

CONSUMPTION OF BLACK AND GREEN TEAS AS A DIETARY SOURCE OF POLYPHENOLS IN POLISH INHABITANTS OF THE MAZOVIAN REGION

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ABSTRACT

Background. Tea is a very popular drink throughout many parts of the world, that includes Poland. The tea infusion (cup of tea) itself contains phenolic compounds with anti-oxidant properties that constitute 30% of the dry mass of tea leaves responsible for a health promoting effect on the human body.

Objectives. To estimate the determinants and amounts of black and green tea consumed by a selected population group, along with their polyphenols intake from tea.

Material and Methods. A survey was conducted of 281 subjects in 2012 from the Mazovian region of Poland, recruited from social-networking sites which had been sent a web application questionnaire (Mini-ankiety.pl).

Results. Subjects were aged 18-56 years, of whom the majority (73%) were aged 21-30 years. City dwellers constituted 86%, whilst those remaining were from small towns (14%). Black tea was drunk by 80% of whom 39% did so daily, whilst green tea was drunk by 72% of whom 17% did so daily. Determinants affecting the amounts of tea drinking were principally gender, education, place of residence and number of household members. Women significantly drank more than one cup of green tea daily compared to men. Those with a higher education significantly drank more than one cup of black tea daily compared to those with lower education levels. Homeowning subjects with 2 household members significantly drank more than one cup of green tea daily than the others. The average daily intakes of polyphenols from black tea in those who drank so regularly was 503 mg and that for green tea was 361 mg.

Conclusions. The main source of tea polyphenols was found to be black tea as this was drunk more often than green tea. There is a need for promoting more green tea to be drunk as a source of polyphenols.

Key words: *black tea, green tea, polyphenols, polyphenols intake from tea*

STRESZCZENIE

Wprowadzenie. Herbata jest bardzo popularnym napojem spożywanym w wielu rejonach świata, w tym w Polsce. Zawarte w składzie naparów herbacianych związki fenolowe wykazują antyoksydacyjne działanie. Stanowią one ponad 30% suchej masy liści i to właśnie im herbata zawdzięcza swój prozdrowotny wpływ na organizm.

Cel badań. Celem badań było oszacowanie poziomu i uwarunkowań spożycia herbaty czarnej oraz zielonej w wybranej populacji, a także szacunkowa ocena spożycia polifenoli wraz z herbatą.

Material i metoda. Badanie przeprowadzono w 2012 roku wśród 281 osób za pośrednictwem aplikacji internetowej Mini-ankiety.pl, do której adres internetowy został rozpowszechniony na portalach społecznościowych.

Wyniki. W badaniach udział wzięły osoby w wieku od 18 do 56 roku życia, przy czym najliczniejszą grupę (73%) stanowiły osoby w wieku 21-30 lat. Wśród badanych 86% osób pochodziło z dużego miasta, a pozostałe (14%) zamieszkiwały małe miasta. Uzyskane wyniki wskazały, że 80% badanej populacji spożywało herbatę czarną, z czego 39% codziennie. Herbatę zieloną spożywało 72% badanych z czego codziennie -17%. Czynniki mające wpływ na ilość spożywanej herbaty to przede wszystkim płeć oraz wykształcenie, a także miejsce zamieszkania i liczba osób w gospodarstwie domowym. Kobiety istotnie częściej w ilości 1 szklanki/dzień pijały napar z zielonej herbaty w porównaniu do mężczyzn. Respondenci z wykształceniem wyższym istotnie częściej (codziennie) spożywali herbatę czarną i zieloną w porównaniu z osobami z niższym wykształceniem. Ankietowani zamieszkujący mieszkanie własne w gospodarstwie dwuosobowym istotnie częściej pijali 1 szklankę/dziennie naparu z zielonej herbaty. Średnia ilość polifenoli przyjmowana dziennie z herbatą czarną wśród osób deklarujących jej regularne spożycie wyniosła 503 mg, natomiast z herbatą zieloną 361 mg.

Wnioski. W badanej populacji, ze względu na wyższe spożycie, lepsze źródło polifenoli stanowiła herbata czarna niż zielona. Istnieje konieczność większego propagowania picia herbaty zielonej, jako źródła polifenoli.

Słowa kluczowe: *herbata czarna, herbata zielona, polifenole, pobranie polifenoli z herbatą*

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INTRODUCTION

The tea beverage is obtained from the *Camellia sinensis* (L.) plant, which not counting water is the most common drink consumed throughout the world. It is of enormous nutritional significance to many global populations. From its origins in China at around 2700 BCE, tea drinking has rapidly expanded.

Tea drinking initially became widespread due to its health benefits although it soon also became very popular because of its uncommonly good taste/flavour. The many different tea varieties and its huge worldwide consumption make it an essential part of many cultures as well as fulfilling important social functions. Tea infusions are a vital source of dietary antioxidants. They also impart various physiological effects such as stimulant, refreshment, pain relief, reducing body mass, anti-cancer, reducing cardiovascular disease and strengthening the immune system [3, 11].

Due to the presence of polyphenols, tea has a high antioxidant potential thus being of benefit to the human body and these, at 36%, are the most important antioxidant compounds of which flavonols (or catechins) are the most numerous (80%). They principally consist of epigallocatechin gallate (EGCG), epigallocatechin (EGC) and epicatechin gallate (ECG). Other polyphenols present in smaller amounts are catechin, gallic acid, catechin gallate, epigallocatechin and epicatechin digallate [7, 12]. Such polyphenols in tea infusions demonstrate antioxidant and, indirectly, anti-inflammatory and anti-cancer properties, as confirmed by *in vitro* and *in vivo* clinical studies. These compounds inhibit transcription factors sensitive to changes in the redox balance, show pro-oxidative enzyme activity and may induce anti-oxidative enzymes in the Phase II auto-oxidative process. Many studies confirm that oxidative damage to DNA, lipids or protein is vitally significant to cancer development. The formation of nitrogen and oxygen free radicals in the human body are often too much for defence mechanisms to cope with. Dietary antioxidant intake is thereby particularly important in preventing chronic disease. Both green and black teas are a rich source of polyphenols with antioxidant properties, which may thus beneficially impact the human body [5]. The study aim was to therefore estimate the amounts and determinants of consumption green and black tea in a selected population, together with estimating polyphenols intakes derived from drinking such teas.

MATERIAL AND METHODS

The survey was conducted by means of an internet application (available on www.mini-ankieta.pl) that was made distributed throughout social networking sites.

The questionnaire was designed for determining the rates and amounts of green and black tea drunk, along with determinants/factors affecting such consumption. There were 22 questions covering anthropometry, demographics (eg. types of household, numbers of household members), education, rates and amounts of green and black tea consumption, presence of additives in tea, reasons for making tea variety choices, the significance of chosen tea quality and the drinking of other beverages. Replies to most questions required selecting a single definite response from a closed list. Some however were half-open ended, where more than one reply could be chosen. Several questions on anthropometry were also open-ended that included age, height, body mass and place of residence.

The flavonoid content was estimated from the USDA Flavonoid Data base prepared by the U.S. Department of Agriculture, Agricultural Research Service [4], from which the mean polyphenols content in 100 g of an 1% infusion of black or green tea was taken as respectively 119 and 121 mg.

Statistics were performed on the Statistica 6.0 package. The Chi^2 test for independence was used to assess if there were any significant associations between black and green tea intakes with the studies variables (ie. gender, age, BMI, education, water consumption, place of residence and number of family members). A significance level of $p \leq 0.05$ was adopted.

RESULTS AND DISCUSSION

The study subjects were 158 men and 123 women aged 18-56 years, of whom the most frequent were aged 21-30 years (73%). Most lived in the large city of Warsaw (86%) whilst the others came from small cities (Legionowo, Piaseczno and Pruszkow). Subjects possessing higher education were the most common (62%), whereas those with middle, vocational and secondary education were respectively 15%, 1% and 6%. Of all, 6% claimed to be students. According to their BMI, 68% subjects had normal body mass, 23% were overweight, 5% obese and 4% underweight. Family homes accounted for 39% subjects, 36% were homeowners and 20% lived in rented flats; the smallest group (5%) lived in rented rooms or student accommodation. Two member households were found to be the most frequent (28%), with respectively 3, 4 and single membered households at levels of 24%, 21% and 17%.

Black tea was daily drunk by 39% subjects with those most often having one cup daily (19%) and 39% added sugar. Green tea was daily drunk by 17% subjects with those most often (35%) having one cup daily and 52% not adding anything (Table 1).

Table 1. Ways of consumption tea in the subjects studied

	Black tea		Green tea	
	Numbers n=281	%	Numbers n=281	%
Types of tea drunk:				
Tea bags	180	64.1	104	37.0
Instant tea	3	1.0	-	-
Loose leaf	41	14.6	98	34.9
Tea not drunk	57	20.3	79	28.1
Consumption frequency				
Daily	111	39.5	48	17.1
1 – 2 times weekly	35	12.5	43	15.3
3 – 4 times weekly	29	10.3	33	11.7
5 – 6 times weekly	18	6.4	24	8.5
Less than once weekly	36	12.8	60	21.4
Not applicable	52	18.5	73	26.0
Daily consumption				
1 cup	56	19.9	100	35.6
2 cup	52	18.5	40	14.2
3 cup	33	11.7	9	3.2
4 cup	20	7.2	6	2.1
More	7	2.5	6	2.1
Not applicable	113	40.2	120	42.8
Additives used				
Sugar	96	34.2	32	11.4
Lemon	38	13.5	10	3.6
Milk	2	0.70	0	0
Honey	15	5.30	7	2.5
None used	75	26.7	147	52.3
Not applicable	55	19.6	85	30.2
Reasons for drinking*:				
Taste	143	-	115	-
For health	14	-	133	-
As a stimulant	20	-	29	-
Thirst quenching	80	-	51	-
From habit	92	-	15	-
Not applicable	57	-	48	-

* - more than one answer can apply.

In Poland, black tea is currently one of the most popular beverages. Together with the UK, Ireland, Holland and Germany, Poland has one of the highest consumption rates in Europe [8]. According to the Polish Chief Statistical Office (GUS), the average annual tea

consumption is 1 kg (dry mass) per person; this being equivalent to drinking almost 1.5 cups of tea (infusions) daily. According to a 2010 report [15], 64% of Poles drink tea twice daily, 21% once daily and over 15% did so four or more times daily.

Of the 281 subjects, apart from tea, 89% also most frequently drank mineral water, 54% fruit/vegetable juices and 54% coffee. Next to follow were isotonic beverages at 40%, whilst 30% consumed fizzy sweetened drinks (cola, fanta, sprite) and 30% fresh fruit drinks. Lower consumption rates of sweetened non-fizzy fruit or nectar drinks (22%) were observed along with 21% frozen teas (Nestea type) and 19% energy drinks. The least frequent drinks were fresh vegetable juices at 10%.

A significant relationship was seen between the frequency and amounts of green tea drunk with gender (Table 2), where women more often drank one cup daily ($p=0.001$) than men. Another significant association was observed where those drinking mineral water, more frequently drank black ($p=0.048$) and green teas ($p=0.02$). Subjects with higher education, had significantly higher rates (daily) of black and green tea consumption compared to the other less educated subjects; respectively $p=0.018$ and $p=0.013$. There was also a significant link demonstrated between amounts of green tea drunk with the place of residence and numbers of household/family members; those living in their own homes ($p=0.023$) in two membered households ($p=0.003$) more frequently drank one cup of green tea daily.

Education was found to affect rates of tea consumption (along with that of polyphenols), where those with higher education, daily drank more which may be related to having a higher awareness of the tea's health benefits. Women also decidedly drank more green tea than men, however there was no such difference for black tea. A possible explanation could be that information on green tea can be mostly found in women's magazines.

Table 3 shows the subjects' estimated polyphenols intakes from black and green teas. Those drinking black

Table 2. The effect of studied determinants/factors on the frequency and amount of black/green tea consumed in subjects under study

Factors	Black tea		Green tea	
	Frequency	Amount	Frequency	Amount
Gender	NS*	NS	0.001**	0.002
Age	NS	NS	NS	NS
BMI	NS	NS	NS	NS
Education	0.018	NS	0.013	NS
Place of residence	NS	NS	NS	0.023
Number of household members	NS	NS	NS	0.003
Mineral water consumption	0.048	NS	0.020	0.015

* NS-statistically insignificant; ** p value by Chi^2 test

tea consumed 503 mg polyphenols daily, whilst those drinking green tea consumed 361 mg polyphenols daily.

Table 3. Polyphenols intake from black/green tea in studied subjects

Daily tea consumption	Polyphenols intake from tea [mg/person/day]
Black tea	
1 cup (n=56)	238
2 cups (n=52)	477
3 cups (n=33)	715
4 cups (n=20)	954
Mean (n=161)	503
Green tea	
1 cup (n=100)	242
2 cups (n=40)	485
3 cups (n=9)	727
4 cups (n=6)	970
Mean polyphenols intake (n=155) [mg/person/day]	361

Analytical data on the amounts of polyphenols in tea normally consider tea infusions. Their practical preparation however varies according to country and consumer preference. For this reason it is difficult to compare flavonoid amounts in tea infusions from various sources and methods of brewing tea. The amounts of polyphenols in tea infusions rise in relatively linear fashion according to the number of tea leaves used. The brewing time however does not significantly affect flavonoid content in the infusion as most become quickly extracted within 3 minutes of starting the brew and their quantities do not significantly rise if the brewing time is extended [2, 19].

Due to the proven health benefits of drinking green tea, (as a source of polyphenols), it seems reasonable and appropriate to promote and popularise this custom. Because of the antioxidant properties of the polyphenols found in tea, their beneficial effects can be seen on preventing and treating cardiovascular disease, cancer, diabetes as well as their anti-bacterial actions and as an assist in reducing body mass [1, 6, 10, 14]. Furthermore, green tea contains the least oxalates when compared to other types of tea [13].

CONCLUSIONS

1. Black tea provided a better dietary source of polyphenols than green tea because it was drunk more by the studied subjects.
2. Gender, education, place of residence and number of household members were found to be the main factors determining polyphenols intakes from drinking tea.
3. Consumption of green tea should be promoted more as a valuable source of polyphenols.

Conflict of interest

The authors declare no conflict of interest.

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