Comparative Review on Nutraceutical Attributes of Different Teas from India

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ABSTRACT

After water, Tea is being consumed greatly in almost every part of the world. This nonalcoholic healthy drink is usually prepared from tea plant, also known as Camellia sinensis, along with various other additional ingredients. Tea belonging to different places has varied flavor and aroma which depends upon its preparation style. Depending upon the processing techniques, tea can be found as green tea, black tea, oolong tea, dark tea and white tea. In India, Tea plantation and consumption is very prominent. Tea plant is considered to have several bioactive compounds which help in prevention from many diseases. Earlier Tea was just used as a beverage but advanced research has made it a leading health drink amongst its consumers. This review paper discusses few important Teas from India and the analysis of important bioactive compounds. Also, the important health benefits of tea consumption have also been discussed in detail too. It has been found out that important bioactive compounds present in tea are able to manage metabolism and prevent cardiac health as well as bone health. Moreover, Polyphenols are known to reduce inflammation and cancer cells’ growth. Apart from consuming tea leaves in the form of drink, people also consume it in the form tea oil, which is known to reduce the inflammation. Besides many known revelations, future studies must include more explorations on molecular interactions of its bioactive compounds and its other therapeutic benefits, hence helping everyone to realize its importance in a more elaborated manner.

Keywords: Indian Tea, Tea Polyphenols, Health Benefits, Bioactive compounds, Catechins.

INTRODUCTION

Tea is enjoyed as a luxurious drink in many parts of the world. But advanced research technologies have resulted in exploration of many potent constituents present in tea leaves. As a result of this, it has gained its importance as a medicinal alternative just like earlier times. Usually tea leaves are extracted from tea plant called as, *Camellia sinensis* which is generally grown in places belonging to tropical and subtropical climate. Appropriate soil and climatic conditions are very important for growth of the plant. Also, tea plants are known to show better growth in areas of rainfall. Moreover, it has been known that tea plant growing at higher altitudes with slow growth rate, tend to develop more strong taste and flavor. Once the tea plants are matured enough, the tea leaves are plucked and exposed to withering process to remove the excess moisture. This is generally done to reduce the chances of any microbial growth and spoilage in fresh leaves. After this, tea leaves are oxidized depending upon what variety of tea is to be produced at the end. When the oxidation process is stopped, the leaves are then pressed or rolled and exposed to drying. In some cases, few tea leaves are introduced to aging process where fermentation may occur to develop distinct flavors. The last step is sorting, where waste materials are discarded and processed leaves are stored for further selling purposes. Depending upon difference in processing techniques, teas can be of varied types like green tea, yellow tea, white tea, black tea, oolong tea and orange tea. In India, Tea plantation is majorly seen in states like Assam, West Bengal, Karnataka, Tamil Nadu, Kerala, Himachal Pradesh and some parts of Uttarakhand and Jammu- Kashmir. Every tea plant belonging to individual place has disparate phenotypes. For instance, tea leaves belonging to Assam state has larger leaves as compared to tea leaves from Himachal Pradesh. Along with this, the overall size of the tea plant also varies. Apart from this, the time of flush (also called as time of harvesting) also matters. Many teas which are available in the market are categorized on the basis of time of flushes. To illustrate, Kangra tea from Himachal Pradesh has 3 important flushes categorized on the basis of time of flushes. Many studies have reported the presence of several potent bioactive compounds in tea leaves and their relation in prevention and balancing many common diseases. These leaves are a pool of antioxidant as well as several other phenolic compounds and are known to control oxidation reactions inside the host. Hence, proving itself as a potent nutraceutical in today’s time. This review paper throws some light on few important teas from India. Also, their nutritional attributes and health benefits have been discussed in detail too. This review study aims to update and satisfy other researchers about the potential of tea...
leaves in managing basic healthy life and hence reduce the
dependence on other artificial drinks.

1. **Teas varieties from India:**

In India, tea plantation as well as consumption has been
done since ages. Though tea plants were already present
in deep Indian forests, it was British people only who first
opened commercial tea plant in India. Since then the
production has been continued and now India is known as
the second largest producer of Tea in the world. Several
Tea varieties and sub varieties from Indian origin are
famous for their peculiar flavor, taste and health beneficial
compounds. This section discusses few important Teas
which from India like- Kangra Tea, Nilgiri Tea, Darjeeling
Tea and Assam Tea 5, in detail:

1.1. **Kangra Tea of India:** Tea leaves from Kangra valley,
Himachal Pradesh belongs to species *Camellia sinensis (L.) O. Kuntze*. Plants grown in these regions have
perceptible flavors and aroma. Tea plantation areas
lying in Kangra valley are present at higher altitudes
and receive appropriate rainfall throughout
the growth seasons. Moreover, temperature in these
areas is maintained perfectly from 18°C to 32°C. Tea
leaves are of two types namely, green tea leaves and
black tea leaves which not only are exported all
around the country but are traded to many foreign
countries too.

1.2. **Darjeeling Tea of India:** This variety of tea is
considered one of the superior varieties of the
country. Tea plantation was started a long back in
Darjeeling, West Bengal by British people. The
location has all the appropriate aspects for growth of
tea plant. Black tea is dominantly produced and
consumed but now other hybrid forms are also
famous from this place. The sloppy hills present in this
region have the well drained soil and allow the long
roots of the plant to penetrate deep into the ground
too 5. Since, this place comes under subtropical region,
the temperature also remains appropriate, favoring
the plant growth. Tea leaves from Darjeeling are
famously known for their muscatel flavors, little more
astringent, and fruity or woody aromas.

1.3. **Assam Tea of India:** Unlike other tea plant, which are
grown at hilly areas, tea plants belonging to Assam
state are often grown at lower lands, near the sea level
7. The plantation done on the sides of Brahmaputra
river results in giving the place appropriate rainfall and
tropical climatic conditions. These conditions help the
plant to grow slowly and develop all the essential
features. Assam tea, famously known as Assam Black
tea, has the malty flavor and strong colored
appearances. From India, this region is famously
involved in trade for tea across many other countries.

1.4. **Nilgiri Tea of India:** Present in the hills of Tamil Nadu,
these hills provide the suitable climate and rainfall for
the tea plants to grow well 8. Generally the lower
temperature results in slower growth of the tea plant
hence offers greater accumulation of bioactive
compounds and flavoring agents. The leaves often
have mint, fruit like flavors and are plucked all around
the year. Nilgiri tea is the Black tea and is very dark
colored and strong aroma.

2. **Important Bioactive Compounds:**

Teas from different regions are fully packed with important
bioactive components. These bioactive compounds are
considered to prevent many diseases when consumed in
adequate amounts. Catechins, Polyphenols and Theanine
are few amongst many. Every compound has its own
individual role in balancing the important cellular
pathways during diseased conditions. Catechins are the
form of antioxidants only which are known to prevent the
host form oxidative stresses and related damages. Usually
these catechins are found in different forms in the tea
leaves, namely- Epicatechins (EC), Epigallocatechin (EGC),
Epigallocatechin-3-gallate (EGCG), Epicatechin-3-gallate
(ECG). Epicatechins are known to affect the functioning at
 cellular levels and promote the healthy cellular state,
whereas Epigallocatechin-3-gallate promotes reduction of
inflammation in the body. Moreover, one of the major
amino acid, Theanine is present abundantly and is known
to support good mental health. Caffeine when consumed
in appropriate amounts is known to provide good range of
antioxidants to the host and hence is considered as the
bioactive component. Kangra tea, Darjeeling Tea, Nilgiri
Tea and Assam Tea are known to contain caffeine,
Theanine and all forms of catechins. Table1 shows the
proximate date on the amount of bioactive components
present in different tea leaves. Most of the catechins are
found to be present in Assam tea, followed by Kangra Tea
and Darjeeling Tea. No data was found on quantifying the
amount of catechins present in Nilgiri Tea. Along with this,
maximum of Epicatechin is found in Kangra Tea, i.e. 27.7
mg/g, followed by Assam Tea 13 and least amount in
Darjeeling Tea, i.e. 2.3 mg/g. Kangra Tea is also reported
to have the maximum of EGCG amongst all the four
varieties and the least amounts are found out in Nilgiri Tea
11. Nilgiri Tea also reports for 0.7 mg/g as the minimum of
EGC content when compared to other teas during this
review study. However, Assam tea could have up to 64.6
mg/g of the ECG content. Theanine is also found out to be
present in higher amounts in the Assam Tea with
concentration up to 13.3 mg/g 15. Kangra tea and
Darjeeling Tea are known to have the almost similar
amounts of Theanine 10, 14. Caffeine is highest in Assam Tea
and has comparative lower values in other varieties of
teas.
3. Health benefits of India Teas:

Since the above considered teas are rich source of potent bioactive compounds, these can be used to prevent as well as treat many common diseases. Traditionally also, local people have been using these tea plants to overcome common ailments. This section of the review paper discusses the health benefits of teas in cancer prevention, aiding weight loss, controlling diabetes and prevention from oxidative reactions inside the humans, in detail.

3.1. Tea and Cancer: Cancer is one of the major diseases affecting many people across world. Mainly caused due to imbalance lifestyle, this must be prevented rather than treating. Choosing healthy life style options may result in prevention and tea is one of the solutions. Since tea is known to be rich pool of Polyphenols and other bioactive components, it can be useful in prevention. To prove this, one of the studies were conducted to check the anticancerous properties of Darjeeling tea extracts. The human histiocytic cell lines (U937) were chosen to the anticancerous nature of Darjeeling tea extracts. Results proved that bioactive compounds present in tea extracts were able to induce apoptosis in cancerous cell lines and hence resulted in their decline. Hence, the study proved the anticancerous properties of Darjeeling tea. Another study also states the role of Kangra tea in inhibiting the cancer cells growth. To illustrate, the few other important bioactive components, Saponins, were extracted from the tea seeds belonging to Kangra region, followed by checking their ability to affect the cancer cells. Researchers considered five cancerous cell lines of human origin, OVCAR5, MCF7, PC3, HL60 and Colo205. Results demonstrated that Saponins from Kangra tea seeds were able to show cell toxicity effects greatly and highest on the PC3 cancer cell line. Hence proving the anticancerous potential again. In addition to this, anthocyanins were also extracted from purple tea shoots from tea plants belonging to Kangra regions. The extracted anthocyanins were then tested for their ability to affect the cancer cell line. The results demonstrated that all major anthocyanins extracted were able to show high toxicity effects on rat glioma cancer cell lines by stimulating the apoptosis of cancerous cells.

3.2. Tea and Cardiac Health: Improper lifestyle, age, diet and many other external factors result in onset of cardiovascular diseases. Tea and its bioactive compounds have been able to show the positive effects on promoting the good health. Antioxidants present in tea leaves can support the fact. Antioxidants are known to lower the quantity of oxidative radicals which otherwise are known to damage the heart and vessels connected to heart. These are also known to increase the oxidative stress which later with time often results in heart failure. Hence, consuming tea is found out as an appropriate alternative to promote the heart health. To illustrate the anti oxidative capacity of teas, one study was conducted where along many green and black teas were taken from Darjeeling and Assam areas. The volatile compounds were extracted from all the samples and results showed that compounds from green tea extract were able to control the hexanal oxidation greatly as compared to others. However, the black tea extracts showed a slight anti oxidative nature only. Moreover, green tea extracts from Nilgiri region were used to lower down the effect of oxidative stress in diabetic rats to attenuate the chances of cardiac arrest. It is known that with age, the levels of antioxidants starts declining in the body. As a result the affected areas and tissues start getting damaged. Hence to restore the capacities of body to combat the oxidants or free radicals, the green tea from Nilgiri region was tested. The green tea extracts were prepared from fresh leaves belonging to Nilgiri region and extracts were tested for the ability to rejuvenate the human body with antioxidants to fight against the oxidative stresses. The results proved green tea extracts to be a good source of antioxidants and lowering down the effects of oxidative damage in rat cardiac tissues.

3.3. Tea and Diabetes: Diabetes is the disease caused due to imbalanced metabolic activities, where our body either cannot produce insulin or consume up entire insulin. Many drugs have been reported to cause other
types of side effects and are costly too. Hence, the better option is to switch to food items with nutraceutical values. Tea has been found out as an alternative to prevent the onset of diabetes. For example, green tea extracts from Darjeeling regions were tested for their ability to balance the glycemic index. The rat models were first induced with a drug to introduce the diabetic like conditions. After this, they were fed with green tea extract rich diet and results proved that these extracts were successful in lowering the activity of such enzymes which are a root cause for diabetes, hence proving that green tea extracts from Darjeeling regions can be used up as an alternate to manage the diabetes induced retinopathy in humans too 23. Moreover, the Nilgiri tea extracts were also used to test the effects on plasma glucose levels. The rats were induced with the drug to cause diabetes and then the Nilgiri tea extract rich diet was given to them. The results proved that all the important enzymes causing metabolic misbalance were restored to normal functioning and also the overall plasma glucose levels were back to normal 24. Sometimes, with diabetes there are higher risks of complications to cardiac health too. Bioactive compounds present in Tea are known to protect the cardiac health along with managing the diabetes. To illustrate, Nilgiri tea extracts were extracted and tested against many enzymes involved in diabetes as well as the cardio protective effect in relation to diabetes. Results proved that diabetes mice when introduced with green tea extract diet showed reduced activities of diabetes related enzymes and increased protection for cardiac health 25.

3.4. **Tea as Antimicrobials:** The presence of phenolic compounds and Epigallocatechin- 3- gallocate in teas are responsible for antimicrobial nature 26. Many studies have been done to prove the effects of tea consumption in combating various pathogens. Darjeeling green tea and black tea were tested for their ability to inhibit the growth of several microbes like *E. coli*, *Psuedomonas*, *B. subtilis* and *S. aureus*. Both types of teas were able to inhibit the microbes at different rates but the study also concluded that with storage black tea lost its antimicrobial activity while green tea did not 27. Moreover, Assam tea was also checked for its antibacterial as well as antimicrobial properties against various pathogens. The results concluded that Assam black tea was able to show great response in inhibiting the *S. aureus* growth and also showed positive deductions for antimicrobial tests too. Hence proving the Assam tea to be the good alternate for fighting against many infections 28. Assam tea was also tested for its antimicrobial activity against *S. aureus* in another study. The potent bioactive components were extracted from the Assam tea leaves followed by testing for their antimicrobial activity using zone inhibition method. The results again proved that Assam tea was potent antimicrobial food product which will protect the consumer from food borne bacterial infections 29.

3.5. **Other Health Benefits:** Apart from above mentioned health benefits, there are other health benefits too which are provided while consuming tea regularly. For instance, Darjeeling tea with higher caffeine content is considered in managing the Parkinson’s and Alzheimer diseases 30. Assam black tea has been associated in delaying the onset of Parkinson disease too. The study conducted states that degeneration induced was reversibly slowed down when rats were fed with black tea extracts and hence results were favoring Assam black tea a healthy alternate to prevent individual from Parkinson’s disease 31. As discussed above, these teas are full of antioxidants and hence this fact helps in managing a good bone health. Also the presence of EGCG in tea helps to lower down the bone demineralization and helps in keeping bones in healthy state 32. Since these teas do not have any calories and has abundant catechins, hence it is always considered as an alternate for weight loss 33. Additionally there are many other studies conducted all around the world considering different teas from different regions. But data on health benefits of Indian teas is still very limited.

**CONCLUSION**

Indian teas are very famous all around the world. These have been known for their distinct flavor, aromas and presence of bioactive compounds. Since people are now more focused on switching their regular lifestyle towards healthier side, hence the nutraceuticals play a very dominant role in this regard. With advanced research done on exploiting tea for finding their nutraceutical value, researchers have now started looking tea as a better alternative to manage many common diseases and restoring its value as it was there in ancient time. This paper comparatively reviews few very important teas present in India by analyzing their main bioactive compounds. Also, paper includes the health benefits of these teas in managing different diseases too, in detail. Future studies must include more research on exploration of other bioactive compounds, minerals and vitamins content. Moreover, research must also focus on exploring Indian teas for their other health benefits too, hence helping everyone to understand this everyday beverage from nutraceutical point of view.

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