was expressed as a percentage (w/w) of the sample before analysis (12).

Gravimetric method for ash analysis

The organic substance was broken to pieces by using a drying oven at 525± 25 °C until weight of the extract was constant, as described by TSI method (13).

Gravimetric method for ash solved in water analysis

The total ash was extracted with hot water, filtered with ash-free paper and burned. Then the residue was weighed for the determination of ash unsolved in water. The ash solved in water was calculated by the difference between weighed total ash and the ash unsolved in water. To determine ash solved in water, TSI method was used (14).

Gravimetric method for ash unsolved in acid analysis

After total ash was treated with hidrochloric acid, filtered, burned, the residue was weighed. To determine ash unsolved in acid, TSI method was used (15).

Gravimetric method for water extracts analysis

The methods used for the determination of water extract were based on TSI method. The soluble substances from black tea sample under back cooler and with boiling water were exracted and filtered. Tea extract was then evaporated to dryness over a water bath and the residue was weighed (16).

Gravimetric method for crude cellulose analysis

The black tea samples with 0.255 N sulfuric acid and 0.312 N sodium hydroxide solutions was dissolved. The residue was burned and as a result the loss was determined. Crude cellulose was determined through the guidelines of TSI method and reference methods (10, 17, 18).

Gravimetric method for non-oxidation piece analysis

Non-oxidation green pieces from black tea sample were taken and the residual portion was weighed. To determine non-oxidation piece, TSI method was used (10).

Titrimetric method for alcality of ash solved in water analysis

The filtrate which was obtained in method for ash solved in water, titration volume was measured using the methyl orange indicator and adjusted with hydrochloric acid. TSI method was used (19).

Wool dyeing method for qualitative determination of dyes

The method used for the determination of dyes was based on TSI method. Oil-free white wool was dyed with acidic dyes in 10 % potassium hidrogen sulfate solution and basic dyes in ammonia solution (20).

Spectrophotometric method for caffeine analysis

The methods used for the analysis of caffeine were based on TSI method. The caffeine was extracted in the basic medium, purified as selective in acidic and basic column. The absorbance of the filtrate was measured using a spectrophotometer at 276 nm and was compared with absorbance of standard caffeine solutions (21). The spectrophotometric method is the most oftenly used for determination of caffeine. The technique was found to be repeatable, as similar results were obtained when the same operator used the same equipment.

Statistics

Student's t-test and One-Way Anova test were conducted for statistical comparisons (22).

Student's t-test was used to make a comparison between the analysis results of firms and the standard values. One-Way Anova test was used for statistically controls in amongst the firms.

RESULTS AND DISCUSSION

Quality parameters that moisture, ash, ash solved in water, alcality of ash solved in water, ash unsolved in acid, water extract, crude cellulose, non-oxidation piece, dye and caffeine amounts were analysed in the black tea and results are presented in Table 1,2,3,4,5,6,7,8 and 9.

In black tea samples of ten different firms, avarage (%) moisture as 6.4552±0.1017 g/g, total ash as 5.6233±0.04408 g/g, ash solved in water as 56.5760 ±0.3577 g/g, alkality of ash solved in water as 1.4597±01479 g KOH, ash unsolved in acid as 0.3053±0.01982 g/g, water exract as 30.2793±0.3118 g/g, crude cellulose as 14.6561±0.1384 g/g, non-oxidation piece as 0.4310±0.02771 g/g and caffeine amounts as 2.1540±0.03847 g/g have been determined. Dye was not found in black tea samples.

Results of the analysis were evaluated through the guidelines of Turkish Food Codex (23). According to this the percentages are for total ash (g/g % in dry mass), ash solved in water (g/g % for total ash), alcality in ash solved in water (g % by KOH), ash unsolved in 10% HCl (g/g % in dry mass), water extract (g/g % in dry mass), crude cellulose (g/g % in dry mass), non- oxidation piece (g/g %) and caffeine (g/g % in dry mass) as 4% (min.), 45% (min), 1.5% (max.), 1% (max.), 29% (min.), 16.5% (max.), 8% (max.) and 1.5% (min), respectively. Our data revealed that while the avarage amounts of ash, ash solved in water, alcality of ash solved in water, ash unsolved in acid, water extract, crude cellulose, non-oxidation piece and caffeine found in black tea samples were within the Turkish Food Codex values.

Table 1. The Rates of Moisture in Black Tea Samples (g/g %)

FIRM	N	$\bar{x} \pm s_{\bar{x}}$	Min	Max
A	10	$6.1720^{ab} \pm 0.3225$	4.94	7.50
B	10	$6.8930^{bc} \pm 0.4231$	4.42	8.56
C	10	$7.1820^{c} \pm 0.1704$	5.94	7.87
D	10	$5.6740^{a} \pm 0.2143$	4.86	6.81
E	10	$5.7870^{a} \pm 0.3156$	4.16	7.72
F	10	$6.9440^{bc} \pm 0.1492$	6.06	7.50
G	10	$6.9900^{bc} \pm 0.3253$	5.66	8.89
H	10	$6.7260^{bc} \pm 0.2821$	5.46	8.16
I	10	$5.8470^{a} \pm 0.2018$	5.03	7.21
J	10	$6.3370^{abc} \pm 0.3415$	5.14	8.53
Total	100	6.4552 ±0.1017	4.16	8.89
		F:3.835***		

***: p<0.001

a, b, c: The difference between the mean values of the firms that has different letters in the same column are significant

Table 2. The Amounts of Total Ash in Black Tea Samples (g/g % in dry mass)

FIRM	N	$\bar{x}\pm s_{\bar{x}}$	Min	Max	t
A	10	5.4160 [a]±0.11320	5.02	5.86	12.508***
B	10	5.5520[a]±0.16860	4.85	6.32	9.208***
C	10	5.4570[a]±0.10330	4.99	5.76	14.106***
D	10	5.4060[a]±0.11460	4.96	5.89	12.274***
E	10	5.4420[a]±0.12380	4.99	5.90	11.645***
F	10	6.3230[b]±0.10410	5.97	7.00	22.305***
G	10	5.7360[a]±0.07312	5.33	6.09	23.741***
H	10	5.5420[a]±0.13640	4.96	6.11	11.305***
I	10	5.6810[a]±0.13540	4.98	6.32	12.415***
J	10	5.6780[a]±0.07575	5.32	6.03	22.153***
Total	100	5.6233±0.04408	4.85	7.00	
			F:5.355***		

*** : p<0.001

a,b : The difference between the mean values of the firms that has different letters in the same column are significant

Table 3. The Amounts of Ash Solved in Water in Black Tea Samples (g/g % in dry mass)

FIRM	N	$\bar{x}\pm s_{\bar{x}}$	Min	Max	t
A	10	50.3120a±0.3615	48.00	52.59	14.696***
B	10	55.8950bcd±0.8734	50.16	60.19	12.474***
C	10	57.5960de±0.2652	56.14	58.86	47.501***
D	10	55.3520bc±0.6193	52.77	57.82	16.715***
E	10	55.3480bc±0.4686	52.86	57.50	22.083***
F	10	54.5810b±0.6724	50.16	57.43	14.250***
G	10	61.0580g±0.6195	57.51	64.15	25.923***
H	10	58.3030ef±0.9455	53.30	62.73	14.070***
I	10	57.2340cde±1.1626	50.06	60.93	10.523***
J	10	60.0810fg±0.3830	57.80	61.88	39.373***
Total	100	56.5760±0.3577	48.00	64.15	
			F:19.352***		

*** : p<0.001

a,b,c,d,e,f,g : The difference between the mean values of the firms that has different letters in the same column are significant

Table 4. The Values of Alcality of Ash Solved in Water in Black Tea Samples (g% by KOH)

FIRM	N	$\bar{x}\pm s_{\bar{x}}$	Min	Max	t
A	10	1.2560a±0.01318	1.20	1.33	16.509***
B	10	1.4550b±0.02664	1.30	1.56	1.689-
C	10	1.4890b±0.05646	1.22	1.80	0.195-
D	10	1.4100b±0.05536	1.12	1.66	1.626-
E	10	1.4820b±0.02149	1.42	1.63	0.838-
F	10	1.5320b±0.02711	1.42	1.67	1.180-
G	10	1.4940b±0.02561	1.36	1.61	0.234-
H	10	1.4520b±0.03306	1.29	1.60	1.452-
I	10	1.5110b±0.06990	1.12	1.81	1.157-
J	10	1.5160b±0.05199	1.32	1.80	0.308-
Total	100	1.4597±0.1479	1.12	1.81	
			F:3.623***		

*** : p<0.001,-:p>0.05

a,b : The difference between the mean values of the firms that has different letters in the same column are significant

Table 5. The Amounts of Ash Unsolved in Acid in Black Tea Samples (g/g % in dry mass)

FIRM	N	x̄±sx̄	Min	Max	t
A	10	0.3960±0.04863	0.19	0.61	12.420***
B	10	0.3920±0.08767	0.12	0.87	6.935***
C	10	0.3270±0.04633	0.14	0.56	14.525***
D	10	0.1970±0.02201	0.09	0.28	36.479***
E	10	0.3430±0.07168	0.02	0.83	9.166***
F	10	0.3500±0.03789	0.15	0.52	17.155***
G	10	0.3581±0.10060	0.05	0.89	6.380***
H	10	0.2130±0.04910	0.07	0.59	16.027***
I	10	0.3140±0.06129	0.01	0.67	11.193***
J	10	0.1630±0.02591	0.06	0.30	32.307***
Total	100	0.3053±0.01982	0.01	0.89	
			F:1.933^{-}		

***: p<0.001

Table 6. The Amounts of Water Extract in Black Tea Samples (g/g % in dry mass)

FIRM	N	x̄±sx̄	Min	Max	t
A	10	30.7250^{b}±0.3248	29.31	32.39	5.312***
B	10	30.4090^{b}±1.2049	24.62	34.30	1.169^{-}
C	10	29.0140^{b}±0.3564	27.30	31.20	0.039^{-}
D	10	33.4590^{c}±0.9864	29.95	38.64	4.521***
E	10	29.1020^{b}±0.5625	26.57	31.53	0.181^{-}
F	10	26.4590^{b}±0.4540	23.16	28.03	5.597***
G	10	30.3370^{b}±0.5383	27.00	32.32	2.484*
H	10	30.2370^{b}±0.7147	27.20	33.76	1.731^{-}
I	10	33.8390^{c}±1.4012	28.40	40.12	3.454**
J	10	29.2120^{b}±0.3408	27.65	31.12	0.622^{-}
Total	100	30.2793±0.3118	23.16	40.12	
			F:7.650***		

* : p<0.05, **:p<0.01, ***:p>0.05

b,c : The difference between the mean values of the firms that has different letters in the same column are significant

Table 7. The Amounts of Crude Cellulose in Black Tea Samples (g/g % in dry mass)

FIRM	N	x̄±sx̄	Min	Max	t
A	10	14.0920^{b}±0.3158	12.34	15.26	7.625***
B	10	14.5390^{bc}±0.4365	11.96	16.20	4.493**
C	10	15.7260^{c}±0.3056	14.16	17.27	2.532*
D	10	14.8020^{bc}±0.4764	12.11	16.30	3.564**
E	10	12.9370^{a}±0.5230	10.28	15.08	6.813***
F	10	14.9210^{bc}±0.4538	13.00	17.28	3.480**
G	10	15.4190^{c}±0.3887	13.61	17.40	2.781*
H	10	14.8400^{bc}±0.3852	12.78	17.00	4.310**
I	10	14.6590^{bc}±0.2730	13.96	16.31	6.744***
J	10	14.6260^{bc}±0.2666	13.42	16.20	7.029***
Total	100	14.6561±0.1384	10.28	17.40	
			F:3.720***		

* : p<0.05, **:p<0.01, ***:p>0.001

a,b,c : The difference between the mean values of the firms that has different letters in the same column are significant

Table 8. The Amounts of Non-Oxidation Piece in Black Tea Samples (g/g %)

FIRM	N	x̄±sx̄	Min	Max	t
A	10	0.4430[a]±0.06976	0.19	0.78	15.151***
B	10	0.4670[a]±0.05737	0.20	0.75	18.006***
C	10	0.4200[a]±0.08718	0.08	1.12	12.388***
D	10	0.3250[a]±0.03364	0.13	0.44	34.928***
E	10	0.6900[b]±0.03771	0.47	0.84	21.478***
F	10	0.3460[a]±0.05518	0.14	0.72	20.913***
G	10	0.2370[a]±0.03102	0.11	0.44	40.714***
H	10	0.3640[a]±0.12360	0.02	1.13	9.192***
I	10	0.2540[a]±0.06875	0.10	0.83	18.123***
J	10	0.7640[b]±0.10950	0.34	1.18	6.722***
Total	100	0.4310±0.02771	0.02	1.18	
			F:5.554***		

*** : p>0.001

a,b : The difference between the mean values of the firms that has different letters in the same column are significant

Table 9. The Amounts of Caffeine in Black Tea Samples (g/g % in dry mass)

FIRM	N	x̄±sx̄	Min	Max	t
A	10	1.8870[a]±0.05627	1.52	2.10	6.877***
B	10	2.1190[ab]±0.08450	1.80	2.50	7.325***
C	10	1.9300[a]±0.06864	1.65	2.33	6.265***
D	10	2.5350[c]±0.13180	1.91	3.15	7.853***
E	10	2.1400[ab]±0.12520	1.65	2.84	5.113***
F	10	1.9390[a]±0.03053	1.80	2.11	14.379***
G	10	2.1110[ab]±0.12110	1.80	2.69	5.047***
H	10	2.0360[a]±0.10060	1.65	2.55	5.326***
I	10	2.4550[c]±0.12650	1.90	3.00	7.547***
J	10	2.3880[bc]±0.14210	1.89	2.98	6.248***
Total	100	2.1540±0.03847	1.52	3.15	
			F:4.803***		

*** : p<0.001

a,b,c : The difference between the mean values of the firms that has different letters in the same column are significant

The amount of ash solved in water results in the black tea samples were higher than the other previous survey performed in Turkey. The avarage amount of ash solved in water was determined between 49.4 % and 49.53 % in the black tea samples (24,25). In high quality teas the amount of ash solved in water is higher than the others. Similar studies were previously reported that were concerning with moisture rate, total ash, alcality in ash solved in water, ash unsolved in acid, water extract, crude cellulose and caffeine in the current study. Wetherilt et al. (24) determined for moisture, total ash, ash solved in water, ash unsolved in acid, crude cellulose and caffeine in black tea samples as 1.3-9.8 %, 4.3-5.6 %, 33-65 %, 0.04-0.61 %, 10.5-21.6 % and 1.5-3.2 % respectively. Poyrazoğlu and Gürses (25) have reported that 4.96-5.71 %, 36.6-57 %, 1.20-1.63 %, 0.68-1.33 %, 29.3-44.2 %, 10.5-16.2 % and 1.60-2.49 % were observed for total ash, ash solved in water, alcality in ash solved in water, ash unsolved in acid, water extract, crude cellulose and caffeine, respectively. Yurdagel and Yaman (26) determined for moisture rate, total ash, water extract and crude cellulose in black tea samples as 7.11-8.63 %, 5.00-7.20 %, 28.68-37.15 % and 10.33-17.77 %, respectively. Arslan and Toğrul (27) determined for moisture rate, total ash, alcality in ash solved in water, ash unsolved in acid and water extract in black tea samples as 3.52-9.33 %, 5.28-6.48 %, 1.30-2.23 %, 0.13-0.44 % and 28.02-37.78 %, respectively.

Poyrazoğlu and Gürses (25) reported that non-oxidation piece rate in black tea as 0.12-1.00 %. In our research non-oxidation piece rate was determined as 0.4310±0.02771 % in black tea samples. However, these researches reported that dye was not found in black tea samples. These results were found to be similar to our research.

The contents in black tea samples has also been investigated in several countries (6,28,29). Yao et al. (6) determined for moisture rate, water extract and caffeine in black tea samples as 6.5-7.0 %, 31.50-39.85 % and 3.31-4.61 %, respectively. These content amounts in black tea samples were found to be higher than our

findings. Hall et al. (28) reported moisture rates as 8.9 %-17.3% in black tea samples and its moisture rates were found in high levels. Ravichandran (29) determined for total ash, ash solved in water, ash unsolved in acid, water extract, crude cellulose and caffeine in black tea samples as 4.40-7.10 %, 36.00-47.00 %, 0.60-1.10%, 40.10-46.10%, 13.70-15.50% and 2.72-2.92%, respectively. These total ash and crude cellulose amounts in black tea samples were found to be similar to our research.

Since the climate and the genetical properties effect the amount of the product; picking, processing and storage should be in suitable conditions. Furthermore, quality and control studies should be applied effectively through the periods that pass from production and processing to reaching the consumer.

Turkey has a great potential in black tea production. This potential has to become more valuable because of the advantages that it will supply for the country economy.

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