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Quantitative Analysis of Various Brands of Tea Powder Marketed in Kerala - Comparative Study

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Abstract: ***This research paper attempts an analysis of the content and the various properties of different brands of tea powder marketed in Kerala. Quality parameters like pH, colour absorbance, bulk density, caffeine content, acid content and calcium tannate content was determined and compared for different samples. Each measurement was repeated thrice and the average value is reported. It was found that the aqueous solutions of tea powders are acidic and the caffeine content and colour absorbance is lowest in green tea. Bulk density of the samples varies from 0.258 - 0.614 g/cm^3.***

Keywords: pH, bulk density, caffeine content, acid content, calcium tannate content

1. Introduction

India is the largest producer of tea powder in the world with annual production of over 900 million kgs, representing over 28% of the world production of 3.2 billion kg. Tea is made from the young leaves and buds of the tea plant. Tea leaves are rich in caffeine (alkaloid). Besides caffeine, tea leaves also contain tannic acid and colouring matter, such as polyphenolic compounds. The relative amounts of these substances are different in different varieties of tea leaves, which is why, their tastes and flavours are different.

Tea promotes health but at the same time it causes health problems due to its caffeine content. Thus, to get the benefits of tea, but at the same time minimizing the adverse effects of caffeine, we have to consume the lowest possible amount of caffeine. Many tea brands are present now a days but all are not similar, it differs based upon the availability, colour , texture, quality and cost. The caffeine levels are also different in individual tea powders.

Tea is one of the most popular beverages worldwide due to its taste, aroma, and health effects. Young shoots of tea bushes are mainly processed into black tea, green tea, and oolong tea. Among these, green tea is most beneficial to human health. Recently reported pharmacological properties, e.g., antioxidant, anti- inflammatory, antimutagenic, and anticarcinogenic effects also served to increase the popularity of green tea.

Green tea powder, known as matcha, is an important tea product. It has also become a popular additive in the production of beverages, chocolates, candies, cakes, pastries, cookies, puddings, ice creams, etc.. Green tea powder is made from young shoots of tea bushes that have been shaded for a few weeks, which enriches the free amino acids content (e.g., theanine). In this manner, green tea becomes flavor-rich before it is hand-harvested. Shading leads to greener, tastier, and less astringent tea leaves and, thereby, attracts the consumer. After harvest, the young shoots are processed into green tea powder by series of processing steps: steaming; drying; removing of stems, midribs, and veins; and fine stone milling.

Information about tea powder chemical composition helps in assessing its quality on the one side, and helps to monitor and manage its growing, processing, and storage conditions on the other side. In particular, this knowledge has enabled to establish the relationships between the chemical composition of tea and its properties by identifying the tea constituents which determine its aroma and taste. There are reported studies on green tea powder related to milling methods, particle characteristics and foaming properties. Catechin contents were also studied in green tea powder.

Comparative study and analysis of quality parameters like pH, colour absorbance, bulk density, caffeine content, acid content and calcium tannate content of different brands of tea powder marketed in Kerala is beneficial to human health.

2. Literature Survey

Increasing interest in the health benefits of tea has led to the inclusion of tea extracts in dietary supplements and functional foods. However, epidemiologic evidence regarding the effects of tea consumption on cancer and cardiovascular disease risk is conflicting. Tea is one of the most popular beverages worldwide due to its taste, aroma, and health effects (Khokhar and Magnusdottir, 2002). Young shoots of tea bushes are mainly processed into black tea, green tea, and oolong tea. Among these, green tea is most beneficial to human health. Recently reported pharmacological properties, e.g., antioxidant, anti- inflammatory, antimutagenic, and anticarcinogenic effects also served to increase the popularity of green tea (Higdon and Frei, 2003; Cabrera et al., 2006; Pharn-Huy et al., 2008; Yuan et al., 2011). Medicinal Chemistry of tea was reported by Derek S. Wheeler, William J Wheeler (2004). Green tea powder, known as matcha, is an important tea product. It has also become a popular additive in the production of beverages, chocolates, candies, cakes, pastries, cookies, puddings, ice creams, etc. (Tokunaga, 2004). Green tea powder is made from young shoots of tea bushes that have been shaded for a few weeks, which enriches the free amino acids content (e.g., theanine). In this manner, green tea becomes flavor-rich before it is hand-harvested (Hirai et al., 2008).

Shading leads to greener, tastier, and less astringent tea leaves and, thereby, attracts the consumer (Ku et al., 2009). After harvest, the young shoots are processed into green tea powder by series of processing steps: steaming; drying; removing of stems, midribs, and veins; and fine stone milling (Tokunaga, 2004).

There are reported studies on green tea powder related to milling methods, particle characteristics (Haraguchi et al., 2003; Sawamura et al., 2009; Sawamurai et al., 2010), and foaming properties (Maeda et al., 1999; Sawamura et al., 2012). Catechin contents were also studied in green tea powder (Weiss and Anderton, 2003; Li et al., 2011). Mechanisms and effects of green tea on cardiovascular health was reported by Basu A, Lucas EA.(2007).

Bulk density and angle of repose are important physical parameters of tea leave for free flow behavior during processing. Response surface methodology was used to examine the effect of size of cut leaf and moisture content of tea leaves on the mean bulk density and mean slide angle of repose (Dilip Kumar Kushwaha,et.al., 2015).

3. Experimental Methods

Sample Collection

Different Brands of Tea Powders like Kannan Devan, Green tea, AVT, Premium, Kannamali, Sports tea, Koorq and Navaratna were selected for the study. The sample packets were used as they are purchased. The chemicals and reagents used were of analar grade.

Quantitative Analysis

Caffeine content was estimated by extracting the caffeine from the tea powder by boiling with water; precipitated using 10% lead acetate solution, followed by extraction with Chloroform. The percentage of Caffeine is calculated by using following formula-

$$\text{Percentage of Caffeine} = \frac{\text{Weight of substance obtained}}{\text{Weight of tea powder taken}} \times 100$$

Acid content was estimated by the titration method using standard NaOH solution. pH of the 5% aqueous solution was measured using a pH meter.

Calcium tannate content was determined by the precipitation method using calcium carbonate. Colour absorbance was measured using a colorimeter.

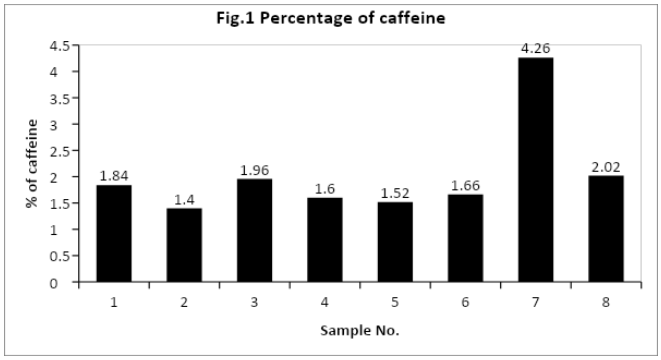
4. Results and Discussion

1. Percentage of Caffeine

The results of caffeine estimation in different brands of tea powder samples are tabulated in Table1. A glance at this table indicates the presence of wide variation from 1.4 - 4.26 % in caffeine content between different sets of tea powder samples studied. The lowest caffeine content was seen in Green Tea, which had only 1.4%. Since variability of caffeine content depends on factors such as variety of tea, location, time of plucking, age of leaves, the particles size and other agro-climatic conditions of tea plantation, it is therefore reasonable to pressure that the above factors might account for the observed variation in the caffeine content in different groups of tea samples. In its pure form, caffeine is a white crystalline powder that tastes very bitter. It is medically useful to stimulate the heart and also serves as a mild diuretic, increasing urine production to flush fluid out of the body. Caffeine can increase blood pressure and cause vasoconstriction. Caffeine is possibly unsafe when used for a long time or in doses over 400 mg daily. Caffeine can cause insomnia, nervousness, restlessness, nausea, increased heart rate, and other side effects. Larger doses might cause headache, anxiety, and chest pain. Caffeine is likely unsafe when used in very high doses. It can cause irregular heartbeat and even death. Products with very concentrated or pure caffeine have a high risk of being used in doses that are too high. It is better to avoid using large quantity of tea per day.

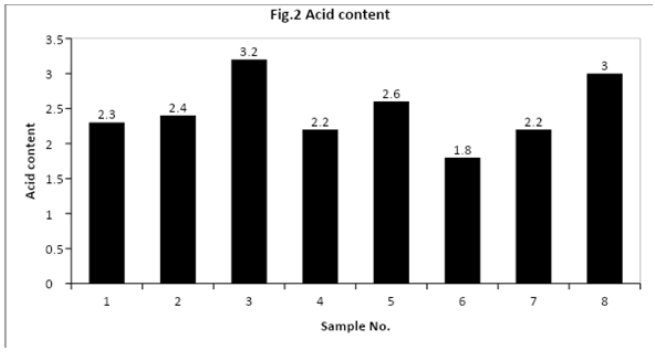
Table 1: Quantitative analysis of Tea powder

Sl. No	Percentage of caffeine	Acid content	pH	Weight of Calcium tannate (g)	Bulk density (g/cm^3)	Colour absorbance
1	1.84	2.3	5.1	0.540	0.554	0.48
2	1.4	2.4	5.4	0.37	0.258	0.17
3	1.96	3.2	5.5	0.339	0.528	0.45
4	1.6	2.2	5.2	0.323	0.614	0.50
5	1.52	2.6	5.0	0.372	0.500	0.42
6	1.66	1.8	4.9	0.337	0.420	0.68
7	4.26	2.2	5.7	0.301	0.310	0.34
8	2.02	3.0	5.3	0.328	0.543	0.37



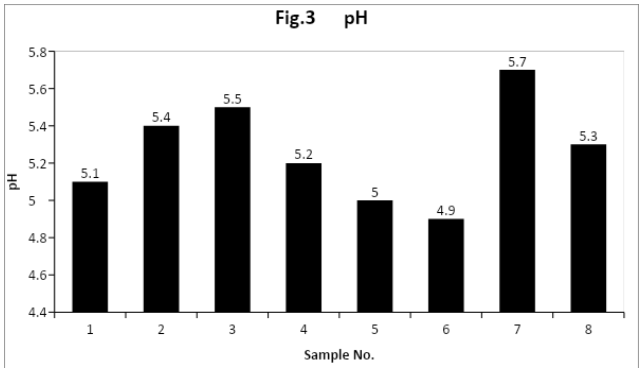
2. Acid Content

The results of estimation of acid content in different brands of tea powder samples are shown in Figure 2. The acidic substances are more in sample 3 and the consumption of more tea is not good for health and will lead to acidity. Tea is a potent stimulant of gastric acid, and this can be reduced by adding milk and sugar. Heartburn is actually a part of that acidic tea reaction in your stomach. It can be caused because of over sweet tea or maybe a brewed tea which exceeds the brewing limit.



3. Determination of pH

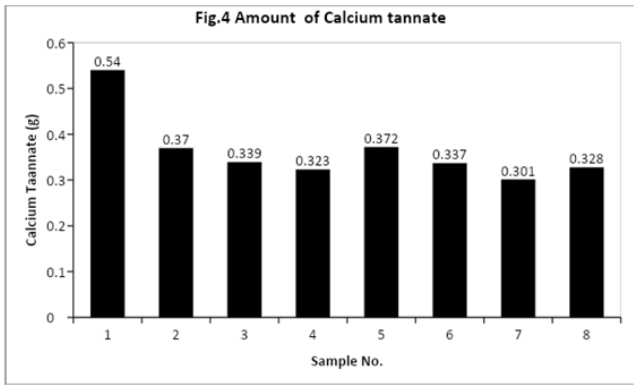
pH of different brands of tea powder samples are shown in figure 3. The pH of the samples ranges from 4.9- 5.7. Sample 7 with a pH of 4.9, had a bitter taste that lingered on the tongue. And all other tea powders tasted only mildly bitter, which could be explained by their higher pH.



4. Estimation of Calcium Tannate

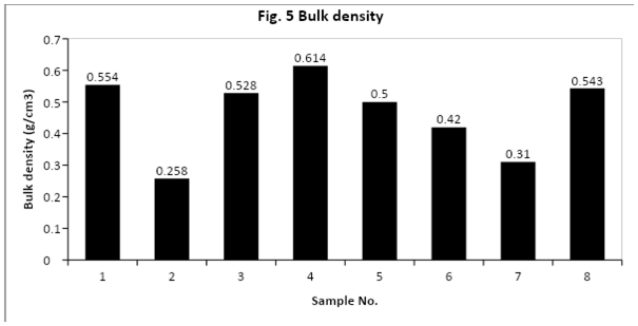
Besides caffeine, tea leaves also contain tannic acid. Tannic acid is a polymer of Gallic acid molecule and glucose. The relative amounts of these substances are different in different varieties of tea leaves, which is why, their tastes and flavours are different. Tannic acid is a specific commercial form of tannin, a type of polyphenol. Its weak acidity is due to the numerous phenol groups in the structure. Pure tannic acid is a light yellowish and amorphous powder. Tannic acid has anti-bacterial, anti-enzymatic and astringent properties. Tannic acid has constricting action upon mucous tissues such as tongue and inside of mouth. The ingestion of tannic acid caused constipation and can be used to treat diarrhoea. The anti-oxidant and anti-mutagenic properties of tannic acid are beneficial. Externally, tannic acid is used to treat ulcers, toothache and wounds. the present study, tannic acid was estimated as its calcium salt- calcium tannate.

The results of estimation of calcium tannate in different brands of tea powder samples are shown in Figure 4. The amount of tannic acid in tea leaves is proportional to the weight of calcium tannate precipitated. The amount of tannic acid is highest for sample 1 and sample 7 has the least. Tannic acid gives the tea to become more darker and also it has antimicrobial properties: effective against many bacteria, fungi and virus. But higher quantity may cause speeding of blood clotting, reduction of blood pressure and effect on the liver and immune system.



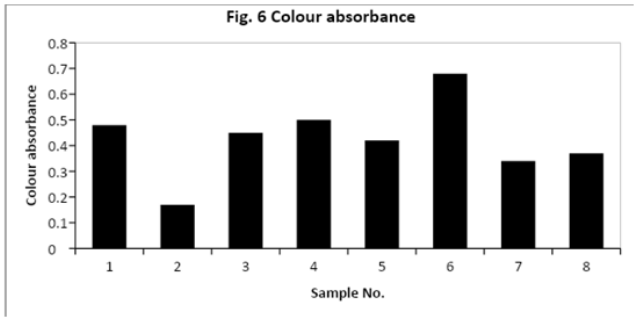
5. Analysis of Bulk Density

Bulk density is a property of powders, granules, and other divided solids, especially used in reference to mineral components (soil, gravel), chemical substances (pharmaceutical) ingredients, foodstuff, or any other masses of corpuscular or particulate matter. It is defined as the mass of many particles of the material divided by the total volume they occupy. The total volume includes particle volume, inter-particle void volume, and internal pore volume. The results of bulk density of different brands of tea powder samples are shown in Figure 5. Bulk density is less for sample 2. So the weight of its consumption will be less.



6. Colour Absorbance

The brownish colour of the tea is due to the presence of polyphenolic compounds and some inorganic ions like manganese ion and ferric ion etc. From our analysis, we can see that sample 6 has high absorbance value and sample 2 has least in black teas, Green tea (sample 2) has the least value than all.



5. Conclusions

- Major content of tea powder is caffeine that vary from 1.4 - 4.26 % in the selected samples. Sample 7 contain more amount of caffeine than actually needed.
- pH of the samples vary from 4.9 to 5.7. From our analysis we can see that all tea powder samples are mildly acidic.
- Among the different samples Sample 1 contain high amount of tannic acid
- Bulk density of the samples vary from 0.258 - 0.614 g/cm^3
- Among the colour absorbance of different samples, sample 6 has higher absorbance value which directly says small of amount of its powder makes tea darker. So it is more profitable than other tea powders.

6. Future Scope

Tea is the most common beverage consumed after water. Different types of tea manufactured are: oolong, green, black and Ilex tea depending on the post-harvest treatment and palatability of a particular region. It is rich in natural antioxidants and is reported to be effective against colon, oesophageal, and lung cancers, as well as urinary stone, dental caries, etc. Tea found to be anticariogenic, anti-microbial, anti-inflammatory, anti-carcinogenic, anti-oxidant can be used as an effective preventive agent. Healthy Foods' containing active scavengers of free radicals are very popular nowadays. The chiefly chemical components of green tea include polyphenols, caffeine and amino acids, tannic acid etc.. Tea also contains flavonoids compounds reported to have anti-oxidant properties having many beneficial effects. It is widely accepted that phenolic compounds of certain foods have potential health benefits. Tea is linked to beneficial effects on human health with the polyphenols as the responsible constituents. India is one of the largest tea-producing, exporting and consuming country. Information about the chemical constituents will be beneficial for us to select the correct brand, suitable amount and number of times; we can consume tea per day. The health issues related to the overconsumption of tea also has to be studied well.

References

[1] Basu A, Lucas EA.(2007), Mechanisms and effects of green tea on cardiovascular health, Nutr Rev., 65:361-75.
[2] Cabrera C, Artacho R, Gimenez R (2006). Beneficial effects of green tea - a review. J Am Coll Nutr 25: 79-99.
[3] Derek S. Wheeler, William J Wheeler (2004), Drug Development Research 61(2):45 - 65
[4] Dhaka NP, Kumar K. (2006), Project 4: To isolate caffeine from the given tealeaves Laboratory skills-Chemistry. Pradeep Publications, India, 1st ed. 124-125.
[5] Dilip Kumar Kushwaha, E.V. Thomas, Biswajit Maiti, B.C. Ghosh (2015), Assessment and Optimization of Bulk Density and Angle of Repose of Tea Leaves for Metering Device Using Desirability Function, International Journal of Scientific Engineering and Technology 4(42):2277-1581
[6] Haraguchi Y, Imada Y, Sawamura S (2003). Production and characterization of fine matcha for processed food. J Jpn Soc Food Sci 50: 468-473.
[7] Higdon JV, Frei B (2003). Tea catechins and polyphenols: health effects, metabolism, and antioxidant functions. Crit Rev Food Sci 43: 89-143.
[8] Hirai M, Yoshikoshi H, Kitano M, Wakimizu K, Sakaida T, Yoshioka T, Nitabaru J, Nakazono K, Hayashi M, Maki T (2008). Production of value-added crop of green tea in summer under the shade screen net: canopy microenvironments. In: ISHS Acta Horticulturae 797: International Workshop on Greenhouse Environmental Control and Crop Production in Semi-Arid Regions, pp. 411-417.
[9] Khokhar S, Magnusdottir SGM (2002). Total phenol, catechin, and caffeine contents of teas commonly consumed in the United Kingdom. J Agr Food Chem 50: 565-570.
[10] Ku KM, Choi JN, Kim J, Kim JK, Yoo LG, Lee SJ, Hong Y-S, Lee CH (2009). Metabolomics analysis reveals the compositional differences of shade grown tea (Camellia sinensis L.). J Agr Food Chem 58: 418-426.
[11] M. Kranthi Kumar, M. Kiran Kumar (2014), The comaparative data between various brands of tea powders and green tea; International Journal of Pharma Sciences and Research (IJPSR), 5: 454-459

[12] Maeda A, Hibi Y, Hayakawa F (1999). The effects of chemical compounds contained in the tea leaves on the foamability of matcha. J Jpn Soc Food Sci 46: 842-845.
[13] Pharn-Huy LAN, He H, Phamhuy C (2008). Green tea and health: an overview. J Food Agric Environ 6: 6-13.
[14] Sawamura S, Haraguchi Y, Yasuda M, Matsusaka S (2009). Flowability properties of matcha varying with particle size and milling method. J Jpn Soc Food Sci 56: 103-107.
[15] Sawamura S, Ichitani M, Ikeda H, Sonoda J (2012). Foaming property and foam diameter of matcha varies with particle size. J Jpn Soc Food Sci 59: 109-114.
[16] Sawamurai S, Haraguchi Y, Ikeda H, Sonoda J (2010). Properties and shapes of matcha with various milling method. J Jpn Soc Food Sci 57: 304-309.
[17] Tokunaga M (2004). New tastes in green tea: a novel flavor for familiar drinks, dishes, and desserts. Kodansha, USA.
[18] Weiss DJ, Anderton CR (2003). Determination of catechins in matcha green tea by micellar electrokinetic chromatography. J Chromatogr A 1011: 173-180.
[19] Yuan JM, Sun CL, Butler LM (2011). Tea and cancer prevention: epidemiological studies. Pharmacol Res 64: 123-135.