VARIATIONS IN PHYSIOCHEMICAL PROPERTIES OF INFUSION EXTRACTS OF COMMERCIALLY AVAILABLE TEA BAG SAMPLES

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خلاصہ

اس مطالہ کا مشقصد الگ الگ زائقوں والی سبز چائے اور کالی چائے کے مختلف نمونون میں چائے کے بیگ کے بھگوئے ہوئے وقت کے لحاظ سے طبعی سے خصوصیات (Specific gravity, conductivity, pH and TDS) کو معلوم کرنا تھا۔ نتائج سے پتا چلا کے چائے کے بیگ کے ڈیونے کا وقت ان تمام طبعی خصوصیات پر اثر انداز ہوتا ہے۔ جیسے کے دبونے کا وقت پی ایچ کے ساتھ بر عکس تناسب ظاہر کرنا ہے۔ جبکہ بقایا خصوصیات براہ راست تعلق ظاہر کرتی ہیں۔ کالی چائے میں سبز چائے کا نسبت زیادہ تیزابیت پائی گئی ہے۔ اسکے علاوہ مصنوعی زائقوں کا اثران چائے کی خصوصیات پر بھی نوٹ کیا گیا۔ مثال کے طور پر لیموں کے زئقے والی چائے نے کم پی ایچ اور زیادہ تیزابیت ظاہر کی جبکہ الائچی کے زائقے والی سبز چائے میں زیادہ پی ایچ اور کم تیزابیت پائی گئی۔

Abstract

The study aimed to determine physiochemical properties (pH, conductivity, TDS and specific gravity) of extracts of various samples of tea (green and black) after their immersion for 5 and 10 minutes in hot water. The time of immersion showed remarkable effects on all studied parameters. In this perspective, the pH exhibited the inverse relation with brewing time while the other parameters showed direct relation with the brewing time. Black tea was found to be more acidic than green tea. Flavor of green tea also influenced the physiochemical properties especially pH/acidity i.e. Lemon flavored green tea has the lowest pH, highest acidity while, Elaichi (Cardamon) flavored green tea had the highest pH, lowest acidity.

Introduction

In our society black tea with milk or tea whitener consume generally, however green tea is popular from last decade as well and make a place in all social circles especially in offices. After water, tea is the most widely consumed beverage in the world (Mcfarlane and Mcfarlane, 2004). An infusion of the dried leaves of *Camellia sinensis* is a common tea beverage, known as green tea; it is a member of *Theaceae* family and it is cultivated in most of the countries around the world (Sharma *et al*., 2007). Largest cultivation of green tea occurs in African countries, such as Nigeria, Kenya, Malawi, Zimbabwe and South Africa (Greenop, 1997; Aroyeun *et al*., 2012). On the basis of industrialized processes, teas are divided into 3 main types; non-fermented green tea, it is formed by drying and scorching the fresh leaves and thus no fermentation occurs; semi-fermented oolong tea, it is formed when the fresh leaves are processed to partial fermentation before drying. In black and red teas, full fermentation occurs before the drying and streaming. Despite the fact that the black tea fermentation is carried out by oxidation by using microorganisms (Zuo *et al*., 2002).

Tea contains large amount of polyphenols like flavonoids and catechins, which are powerful antioxidants. The bio-sorption of the bioactive components of tea takes place in the upper part of the GIT. Milk in black tea diminishes the antioxidant value, since milk protein form complex with tea polyphenols (Serafini *et al*., 1996). It is well known that oxidative damage contributes to the development of cancer and that antioxidants can have a protective effect (Oberley, 2002).Green tea drinkers have up to a 31% lower risk of cardiovascular disease (Shimazu, *et al*., 2007) because Green tea also dramatically increases the antioxidant capability of the blood, which protects the LDL cholesterol particles from oxidation, which is one part of the pathway towards heart disease (Zang *et al*., 2000).Tea catechin leads to decreases in body fat, especially in the abdominal area (Tokimitsu, 2004).Acute green tea ingestion can increase fat oxidation during moderate-intensity exercise and can improve insulin sensitivity and glucose tolerance in healthy young men ((Iso *et al*., 2006; Venables *et al*., 2008; Liu *et al*., 2013).

Tea contain inorganic anions (fluoride, chloride, nitrates, phosphates, sulphates, etc.) heavy metal (e.g. aluminium, copper, cadmium, chromium, etc.) (Simpson *et al*., 2001). Inorganic ions and carboxylic acids contribute to the acidity associated with an agreeable aroma and flavor. (Alcazar *et al*., 2003). Fluoride and iodide are very important micronutrients in small concentrations, and become toxic in high concentrations; an incorrect iodide dietary balance can cause thyroid disorders. Excessive fluoride consumption induces symptoms of acute and chronic fluoride toxicity (fluorosis). Chloride, the main anion in the extracellular fluid, is responsible for muscle irritability. Phosphorus is essential for tissue growth and renewal. Phosphorus compounds carry, store, and release energy and assist several enzymes and vitamins in extracting energy from nutrients. Nitrates and nitrites induce paralysation of the vasomotor centre, causing vasodilatation of small caliber vessels associated with hypotension and collapse (Mincă *et al*., 2013). Tea contain two components that can cause side effects if it is more ingested, side effects are anxiety, diarrhea upset stomach and Nausea due to caffeine constituent, constipation and iron deficiency is due to tannin constituent. (NIH, 2006). There are some precautions for tea ingestion. Skin rashes has been reported in caffeine or tannin sensitive person. Mainly the kidney, heart, ulcer, stomach, anxiety associated patients should avoid tea and Caffeine stimulant may cause insomnia, worsen ulcer and increase heart beats. (Hawkins, 2007; Basch, 2008)

The current studies have been conducted to evaluate the physico-chemical properties (pH, conductivity, TDS and specific gravity) of various brands of tea including black tea and different flavored green tea packed in perforated paper bags and also determined the effect of time of infusion on these parameters.

Materials and Methods

Sampling

Various samples of black tea and green tea enclosed in filter paper bags (~2g each) were chosen for the study. Samples included currently introduced variously flavored green tea (lemon, peach, apple, elaichi, jasmine and mint flavored green tea) and normal black tea bags of different brands were purchased in February 2017 from local market in Karachi. All samples were coded in this manner; GLL, GTP, GTL, GLM, GTA, GVJ, GTM, GTE, GLJ, GTJ, BL, BT, where first latter, G abbreviated for green tea and B for black tea, second letter indicated brand's name L for Lipton, V for Vital and T for Tapal while the third latter represents their flavors as L, P, M, A, J and E for lemon, peach, mint, apple, jasmine and elaichi (cardamon) flavors respectively.

Preparation of tea extract

The preparation of sample's extract based on accordance to general consumer's choice i.e. light and strong tea. In this perspective, two durations 5 minutes and 10 minutes were selected for the preparation of sample extract. The extracts of each sample were prepared by immersing the tea bags in boiled distilled water for specific periods. Each sample was assayed in doublet, for this purpose, 24 beakers were taken with 200mL distilled water and boiled at 100°C and allowed to infuse tea bags for 5 minutes and the same procedure was applied to infuse tea bags for 10 minutes, discarded the tea bags and stand to cool the extracts at room temperature.

Determination of physiochemical parameters

Some physiochemical parameters such as pH, conductivity, TDS (total dissolved solid), and specific gravity of all tea sample extracts were measured. The measurement of pH values were made by JENWAY 3510 pH meter, calibrated by buffer solutions of pH 4.0, 7.0 and 10.0. The pH of all tea extracts was recorded by immersing electrode. Conductivity was determined by conductivity meter Jenwey 4510 CM, the TDS values obtained through conductivity and specific gravity were determined by (AOAC, 2000).

Statistical analysis

Data obtained of each parameter was analyzed statistically by Minitab Version 11. Sets of observations were grouped based on similarity using Euclidean distance and hierarchical tree diagram by applying multivariate Ward cluster analysis separately (Hanrahan, 2012). The mean of data was compared by paired t test at 95% confidence level on SPSS version 14.0.

Results and Discussion

The cluster of Fig 1 constructed on the basis of physiochemical properties of tea extracts obtained by 5 minutes immersion of tea bags. Four group (A, B, C & D) were identified on the basis of similarities. Group A and B comprised of four samples of each flavored green tea while, group C and D exhibited two types of green tea and black tea samples, respectively.

The largest distance of group D revealed that the data was significantly dissimilar as compared to other groups and characterized by lowest values of pH, moderate values of specific gravity and highest values of parameters (conductivity, and TDS). Despite the fact that smaller distance covered by groups A and B which directed the slightly differences and fairly different in contrast to group C (Table 1).

The cluster diagram (Fig 2) constructed on the basis of physiochemical properties of tea extracts obtained by 10 minutes immersion of tea bags indicated three groups (A, B & C) as recognized on the basis of resemblances. Group A included six samples and group B was composed of four samples while group C consisted of two black tea samples. According to Table 2, group A characterized by moderate level of pH, the lowest values of conductivity, TDS and specific gravity. Group B represented the highest level of pH, Specific gravity and moderate level of conductivity and TDS. Group C exhibited lowest value of pH, moderate level of specific gravity and highest level of conductivity and TDS.

Acidity is usually measured by pH, with pure water being given a pH of 7, and acids being given lower pH, we can recognize acidity as sour flavors by the help of pH. Tea that tastes sour thus have greater acidity and low pH. While sourness can sometimes be problematic to separate from other flavors like bitterness, or other qualities like astringency taste can be a good coarse indicator of the relative acidity of different flavored tea samples (Alcazar *et al*., 2003). Collectively, (Fig 3) exhibited the inverse relation in pH values with brewing time. In this perspective, all extract of samples prepared after brewing 5minutes showed greater pH as compared to those prepared after brewing 10 minutes. In other words, acidity significantly different ($r=0.996$; $P<0.05$) with respect to time of infusion of tea bags. In comparison, samples of black tea showed the lower pH values than green tea. The pH of black tea was recorded less than 5 and pH of green tea was found greater than 5 as shown in Tables 1 & 2. Among green tea samples, GTE represented the highest pH values while GLL showed the lowest pH in both immersing times. These measurements disclosed the fact that GTE (Green tea in Elaichi/Cardamon flavor) has the lowest acidity whereas; GLL (Green tea in Lemon flavor) has the highest acidity. The recorded values of pH of tea extract in present study resembled with the reported values of previous studies (Minca *et al*., 2013; Garba *et al*., 2015).

Conductivity measures the amount of electrolytes found in aqueous solution of samples, these electrolytes are sodium, potassium, chlorine, and many other cation and anions (Pyoralla, 2013). Flavoring increases the total anionic content for all infusions studied (Alcazar *et al*., 2003). (Fig 4) exposed strong correlation ($r=0.939$) in conductivity values with brewing time. Infusion for 5 minutes showed lower conductivity and 10 minutes showed significant change ($P<0.05$) in conductivity. In contrast, samples of black tea revealed higher values than green tea. Among green tea samples GTL signified highest conductivity in 5 minutes, While GLJ showed lowest conductivity in both submersing times. It may probably be attributed to the fact that lemon flavored green tea has highest number of moveable free ions than jasmine flavored green tea. Our results resembled with those of (Minca *et al*., 2013).

TDS values help to know about amount of inorganic salts like Na, K, Mg, Ca, and Cl. And organic composite found in samples (Hanrahan, 2012). Fig. 5 displayed large difference in the measurements of green tea and black tea. The lower values of TDS were noted in green tea samples as compared to values of black tea samples this significant difference ($P<0.05$) and strongly corelated ($r=0.931$) with time of infusion. Among green tea samples GTL characterized by the highest TDS value. However, GLJ represented lowest TDS value in both the time of immersion of tea bags.

Specific gravity of water is 1.000 at 4°C. If the density of a liquid is greater than the density of water, then its specific gravity is greater than 1. Fig. 6 demonstrated that the specific gravity of black tea and green tea is near to the specific gravity of water. The highest value of specific gravity was found in GTM, GTL and GTP. It means mint, lemon and peach flavored tea is denser than water. The observed value of specific gravity of lemon flavored found in the range of the standard values 1.03 - 1.04 established by FAO/INfoods (2012). The significant change ($r=0.930$; $P<0.05$) in specific gravity with respect to time of infusion was noticed.
Variation in properties of green and black tea samples may also be due to different flavor and aroma in tea (Hara *et al*., 1995). By increasing infusion time of tea bags in hot water, all nutrients, and metal contents increases, that increases all physiochemical parameters (Garba *et al*., 2015).

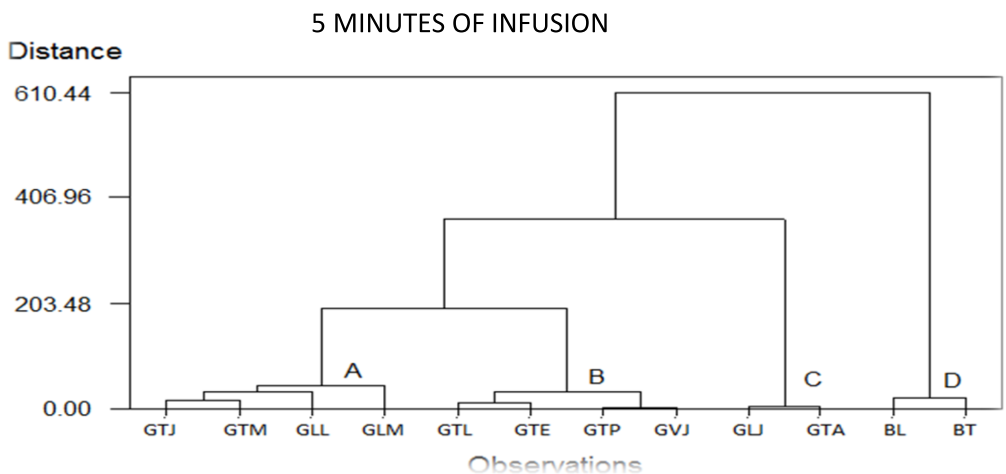

Fig.1. Dendrogram of tea samples based on physiochemical properties of tea extracts obtained by 5 minutes infusion of tea bags.

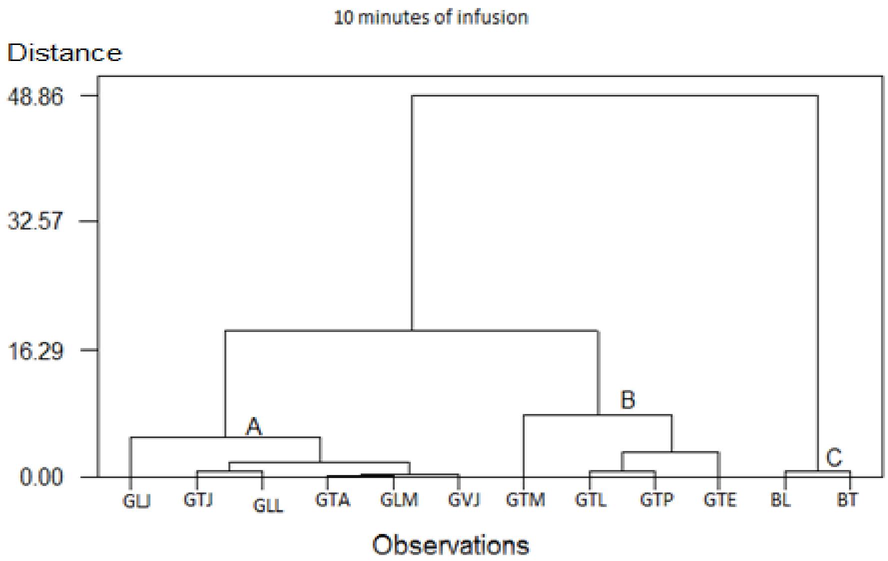

Fig.2. Dendrogram of tea samples based on physiochemical properties of the tea extracts obtained by 10 minutes infusion of tea bags.

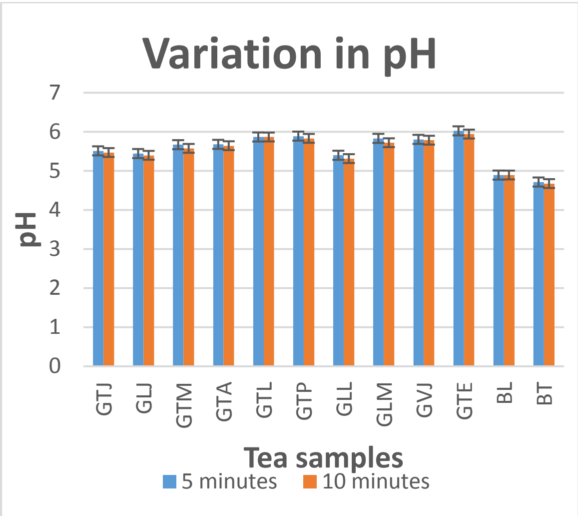

Fig.3. Variation in pH of 5 minutes and 10 minutes extracted samples

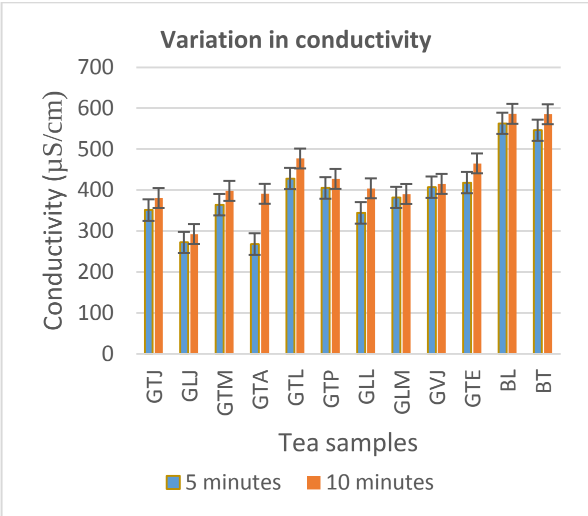

Fig.4. Variation in conductivity of 5 minutes and 10 minutes extracted samples.

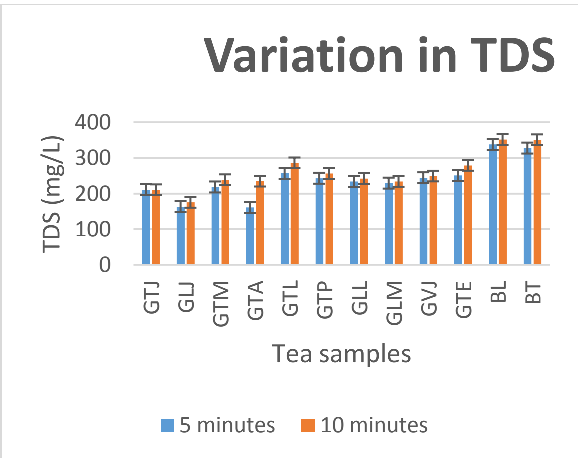

Fig.5. Variation in TDS of 5 minutes And 10 minutes extracted samples.

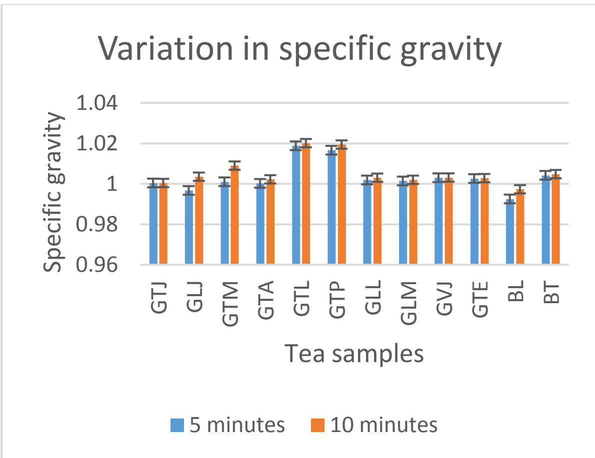

Fig.6. Variation in specific gravity of 5 minutes And 10 minutes extracted samples.

Table 1. Observed ranges of physiochemical parameters of tea extracts of Commercially Available Tea Bag samples after brewing 05 minutes.

Groups	pH	Conductivity µS/cm	TDS mg/L	Specific gravity
A	5.314 - 5.72	344 – 382	210 .6 – 234	1.00 – 1.002
B	5.785 – 5.942	405 – 428	244.2 – 256.8	1.003 – 1.019
C	5.398 – 5.644	268 – 272	160.8 – 163.2	0.997 – 1.00
D	4.674 – 4.894	546 – 563	327.6 – 337.8	0.993 – 1.004

Table 2. Observed ranges of the physiochemical parameters of tea extracts of Commercially Available Tea Bags samples after brewing 10 minutes.

Groups	pH	Conductivity µS/cm	TDS mg/L	Specific gravity
A	5.399 – 5.831	292 – 415	175.2 – 249	1.0004 – 1.0035
B	5.670 – 6.024	398 – 477	238.8 – 286.2	1.0028 – 1.0360
C	4.714 – 4.842	585 – 586	351.0 – 351.6	0.9973 – 1.0048

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