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# Antioxidant status of various types of tea and coffee

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### Abstract

As number of people worldwide including India have become much conscious about their health, there is overloaded research papers published on health effects of various food item. In India its difficult to get a home where tea or coffee is not consumed. They are offered as part of welcoming guests, besides using them in daily diet. Health effects of tea and coffee are always argued. Beneficial effects of tea and coffee are associated with their antioxidant properties.

Temperature, time and variation in preparation can change the flavor of coffee and tea by affecting the rate of oxidation, which is the rate at which the oils, acids break down. Depending on how quickly this process happens, the aroma, flavor and texture of each cup can greatly differ. This also affects antioxidant properties as well.

The present study focuses on various tea and coffee types and their antioxidant properties by two different methods viz Ferric reducing power assay and Phosphomolybdic method. Both the method have shown parallel results whereas, there is considerable difference between antioxidant levels varying with their type and preparation.

**Keywords:** Coffee, Tea, Antioxidants, Free radicals, Oxidative stress

### Introduction

Most of the world's population starts their day by having tea or coffee. Tea and coffee are most widely consumed beverages. In India either tea or coffee is offered to visitors as a welcoming gesture.

The health effects of tea and coffee are always argued and debated all over scientific community. Beneficial health effects of Tea and coffee are usually attributed to their high antioxidant activity <sup>[1, 2]</sup>. Antioxidants protect the body from damage caused by harmful molecules called free radicals. Free radicals are any species which are having capacity to exists independently and are having unpaired electron in their orbital <sup>[3]</sup>.

Though free radicals have some useful functions in our body, their damaging nature is much potent, which masks their usefulness. These free radicals include Superoxide radical, Nitric oxide, Peroxynitrites, lipid peroxides, hydroxyl radicals and many more can be added to the list. They can cause oxidative damage to proteins, carbohydrates, lipids and nucleic acids. Their deleterious effects have been studied in various diseases including cancer cardiovascular disorders etc. Oxidative stress can be caused by various negative impacts, such as gamma or UV radiation, environmental factors, polluted and poor-quality food, stress, some medications or treatments, smoking, alcoholism, etc <sup>[1]</sup>.

Thanks to the nature for providing the machinery which can counter the free radicals and their effects. These includes antioxidants such as superoxide dismutase, glutathione peroxidase, ascorbic acid, beta carotene, vitamin E and many more can be added to the list. Many of these antioxidants can be obtained from food. Thearubigins, epicatechins, and catechins are among those which all are considered flavonoids, a type of antioxidants. Tea is rich in flavonoids. Antioxidant activity of coffee is related to chlorogenic, ferulic, caffeic, and *n*-coumaric acids contained in it <sup>[2, 4]</sup>.

Oxidative stress is the imbalance between free radicals and antioxidants in favour of free radicals. Oxidative stress has been studied extensively in recent years. Oxidative stress theory provides molecular basis for many biochemical changes in more than 50 diseases.

The present study was undertaken to explore the activity of antioxidants present in tea and coffee, which are the most consumed beverages among Indian population. Many studies have already been conducted to reveal the antioxidant properties of tea and coffee. Going way

further our study demonstrate the comparison of two different methods of antioxidant estimation and comparison within various types of tea and coffee consumed by Indian population.

### Material and Method

Various samples required for present study were obtained from grocery markets in Mumbai. This includes various types of tea and coffee (Table 1) easily available in local markets. The extracts of these sample were prepared by various methods. As general population uses water as medium to prepare tea or coffee we had decided to use water for extraction of sample used for analysis.

**Table 1:** Various types of tea and coffee samples used for analysis.

Tea samples	Coffee samples
Black tea powder	Filter coffee powder
Black (dried) tea leaves	Instant coffee powder
Green tea leaves	
Ice tea powder	

### Extraction

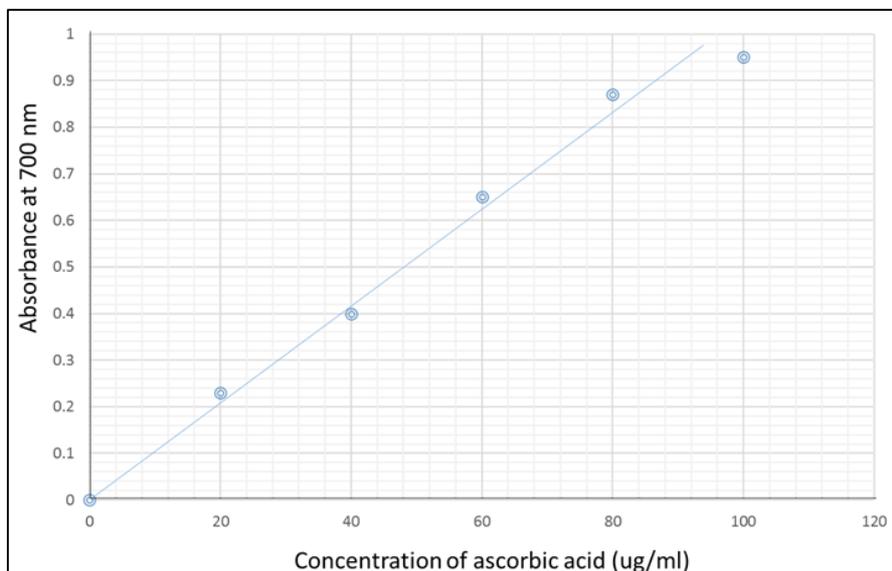
2 gms of sample was weighed and was added to 100 ml

distilled water boiled at about 100° C. The suspension is further boiled for about 1 min. Then this is allowed to cool at room temperature and is filtered to get clear sample for analysis.

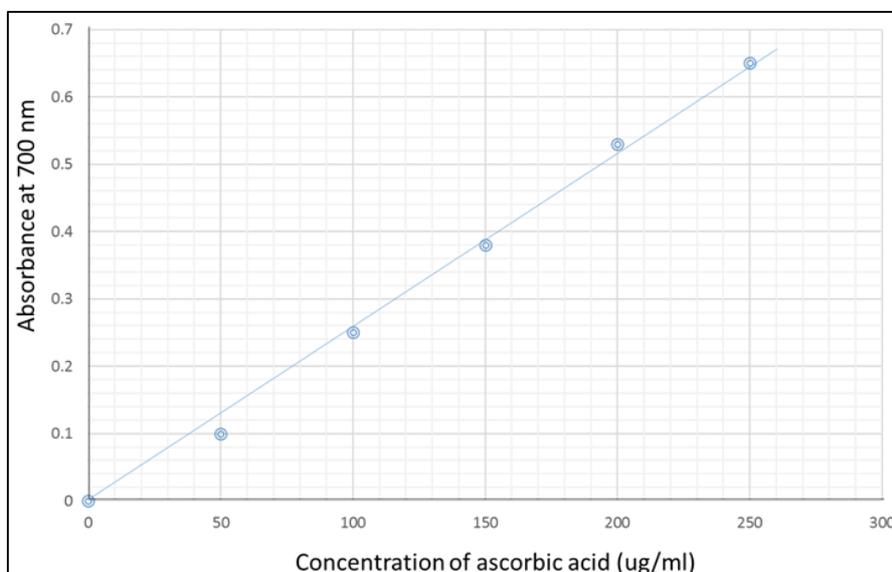
Sample for analysis of cold coffee and ice tea was obtained without boiling by using chilled water and suspending tea/coffee for about 4-5 min. These samples were filtered to get clear extract.

### Analysis

Total antioxidant properties of food samples can be studied by various methods. The common and widely used methods were opted for Total antioxidant capacity estimation. Two methods used in present study were standardized as shown in graph 1 & 2. These include Ferric ion reducing power assay method described by Oyaizu <sup>[5]</sup> and Phospho-molybdenum method described by Prieto *et al.* <sup>[6]</sup> The former was based on the reduction of ferric ions to ferrous ions in presence of antioxidants present in the sample, while the later uses hexavalent phosphomolybdic acid which is converted tetravalent. Change in the colour thus obtained was measured calorimetrically as described in the method.



**Graph 1:** Standardization Chart for Ferric ion reducing power assay.



**Graph 2:** Standardization Chart for phosphomolybdenum method.

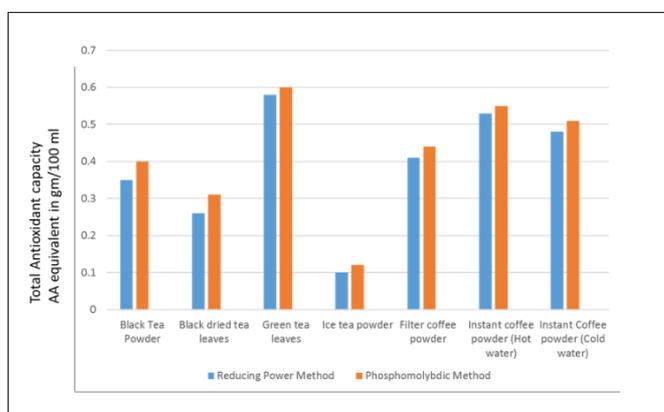
## Observation and results

The results obtained were expressed in terms of mean  $\pm$  SD. Statistical analysis and graphs were prepared using MS Office- Excel 2016 using relevant statistical tools.

**Table 2:** Results obtained by reducing power method and phosphomolybdic method in various samples.

Samples	Reducing power method (gm/ml AA equivalent)	Phosphomolybdic method (gm/100ml AA equivalent)
Black Tea Powder	0.35 $\pm$ 0.07	0.40 $\pm$ 0.11
Black dried tea leaves	0.26 $\pm$ 0.08	0.31 $\pm$ 0.10
Green tea leaves	0.58 $\pm$ 0.11	0.60 $\pm$ 0.13
Ice tea powder	0.10 $\pm$ 0.05	0.12 $\pm$ 0.07
Filter coffee powder	0.41 $\pm$ 0.13	0.44 $\pm$ 0.09
Instant coffee powder (Hot water)	0.53 $\pm$ 0.16	0.55 $\pm$ 0.12
Instant Coffee powder (Cold water)	0.48 $\pm$ 0.12	0.51 $\pm$ 0.11

\*AA- Ascorbic acid values are measured against ascorbic acid standard.



**Graph 3:** Comparison of various samples and methods

## Discussion

Excess free radicals comparative to antioxidants causes steady increase of oxidative stress in the cell, wherein free radicals oxidize blood vessel walls, protein molecules, DNA, carbohydrates, and lipids. Antioxidants counter their effects or a radical itself. In spite of having number of natural antioxidants in our body, we need some from diet to keep the check on free radicals which can be formed from multiple sources. Coffee and tea consumed considerably in India, even worldwide. Many evidences suggested potential antioxidants property of tea and coffee [1, 4].

The antioxidant activity cannot be measured directly, what is typically measured is the effect of the antioxidants on the degree of oxidation. All of these methods often give conflicting results. In the present study we have used reducing power method and phosphomolybdate method. The results were almost similar with negligible difference. (Table 2 & Graph 3). Current literature taking a philosophical look at antioxidant indexes clearly states that there is no 'total antioxidant' as a nutritional index available for food labeling because of the lack of standard quantitation methods. However having with its own benefits and drawbacks, the currently available methods shows antioxidant power relative to its own principle or mechanism of reaction [8, 9].

The results have suggested that there is effect of temperature on extraction of antioxidants especially in tea. Iced tea has shown minimum antioxidant property. Whereas in coffee

though it shows the similar trend the difference is minimal. (Graph 3).

Instant coffee is prepared from green coffee beans (Arabica and Robusta). Roasting affects the composition of coffee. Changes in the antioxidant capacity of coffee upon roasting are associated with manufacture process, where phenol melonoidins and caffeine get concentrated. This enhances antioxidant properties [10]. Little edge of hot coffee over cold in relation to antioxidant power as observed in results may be associated with increased solubility of antioxidant components in coffee. Where cold brew lacks in temperature, it makes up for in time. Coffee solubles have markedly decreased solubility in room temperature water. Increasing the brew time from a few minutes to many hours aims to maximize extraction of the solubles.

Among different varieties of tea studied green tea shows highest antioxidant levels, followed by black tea powder and then dried leaves (table 2). The difference in manufacturing process can enlighten on the reason. The manufacturing process for green tea involves exposing fresh leaves to higher temperature to deactivate the enzymes e.g. polyphenol oxidase [11]. This will ensure the retention of molecules responsible for antioxidant properties. Green tea leaves are partially fermented, this enhances levels of catechins, which also contribute to antioxidant capacity of green tea. Black dried tea loses moisture which may result in reduction of its antioxidant power as observed in results. (table 2).

The major hypothesis of the beneficial health effects of tea is associated with its antioxidant properties. The major antioxidants in tea are catechins, then theaflavins, thearubigins, oxyaromatic acids, flavonols, such as kaempferol, myricetin, quercetin; flavones, such as apigenin; derivatives of gallic acid, such as tannins, etc. The most powerful antioxidant tea is green tea which is characterized by the presence of large amount of flavan-3-ols known as catechins [11]. In addition to the capturing (quenching) of free radicals, the tea catechins can chelate metal ions such as iron and copper, preventing their participation in Fenton and Haber-Weiss reactions [12]. Although tea polyphenols have generally been regarded as antioxidants, the emerging evidence for the prooxidant effects of these compounds is interesting and raises many potential questions [13].

Coffee does contain antioxidant molecules but the health effects are mainly depending on the way coffee brewed. Temperature affects the solubility and volatility of the coffee soluble. The official USDA 2015 Dietary Recommendations concluded that 3 to 5 cups of coffee per day (or up to 400 mg of caffeine per day) is not associated with any health risks and may offer significant health benefits [14]. However, some researchers have argued about the association of coffee consumption with cardiovascular complications and cancer insurgence.

## Conclusion

Both coffee and tea are enriched sources of antioxidant. This is evident from various studies and the present study supports the findings. The methods available for estimation of antioxidant properties though directly do not measure the natural scavenging ability of antioxidant they give relative information of oxidoreduction ability of solubles in coffee and tea. In present study tea with green tea leaves and hot black coffee were found to be enriched with antioxidant capacity followed by others.

However, there are several methods of preparing tea and coffee. Each of these methods have slight variations in their

preparations which can affect their antioxidant level. The present study does not include all preparations and also all type of coffee and tea. This study can be extended with including various preparations and adding other methods of estimations such as HPLC to bring more clarity on present findings.

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