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# Study on the alimental value, physicochemical constituents and sensory evaluation of chocolate tea

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**Abstract**
A research was undertaken to develop a whole new product with the combination of tea and chocolate. Objectives were also to determine the change in alimental values and physicochemical constituents of market tea with the combination of different branded cocoa powders (eg. Sonali, Cadbury) and chocolate flavors. Sensory evaluation was conducted through all the samples. Results showed that protein, lipid and carbohydrate percentages were higher in chocolate tea than market tea (Black Tea). But they varied with the change of the cocoa powder brands. Similar facts were observed in the physicochemical constituents and antioxidant activities. Meanwhile ash and moisture content were lower in chocolate tea than general tea. In statistical analysis of alimental values and antioxidant activity, significant differences were observed between general tea and chocolate tea. In sensory evaluation, chocolate tea samples got the average standard scores.

**Keywords:** Alimental value, physicochemical constituents, sensory evaluation, chocolate tea

## Introduction
Tea (*Camellia sinensis*) is one of the most popular beverages worldwide due to its taste, aroma, and health effects [1]. Approximately 1820 billion cups of this enticing drink are consumed daily [2]. Worldwide, 80% of the tea consumed is black tea, which is also the most popular drink in Europe, North America, and North Africa (except Morocco) Approximately 76-78% of the tea produced and consumed worldwide is black tea, 20-22% is green tea, and <2% is oolong tea [3]. The chemical composition of tea is complex including alkaloids (theobromine, caffeine, theophylline), polyphenols [4]. Cocoa powder and chocolate are made from the dried seeds that are found in pods on the cacao tree. Chocolate, once stated by Mayan as "Food of God", has a history of 4,000 years [5]**.** Cocoa is rich in polyphenols. Dark chocolate has attracted interest as an alternative treatment option for hypertension, a known risk factor for cardiovascular disease [6]. The antioxidant catechin content of chocolate is four times that of tea. In Kothari Agricultural Manufacture Centre, Tamilnadu, India a research was conducted to produce chocolate tea. This study is a modification of that research.

## Materials and methods
### Sample Collection
#### Materials information

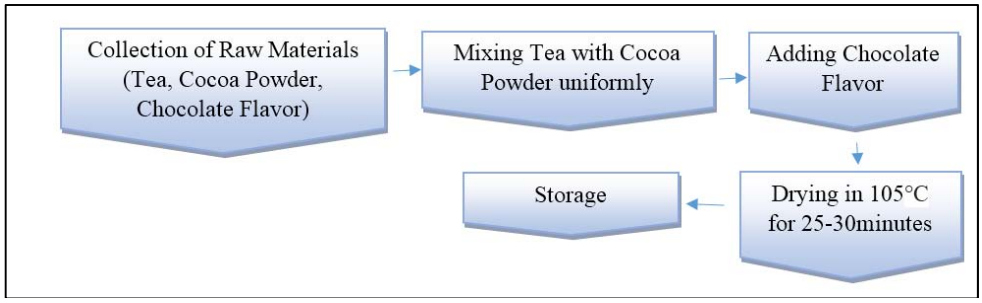
| Sample | Brand Name | Collection Place |
|---|---|---|
| Black Tea | National Tea | Mazar Gate, Sylhet |
| Cocoa Powder | Cadbury Cocoa Powder | Arsingate, Dhaka |
| | Sonali Cocoa Powder | Shwapno Super Shop, Pathantula, Sylhet |
| Chocolate Flavor | Rayner's Chocolate Flavoring Essence | Local Market Supershop, Subidbazar, Sylhet |

### Preparation of Chocolate Tea
Two different branded cocoa powder (Cadburi & Sonali) were mixed manually with made tea (National Tea). Then chocolate flavor was added. After drying in 105˚c for 25-30 minutes in oven samples were taken to storage.

**Sample Ratio of Chocolate Tea**

| Conjugated Samples | Ratio(gm) |
|---|---|
| National Tea(gm) : Cadbury Cocoa Powder(gm) : Chocolate Flavor(ml) | 25 : 2 : 1/10 |
| National Tea(gm) : Sonali Cocoa Powder(gm) : Chocolate Flavor(ml) | 25 : 2 : 1/10 |

**Flow chart of the processing steps of Chocolate Tea**




**Final Samples with their Codes**

| Final Samples | Sample Code |
|---|---|
| National Tea + Cadbury Cocoa Powder + Chocolate Flavor | $NT_c$ |
| National Tea + Sonali Cocoa Powder + Chocolate Flavor | $NT_s$ |
| National Tea (control) | NT(cntrl) |

**Methods of qualitative analysis**

- AOAC (2004) method was used to determine total protein content of the samples.
- Percentage of lipids present in the sample was calculated gravimetrically and expressed as percentage according to Ravichandran and Parthiban *et al*., 2000.
- The moisture content was measured according to the official method 44-ol of AACC (2000).
- Total ash was estimated by directly incineration of sample taken in a crucible according to AACC (2000) method 08-01.
- The carbohydrate content was determined by subtracting Protein, Moisture, Fat and Ash contents from 100 (Lilla *et al*., 2005).
- Quantum of polyphenols present in tea sample was computed using the standard calibration curve derived from known concentrations (10 to 50 ppm) of gallic acid and the results were expressed as percent gallic acid equivalents (Choudhury and Goswami, 1983).
- Quantum of caffeine present in tea leaves was computed using the standard calibration curve derived from known concentrations (0 to 20 ppm) of caffeine and the results were expressed as per cent caffeine equivalents (Maidon *et al*., 2012).
- According to Chang ST. *et al*. (2001), DPPH free Radical Scavenging Activity was determined by using DPPH reagent.

**Statistical Analysis**

The experimental data were statistically analyzed by IBM SPSS statistics version 20 statistical software. The results are expressed as Mean and data were statistically analyzed by one-way ANOVA, with the level of significance set at $p<0.05$. The mean values adjusted by Duncan's Multiple Range Test (DMRT) (Duncan, 1951).

**Grading Standard of Tea based on Organoleptic Scores [7, 8, 9]**

| Score | Remark |
|---|---|
| = 34 | Excellent |
| 32 to <34 | Above Average |
| 30 to <32 | Average |
| <30 | Below Average |

**Results and discussions**

**Alimental values of different Chocolate Tea**

| Tea Sample | Protein % | Lipid % | Moisture % | Ash % | Carbohydrate % |
|---|---|---|---|---|---|
| $NT_C$ | $21.9071^{b}\pm1.0442$ | $4.9023^{c}\pm0.1007$ | $5.9039^{b}\pm0.4546$ | $4.8012^{a}\pm0.2134$ | $62.4509^{c}\pm0.7986$ |
| $NT_S$ | $21.8124^{b}\pm1.0032$ | 4.8123c±0.1328 | $5.7011^{a}\pm0.1223$ | $4.9039^{a}\pm0.1212$ | $62.3056^{b}\pm0.8766$ |
| NT (cntrl) | $19.1061^{a}\pm1.0432$ | $4.5009^{a}\pm0.1998$ | $8.1045^{c}\pm0.1476$ | $5.7489^{b}\pm0.8768$ | $61.7765^{a}\pm0.9892$ |

[Values are expressed as Mean±SD of three observations, different letter(s) are significantly different by DMRT ($p>0.05$)]

Significant differences between NT(cntrl) and $NT_C$ in the amount of protein, lipid, moisture content, ash content, & carbohydrate. Significant differences were also observed between NT(cntrl) and $NT_S$. Meanwhile between $NT_C$ and NT, the significant differences were found in moisture content and carbohydrate. Protein, lipid and ash content didn't show any significant differences between NT and $NT_S$.

**Determination of Protein content**

Protein was determined using Kjeldahl apparatus. Protein content of $NT_C$, $NT_S$, NT (cntrl) were found 21.9071%, 21.8124%, 20.9093% respectively. "Diet & Fitness Today" (2013) [10], an online research site analyzed 20 different type of tea samples and found the highest amount of protein was 20.21gm in 100gm sample which is approximately 20.21%. Antonella Bertazzo**,** *et al*., (2007) found [11] 15.7% protein in cocoa bean collected from Ivory Coast.

**Quantification of Lipid**

The most prominent change in lipid content of tea with the combination of cocoa powder and chocolate flavor content ranges from 4.5009% to 4.9023%. Among the samples containing cocoa powder and chocolate flavor, $NT_S$ showed comparatively low lipid content. According to Italian study [4] (Xiong, ZC, *et al.,* 2012) 10-15% lipid were found in cocoa (European type). Meanwhile Lakshi. P.B. *et al.,* (1991) found [12] 4.6% neutral lipid in Assam tea.

**Moisture Content Determination**

Moisture content of $NT_C$, $NT_S$, NT (cntrl) are found 5.9309%, 5.7011%, 6.3012% respectively. In this case, moisture content decreased in tea with the combination of cocoa powder and chocolate flavor. Ahmad, I., *et al.,* (2013) found 8.38% moisture in Malnichara tea. Henderson, S., *et al*., (1984) found [13] 5.0% – 5.9 % moisture in different cocoa powder and cocoa beans of different countries.

**Determination of Total Ash Content**

Ash content of $NT_C$, $NT_S$, NT (cntrl) were found 4.8012%, 4.9039%, 5.7489% respectively.

Range between the lowest and the highest amount of ash content was from 4.8012% to 5.7489%. Ahmad, I., *et al*., (2013) found 5.34% ash in tea made from Malnichara Tea Estate which is close to my results. Ndife, J., *et al.,* (2013) found [14] 5.32% ash content in cocoa powder.

**Estimation of Total Carbohydrate**

In proximate analysis NT showed 61.7765% carbohydrate, it's because tea is affluent in carbohydrate (0.7g in 1 oz). Henderson, G.W. *et al.,* (2009) analyzed [15] different types of black tea produced in Kenya. He found 55-60% carbohydrate in Black Tea. However cocoa powder is also rich in carbohydrate.

**Physicochemical Constituents of Chocolate Tea**

**Estimation of Polyphenols in Chocolate Tea**

| Tea Sample | Polyphenol (%) |
|---|---|
| $NT_C$ | 21.12 |
| $NT_S$ | 20.09 |
| NT | 18.24 |

The polyphenol content is generally high in tea. Rosana, F., *et al*., (2011) found 17.65% total polyphenol in Black Tea (orthodox). Amount of polyphenol content found in NT (cntrl) was 18.24%. NT (cntrl) went up with the combination of cocoa powder as cocoa powder is also rich in polyphenol. $NT_C$ and $NT_S$ contain higher amount of polyphenol than NT (cntrl).

**Estimation of Caffeine in Chocolate Tea**

| Tea Sample | Caffeine (%) |
|---|---|
| $NT_C$ | 5.82 |
| $NT_S$ | 5.76 |
| NT(cntrl) | 5.51 |

In 2013, Ahmad, I., 5.6% caffeine content in tea made from Malnichara Tea Estate. In this research caffeine content NT (cntrl) was found 5.51%. Here $NT_C$ and $NT_S$ contain higher amount of caffeine than NT (cntrl). Meanwhile, sample containing Cadbury cocoa powder showed the highest percentage of caffeine than sample containing Sonali cocoa powder.

**Determination of Antioxidant Activity of Chocolate Tea**

| Tea Sample | Scavenging Effect | | | |
|---|---|---|---|---|
| | 5000(mg/ml) | 500(mg/ml) | 50(mg/ml) | 5(mg/ml) |
| $NT_C$ | $97.2213^{c}$±0.6238 | $62.2321^{a}$±0.4097 | $53.0908^{b}$±0.6127 | $48.3489^{a}$±0.4832 |
| $NT_S$ | $94.3287^{a}$±0.3985 | $60.03164^{b}$±0.3276 | $50.3461^{c}$±0.52364 | $46.3846^{c}$±0.6243 |
| NT (cntrl) | $86.7143^{b}$±0.5469 | $53.0723^{c}$±0.5472 | $42.3947^{a}$±0.5463 | $39.6109^{b}$±0.6811 |

[Values are expressed as Mean±SD of three observations, different letter(s) are significantly different by DMRT ($p$>0.05)]

In all the solutions $NT_C$ and $NT_S$ showed highest amount of antioxidant activity than NT (cntrl). Shizuo Toda [16] analyzed different types of herb teas in 2011. In Arabian Jasmine he found 144 ± 1.4 mmol/L antioxidant activity. However, in Oolong Tea the antioxidant activity was 187.8 ± 2.7 mmol/L.

**Sensory Evaluation**

**Organoleptic Taste scores and remarks of Chocolate Tea**

| Tea Sample | Infusion Score: 10 | Liquor Color 10 | Briskness 10 | Strength 10 | Creaming down. 10 | Total 50 | Remarks |
|---|---|---|---|---|---|---|---|
| $NT_C$ | 6.46 | 6.35 | 6.42 | 6.17 | 6.21 | 31.71 | A |
| $NT_S$ | 6.31 | 6.12 | 6.55 | 6.26 | 6.11 | 31.35 | A |
| NT(cntrl) | 6.2 | 6.21 | 6.17 | 6.22 | 5.1 | 29.39 | BA |

Here, A= Average; BA= Below Average

In organoleptic taste, samples containing cocoa powder and chocolate flavor got higher score than general tea. NTC the highest score among all three samples. It got highest score especially in the criteria of infusion & liquor color. However, a distinctive change from NT(cntrl) was the creaming down effect. $NT_C$ got a total score of 31.71 and its grade of remark was 'Average'. In other case, $NT_S$ got a total score of 31.35, pretty close to score of $NT_C$ and its grade of remark was 'Average'. The briskness of this sample was quite prominent. NT(cntrl) scored 29.39 in the organoleptic taste to achieve a grade remark of "Below Average".

**Conclusion**

The new product, "Chocolate Tea" was found more rich in caffeine, protein, lipid, carbohydrate, polyphenol and antioxidant activity than black tea. Among the samples, $NT_C$ showed the highest percentage of protein (21.9071%), lipid (4.9023), caffeine (5.82%), carbohydrate (62.4509%), polyphenol (21.12%) and antioxidant activity. In organoleptic taste $NT_C$ got the highest score (31.71) signified as 'Average'. Sample containing Sonali cocoa powder also showed higher amount of protein (21.8124%), lipid

(4.8123%), caffeine (5.76%), carbohydrate (62.3056%), polyphenol (20.09%) and antioxidant activity than NT (cntrl). However, moisture and ash content were comparatively lower in $NT_C$ and $NT_S$ than NT (cntrl). The producted generated outstanding flavor and taste with nutritional qualities.

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