



## Comparative Review on Nutraceutical Attributes of Different Teas from India

Shubhi Singh\*

School of Bioscience and Technology, VIT University, Vellore, India.

\*Corresponding author's E-mail: [shubhi.singh2014@vitalum.ac.in](mailto:shubhi.singh2014@vitalum.ac.in)

Received: 14-09-2020; Revised: 26-11-2020; Accepted: 03-12-2020; Published on: 15-12-2020.

### 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.

### QUICK RESPONSE CODE →

#### DOI:

10.47583/ijpsrr.2020.v65i02.014



DOI link: <http://dx.doi.org/10.47583/ijpsrr.2020.v65i02.014>

### 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<sup>1</sup>. 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<sup>2</sup>. 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<sup>3</sup>. 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 and comprises of strong flavors. Many studies have reported the presence of several potent bioactive compounds in tea leaves and their relation in prevention and balancing many common diseases<sup>4</sup>. 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 <sup>5</sup>, 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 slopy 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 <sup>6</sup>. 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 <sup>7</sup>. 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 <sup>8</sup>. 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 from 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 data 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 <sup>10</sup>, followed by Assam Tea <sup>13</sup> and least amount in Darjeeling Tea, i.e. 2.3 mg/g <sup>11</sup>. 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 <sup>11</sup>. Nilgiri Tea also reports for 0.7 mg/g as the minimum of ECG 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 <sup>15</sup>. Kangra tea and Darjeeling Tea are known to have the almost similar amounts of Theanine <sup>10,14</sup>. Caffeine is highest in Assam Tea and has comparative lower values in other varieties of teas.



**Table 1:** Proximate data on important bioactive compounds present in Indian Teas

	Kangra Tea	Darjeeling Tea	Assam Tea	Nilgiri Tea
<b>Bioactive Compounds</b>				
Catechin	3.6 mg/g	0.7 mg/g	~3.5- 9.5 mg/g	-
Epicatechin	27.7 mg/g	2.3 mg/g	~10- 21.2 mg/g	3.9 mg/g
Epigallocatechin	43.6 mg/ g	3.0 mg/ g	~41.2- 63.1 mg/ g	1.6 mg/ g
Epigallocatechin- 3- gallate	102.7 mg/g	24.9 mg/g	~108- 147 mg/g	6.2 mg/g
Epicatechin- 3- gallate	39.4 mg/g	5.9 mg/g	~34.2- 64.6mg/g	0.7 mg/g
Theanine	~1.3- 1.5 %	~1.3%	~2.9- 13.3 mg/g	-
Caffeine	4.49 %	22.1 mg/g	~30-55 mg/g	24.8 mg/g
<b>References</b>	9, 10, 12	11,14	13,15	11

### 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 <sup>16</sup>. 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 <sup>17</sup>. 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 <sup>18</sup>.

**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 <sup>19</sup>. 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 <sup>20</sup>. 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 <sup>21</sup>. 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 <sup>22</sup>.

**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<sup>23</sup>. 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<sup>24</sup>. 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<sup>25</sup>.

**3.4. Tea as Antimicrobials:** The presence of phenolic compounds and Epigallocatechin-3-gallate in teas are responsible for antimicrobial nature<sup>26</sup>. 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<sup>27</sup>. 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<sup>28</sup>. 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<sup>29</sup>.

**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<sup>30</sup>. 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<sup>31</sup>. 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<sup>32</sup>. Since these teas do not have any calories and has abundant catechins, hence it is always considered as an alternate for weight loss<sup>33</sup>. 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.

**Conflict of Interest:** It is to specifically state that "No Competing interests are at stake and there is No Conflict of Interest" with other people or organizations that could inappropriately influence or bias the content of the paper.





## REFERENCES

- Deshpande, S., Singh, S., Panneerselvam, A. and Rajeswari, V.D, "Nutrients in Caffeinated Beverages—An Overview," *Caffeinated and Cocoa Based Beverages*, Woodhead Publishing, 2019, 367-389.
- Deb, S. and Pou, K.J., "A review of withering in the processing of black tea." *Journal of Biosystems Engineering* 41(4), 2016, 365-372.
- Yang, X. and Kong, F., "Effects of tea polyphenols and different teas on pancreatic  $\alpha$ -amylase activity in vitro." *LWT-Food Science and Technology* 66, 2016, 232-238.
- Chandrasekara, A. and Shahidi, F., "Herbal beverages: Bioactive compounds and their role in disease risk reduction-A review." *Journal of traditional and complementary medicine* 8(4), 2018, 451-458.
- Lagad, R.A., Alamelu, D., Laskar, A.H., Rai, V.K., Singh, S.K. and Aggarwal, S.K., "Isotope signature study of the tea samples produced at four different regions in India." *Analytical Methods* 5(6), 2013, 1604-1611.
- Gohain, B., Borchetia, S., Bhorali, P., Agarwal, N., Bhuyan, L.P., Rahman, A., Sakata, K., Mizutani, M., Shimizu, B., Gurusubramaniam, G. and Ravindranath, R., "Understanding Darjeeling tea flavour on a molecular basis." *Plant molecular biology* 78(6), 2012, 577-597.
- Misra, U., "Assam tea: the bitter brew." *Economic and Political Weekly*, 2003, 3029-3032.
- Pilgrim, T.S., Watling, R.J. and Grice, K., "Application of trace element and stable isotope signatures to determine the provenance of tea (*Camellia sinensis*) samples." *Food Chemistry* 118(4), 2010, 921-926.
- Sourabh, A., Kanwar, S.S., Sud, R.G., Ghabru, A. and Sharma, O.P., "Influence of phenolic compounds of Kangra tea [*Camellia sinensis* (L) O Kuntze] on bacterial pathogens and indigenous bacterial probiotics of Western Himalayas." *Brazilian Journal of Microbiology* 44(3), 2013, 709-715.
- Kumar, D., Gulati, A. and Sharma, U., "Determination of theanine and catechin in *Camellia sinensis* (Kangra Tea) leaves by HPTLC and NMR techniques." *Food Analytical Methods* 9(6), 2016, 1666-1674.
- Khokhar, S. and Magnusdottir, S.G.M., "Total phenol, catechin, and caffeine contents of teas commonly consumed in the United Kingdom." *Journal of agricultural and food chemistry* 50, 2002, 565-570.
- Sharma, A., Bhonekar, A.P., Bari, S.S., Gulati, A., Kapur, P. and Singla, M.L., "Development and optimization of an HPLC method for the routine analysis of catechins, caffeine, and gallic acid in tea (*Camellia sinensis*)." *Journal of liquid chromatography & related technologies* 34(19), 2011, 2243-2255.
- Sabhapondit, S., Karak, T., Bhuyan, L.P., Goswami, B.C. and Hazarika, M., "Diversity of catechin in northeast Indian tea cultivars." *The Scientific World Journal* 2012, 2012.
- Chatterjee, S., Chatterjee, A. and Bandyopadhyay, S.K., "Seasonal variation of L-Theanine content in tea: A study on Darjeeling Black Tea." *International Journal of Scientific Research in Science, Engineering and Technology* 2(3), 2016, 522-4.
- Deka, H., Barman, T., Sarmah, P.P., Devi, A., Tamuly, P., Paul, R.K. and Karak, T., "Quality characteristics of infusion and health consequences: a comparative study between orthodox and CTC green teas." *RSC Advances* 10(54), 2020, 32833-32842.
- Bhattacharya, U., Adak, S., Majumder, N.S., Bera, B. and Giri, A.K., "Antimutagenic and anticancer activity of Darjeeling tea in multiple test systems." *BMC complementary and alternative medicine* 14(1), 2014, 327.
- Joshi, R., Sood, S., Dogra, P., Mahendru, M., Kumar, D., Bhangalia, S., Pal, H.C., Kumar, N., Bhushan, S., Gulati, A. and Saxena, A.K., "In vitro cytotoxicity, antimicrobial, and metal-chelating activity of triterpene saponins from tea seed grown in Kangra valley, India." *Medicinal Chemistry Research* 22(8), 2013, 4030-4038.
- Joshi, R., Rana, A., Kumar, V., Kumar, D., Padwad, Y.S., Yadav, S.K. and Gulati, A., "Anthocyanins enriched purple tea exhibits antioxidant, immunostimulatory and anticancer activities." *Journal of food science and technology* 54(7), 2017, 1953-1963.
- Zhang, P.Y., Xu, X. and Li, X.C., "Cardiovascular diseases: oxidative damage and antioxidant protection." *Eur Rev Med Pharmacol Sci* 18(20), 2014, 3091-6.
- Yanagimoto, K., Ochi, H., Lee, K.G. and Shibamoto, T., "Antioxidative activities of volatile extracts from green tea, oolong tea, and black tea." *Journal of agricultural and food chemistry* 51(25), 2003, 7396-7401.
- Babu, P.V.A., Sabitha, K.E. and Shyamaladevi, C.S., "Therapeutic effect of green tea extract on oxidative stress in aorta and heart of streptozotocin diabetic rats." *Chemico-Biological Interactions* 162(2), 2006, 114-120.
- Kumaran, V.S., Arulmathi, K. and Kalaiselvi, P., "Senescence mediated redox imbalance in cardiac tissue: Antioxidant rejuvenating potential of green tea extract." *Nutrition* 25(7-8), 2009, 847-854.
- Kumar, B., Gupta, S.K., Nag, T.C., Srivastava, S. and Saxena, R., "Green tea prevents hyperglycemia-induced retinal oxidative stress and inflammation in streptozotocin-induced diabetic rats." *Ophthalmic Research* 47(2), 2012, 103-108.
- Sundaram, R., Naresh, R., Shanthi, P. and Sachdanandam, P., "Modulatory effect of green tea extract on hepatic key enzymes of glucose metabolism in streptozotocin and high fat diet induced diabetic rats." *Phytomedicine* 20(7), 2013, 577-584.
- Babu, P.V.A., Sabitha, K.E., Srinivasan, P. and Shyamaladevi, C.S., "Green tea attenuates diabetes induced Maillard-type fluorescence and collagen cross-linking in the heart of streptozotocin diabetic rats." *Pharmacological research* 55(5), 2007, 433-440.
- Gopal, J., Muthu, M., Paul, D., Kim, D.H. and Chun, S., "Bactericidal activity of green tea extracts: the importance of catechin containing nano particles." *Scientific reports* 6, 2016, 19710.
- Choudhury, S.S., Majumder, A., Bera, B. and Singh, M., "Antimicrobial, Antioxidant Evaluation of Majestic Darjeeling Green and Black Tea during Storage." *Research & Reviews: A Journal of Microbiology & Virology* 5(3), 2015, 24-34.
- Hutková, J., Kántor, A., Terentjeva, M., Petrová, J., Puchalski, C., Kluz, M., Kordiaka, R., Kunová, S. and Kačániová, M.,



- "Indicence of bacteria nad antibacterial activity of selected types of tea." *Potravinarstvo Slovak Journal of Food Sciences* 10(1), 2016, 65-71.
29. Sarma, Jogesh, Nirada Devi, and Suparna Lodh. "A Study on the Antimicrobial Activity of the Different Stages of Leaves of *Camellia sinensis* of Assam against *Staphylococcus aureus*."
30. Muthukkaruppan, M., Nithya, A. and Parthiban, P., "Caffeine estimation in Darjeeling District tea samples." *Research Journal of Pharmacy and Technology* 11(5), 2018, 1981-1983.
31. Chaturvedi, R.K., Shukla, S., Seth, K., Chauhan, S., Sinha, C., Shukla, Y. and Agrawal, A.K., "Neuroprotective and neurorescue effect of black tea extract in 6-hydroxydopamine-lesioned rat model of Parkinson's disease." *Neurobiology of disease* 22(2), 2006, 421-434.
32. Gardner, E.J., Ruxton, C.H.S. and Leeds, A.R., "Black tea–helpful or harmful? A review of the evidence." *European journal of clinical nutrition* 61(1), 2007, 3-18.
33. Janssens, P.L., Hursel, R. and Westerterp-Plantenga, M.S., "Nutraceuticals for body-weight management: The role of green tea catechins." *Physiology & behavior* 162, 2016, 83-87.

**Source of Support:** None declared.

**Conflict of Interest:** None declared.

For any question relates to this article, please reach us at: [editor@globalresearchonline.net](mailto:editor@globalresearchonline.net)

New manuscripts for publication can be submitted at: [submit@globalresearchonline.net](mailto:submit@globalresearchonline.net) and [submit\\_ijpsrr@rediffmail.com](mailto:submit_ijpsrr@rediffmail.com)

