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Documentation of processing methods and Biochemical quality study of Green Tea manufactured by small tea growers of Assam, India

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ABSTRACT
Considering lack of reports on documentation of processing methods, together with biochemical analysis of green tea manufactured by gradually increasing small tea growers of Assam, India the present investigation was carried out. The green tea made at four plucking seasons through four different traditional processes were analyzed for some important biochemical parameters and those were compared with the green tea made from the same clone in large processing units by commercial methods (roasting). The present investigation, revealed that the constituents like moisture, ash, ascorbic acid, total phenol and total chlorophyll content in green tea varied significantly from 2.08 to 9.02%, 2.18 to 5.86%, 8.52 to 16.49mg/100gm, 20.3 to 36.34%, and 0.480 to 1.160mg/gm, respectively. Boiled samples revealed less content of total chlorophyll than steamed sample. However, the former revealed presence of higher total phenol and ascorbic acid content than those processed by steaming and roasting(commercial) . The effect of drying was prominent over pan firing. The commercial sample had the highest chlorophyll (1.16mg/gm) than all other samples manufactured traditionally. The green tea leaves plucked during second flush showed better result in the content of ascorbic acid and total phenol.
Key words: green tea, total phenols, ascorbic acid, processing, season

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INTRODUCTION

Assam produces about 51% of the tea produced in India and about 1/6th of the tea produced in the world. India produced around 1267 million kg of tea in 2016-17 [1]. Upper Assam covers about 592 ha of land under tea cultivation [2].Though Assam is well known for black tea, small tea growers in Assam and other North Eastern states of India have started making green tea.

The concept of small tea garden (STGs) is a recent phenomenon and the first small tea garden was established in Sivasagar District (present Golaghat district) of Assam in the year 1978. These gardens were come into existence after an arduous wait of 150 years since the introduction of tea in Assam. Within a short span of just over two decades it has spread to almost all the districts of Assam, thereby adding around 50 thousand hectares additionally under tea and producing around about 25 percent of total tea production in Assam and significantly converting the small tea sectors to a major player. The concentration of small tea garden is largest in Assam followed by West Bengal, Tamilnadu, Kerala, Tripura, Arunachal Pradesh, Himachal Pradesh, Mizoram, Meghalaya and Bihar[3].

Green tea, called non-fermented tea with more subtle, delicate flavour, and far less caffeine content than fermented tea, is medicinally beneficial because the non-fermented leaves retain a higher concentration of natural vitamins and polyphenols than the fermented counterparts. Green tea components possess antioxidants, antimutagenic, and anticarcinogenic activity [4]. Green tea consumption has also been linked to the prevention of many types of cancer, including lung, colon, esophagus, mouth, stomach, small intestine, kidney, pancreas, and mammary glands [5]. This beneficial effect has been attributed to the

presence of high amounts of polyphenols which are potent antioxidants. In particular, green tea may lower blood pressure and thus reduce the risk of stroke and coronary heart disease. The study involving animals suggested that green tea might protect against the development of coronary heart disease by reducing blood glucose levels and body weight [6].

The chemical composition of tea depends on growth of the plants, clones of tea, horticultural practices, soil, growth altitude, plucking season, sorting, grading, manufacturing or processing methods such as extraction, storage and drying of tea [7, 8, 9,10]. Tea clones may have different fermenting characteristics (e.g. slow or fast fermenting). Poor fermentability of some clones were still green after 90 min fermentation, implying that they would be more suited to green tea production [11].

In Assam, among Tocklai vegetative (TV) clones, TV 1, TV 9, TV 19, TV 23 and TV 26 are very popular among tea growers.TV 23 was found to be highly tolerant to drought among the TV clones. Moreover, TV 23 has also been reported to have high yield and average quality [12] and is also one of the most preferred clones by the present day tea growers of North-East India.

Green tea is sold as fresh or dried unfermented leaves. In green tea production, the young leaves are not allowed to oxidize. Instead, they are heated, which inactivates the enzymes (i.e. polyphenol oxidase), thus preserving the polyphenols. The fresh green leaves are steamed or boiled, rolled, and finally dried or pan-fired. The way the tea leaves are rolled determines the ultimate flavour of the tea. Another factor that decides the quality of the green tea is the plucking standard followed. Tender tea leaves and buds are manually plucked by skilled women workers from the tea plants after a fixed duration. Ideal plucking period for making a good quality green tea is 5-8 days. [8] .

Green tea is processed using either artisanal or modern method. The green tea production is still a cottage industry in many countries, though, the green tea processing methods followed in different countries are already reported [13], the exact processing conditions presently followed by the gradually increasing the small tea growers of Assam are yet to be documented. In addition, considering lack of data regarding the biochemical quality as affected by those traditional manufacturing methods of green tea, the present investigation was carried out.

MATERIALS AND METHODS

Commercial green tea samples made from Tocklai vegetative 23 (TV 23) were collected from Labonya Tea Industry, District Sonitpur, Assam, India. The fresh tea leaves of clone TV 23 and traditionally manufactured green tea samples were collected from a small tea grower Shri Basanta Duwara of Geleki, Sivsagar, Assam, India.

The made green tea samples, both commercially and traditionally manufactured were collected at four different plucking seasons; first flush(late march to April), second flush (end of may to June), third or rainy flush (July to September) and forth flush or autumn flush (october to mid november).

Four types of traditionally manufactured green tea and one type of commercially manufactured green tea were used for the present study, which are mentioned below:

1) Commercially manufactured (roasting and drying),
2) Traditionally manufactured (boiling and drying),
3) Traditionally manufactured (boiling and pan firing),
4) Traditionally manufactured (steaming and drying)
5) Traditionally manufactured (steaming and pan firing).

The moisture on fresh weight basis, the ash content and the ascorbic acid content were determined by the methods of AOAC, [14]. The phenol content was determined by Folin-ciocateu method given by Bray and Thorpe [15] . For the estimation of total chlorophyll, the method given by Arnon (1949) [16] was followed.

The analysis of variance (ANOVA) was done with 2 treatments (four types of seasonal effect and five types of manufacturing process of green tea) and three replications in the Factorial Randomized Block Design (RBD).

RESULTS AND DISCUSSION

Documentation of the processing methods of green tea

Green tea manufacturing process followed in commercial unit/factory of Assam is presented in FIG 1. After plucking, fresh tea leaves are roasted for about 6 mins. The heat treatment deactivates enzymes in leaves and shoots in order to prevent oxidation and fermentation and to maintain a green color. After heating, cooling of roasted leaves is done using cooling trough for 10-20mins (depending upon weather).Then, first rolling of leaves is done by single action table roller in order to shape the product. After rolling of leaves, first drying is done in Endless Chain Pressure (ECP) dryer at 80-85ºC for 20 mins. Then the dried leaves are transferred to 'ghoogie' to separate the fines. Coarse leaves are subjected to

second rolling using single action rolling table for 35-40 mins. The final drying of fine leaves is done at 100 to 105 ^{0} C .

The green tea manufacturing process followed in traditional unit is presented in FIG 2. Tea leaves for green tea are plucked at the age of 6-8 days (a leaf and a bud) in two days interval. After plucking, within an hour, fresh tea leaves are exposed to heat by boiling (10-15 sec) or steaming (40-60 sec). After heating, cooling of steamed/boiled leaves is done for 3 mins, immediately in a stream of cold air (by an electric table fan).Then, leaves are rolled by hand on a wooden table in order to disrupt their cell walls, release leaf moisture and also to shape the final product. Rolled tea leaves are shaped into various forms including twists, round, flat, needle, and flaky, etc. In traditional process, after rolling of leaves, drying is done by two ways, pan firing and drying in stage dryer. Drying is done for one to few hours according to amount of leaves processed. The dryer is heated using a suitable fuel, mostly by fire wood as energy source. For pan firing, an iron pan is heated with fire wood and then the rolled tea leaves are dried over it with continuous stirring. In both the cases, the drying/ pan firing continued till the moisture content of leaves reduced to less than 10% (fresh basis).

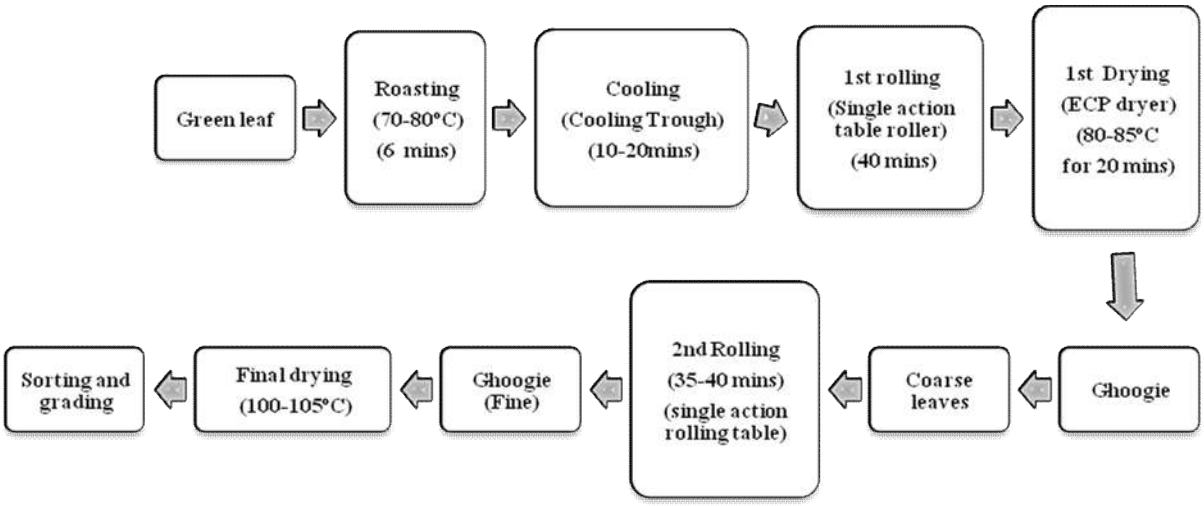

Fig 1. Green Tea Manufactured In Commercial Green Tea Manufacturing Units Of Assam.

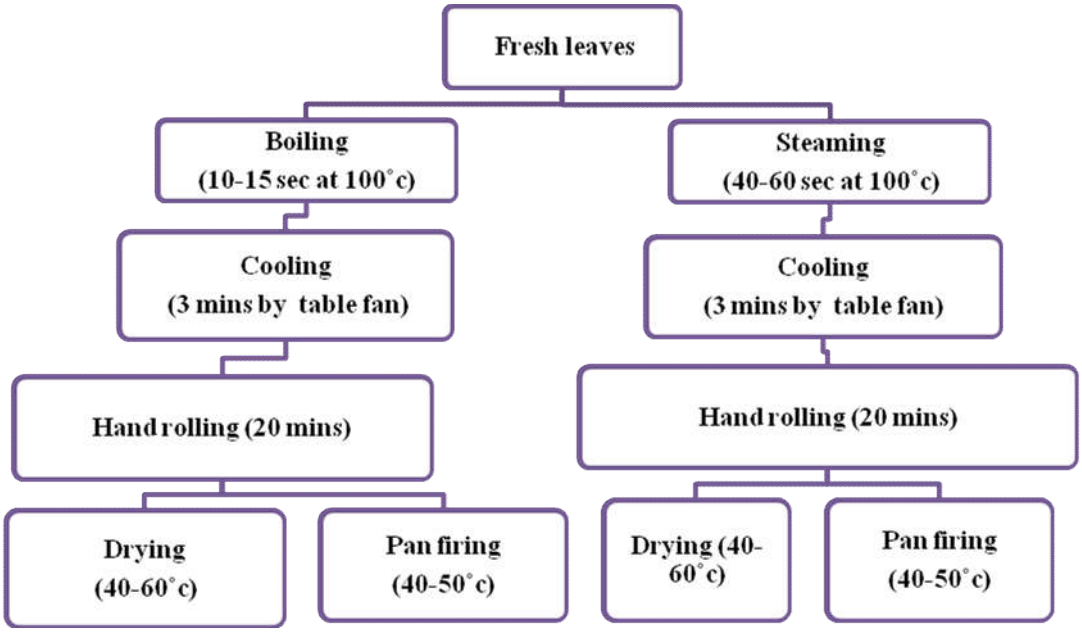

Fig 2. Green Tea Manufacturing Process Followed In Traditional Green Tea Manufacturing Unit Of Assam

The green tea production is still a cottage industry in many countries. It is reported [13] that in china, the procedure of making green tea consists of putting the freshly plucked leaf into a hot iron pan for a few minutes, during which a considerable development of steam occurs, while the leaf turns yellow, the

enzymes are inactivated and the leaf killed. After this the tea is hand-rolled on a table, subsequently given two or more further roasting and rolling, during which its colour turns to a dark olive green, and finally takes on a bluish tint or bloom. In Malaysia and Indonesia, the withered leaves are placed in an iron pan which has previously been heated over a charcoal or wood fire to a temperature ranging from 90°C to about 130° C. In Malaysia, the rolled leaves are placed in an iron pan which is heated to a temperature of 93°C and agitated until they become crisp and dry. In Japan, the preliminary heating is conducted by steam while subsequent rolling and drying take place in a series of machines specially designed to suit each stage of the process.

Table 1. Moisture content (%, fresh weight basis) of green tea manufactured in Assam

Treatments	Commercial	Boiling and drying	Boiling and pan firing	Steaming and drying	Steaming and pan firing	Mean
Flush 1	3.62	5.58	2.80	4.74	4.98	4.34
Flush 2	3.54	7.16	5.50	3.86	5.10	5.03
Flush 3	9.02	5.08	5.34	3.50	4.34	5.45
Flush 4	6.56	2.08	4.50	4.68	5.50	4.66
Mean	5.68	4.97	4.53	4.19	4.98	

Factors	C.D. (0.05)	SE(d)	SE(m)
Flush (F)	0.083	0.041	0.029
Manufacturing Process (T)	0.093	0.046	0.032
F X T	0.185	0.091	0.065

Factors	C.D.(0.05)	SE(d)	SE(m)
Factor(Flush)	0.007	0.003	0.002
Factor(Process)	0.007	0.004	0.003
Factor(A X B)	0.015	0.007	0.005

Table 2. Ash content (%, dry weight basis) of green tea manufactured in Assam

	Commercial	**Boiling and drying**	**Boiling and pan firing**	**Steaming and drying**	**Steaming and pan firing**	**Mean**
Flush 1	3.58	**2.18**	3.14	4.42	**5.86**	3.83
Flush 2	5.06	4.56	5.26	4.34	3.02	4.44
Flush 3	4.20	4.24	4.62	4.32	4.50	4.37
Flush 4	4.18	5.70	4.24	4.98	5.78	4.99
Mean B	4.25	4.19	4.31	4.51	4.79	

Table 3. Ascorbic acid content (mg/100g, dry weight basis) of green tea manufactured in Assam

Treatments	Commercial	Boiling and drying	Boiling and pan firing	Steaming and drying	Steaming and pan firing	Mean
Flush 1	11.17	15.96	8.70	12.76	8.70	11.45
Flush 2	14.80	16.49	10.10	12.50	8.51	12.48
Flush 3	10.64	11.17	8.58	9.31	8.52	9.64
Flush 4	11.97	14.63	11.17	10.64	9.31	11.54
Mean	12.14	14.56	9.63	11.30	8.76	

Factors	**C.D.(0.05)**	**SE(d)**	**SE(m)**
Factor(A)	0.053	0.026	0.018
Factor(B)	0.059	0.029	0.020
Factor(A X B)	0.117	0.058	0.041

Table 4. Total phenol content (%, dry weight basis) of green tea manufactured in Assam

Treatments	Commercial	Boiling and drying	Boiling and pan frying	Steaming and drying	Steaming and pan firing	Mean
Flush 1	27.18	30.18	26.20	21.65	32.76	27.59
FLUSH 2	33.75	35.88	36.34	26.45	21.73	30.83
FLUSH 3	24.41	24.51	23.18	20.03	21.02	22.63
FLUSH 4	24.56	23.31	24.55	22.20	20.72	23.06
Mean	27.47	28.47	27.56	22.58	24.05	

Factors	**C.D.**	**SE(d)**	**SE(m)**
Factor(A)	0.135	0.067	0.047
Factor(B)	0.151	0.075	0.053
Factor(A X B)	0.302	0.149	0.105

Table 5. Chlorophyll content(mg/g, dry weight basis) of green tea manufactured in Assam

Treatments	Commercial	Boiling and drying	Boiling and pan firing	Steaming and drying	Steaming and pan firing	Mean
Flush 1	1.03	0.48	0.57	0.90	0.62	0.72
Flush 2	1.08	0.59	0.80	0.73	1.00	0.84
FLUSH 3	1.16	0.64	0.89	0.85	0.94	0.90
FLUSH 4	0.97	0.67	0.80	0.80	0.85	0.82
Mean	1.06	0.60	0.77	0.82	0.85	

Factors	C.D. (0.05)	SE(d)	SE(m)
Factor(Flush)	0.049	0.024	0.017
Factor(Process)	0.055	0.027	0.019
Factor(A X B)	0.110	0.054	0.038

Biochemical qualities of the green tea manufactured in Assam

The lower the moisture content, the less liable the tea is to deteriorate. Very long firing or firing at very high temperature, however, impairs quality. In normal practice, teas are dried to a moisture content of 1-4% and usually of 3% which ensures good keeping qualities, provided that moisture absorption is limited in later stages [13] .

The moisture content data (Table 1) shows that the moisture of the final product was not uniform. For commercially made green tea, moisture content ranged from 3.54% (second flush) to 9.02% (third flush). For traditionally made green tea, the highest moisture content (7.16%) was observed for green tea of second flush processed through boiling and drying. The lowest moisture content (2.08 %) was observed during the fourth flush of green tea processed through same processing method. The present findings of moisture content was found to be comparable with those (3-13% , 3.14-5.21%, 4.39-7.47% and 4.4-11.1%) reported earlier [17,18 and 19 ,20 respectively].

For commercially made green tea, the highest (5.06%) and the lowest (3.58%) ash content (Table 2) was observed during the second and the first flush, respectively. For traditionally made green tea, ash content ranged from 2.18 % (first flush processed through boiling and drying) to 5.78% (first flush processed through steaming and pan firing).The present findings of ash content was found to be comparable with those (2-5% ,3.29-5.86%. ,5.0 -6.6 % and 4.05-5.97%.) reported earlier [117,19 ,20and 21 ,respectively]. The decrease in ash content in the final product in comparison to that in fresh leaves might be related to loss of inorganic materials mainly during rolling.

For commercially made green tea, the highest (14.8 mg/100g) and the lowest (10.64 mg/100g) ascorbic acid content (Table 3) was observed during the second and the third flush, respectively. For traditionally made green tea, the highest ascorbic acid (16.49 mg /100g) was observed for green tea of second flush processed through boiling and drying and the lowest ascorbic acid (8.51 mg/100gm) was observed for green tea of second flush processed through steaming and pan firing. The present findings of ascorbic acid content was found to be comparable with those (21-48mg/100g and 3 to 178 mg/100g) reported earlier [8 and 22 , respectively] .

For commercially made green tea, the highest (33.75%) and the lowest (24.41%) total phenol content(Table 4) was observed during the second and the third flush, respectively. For traditionally made

green tea, the highest (36.34%) total phenol content was observed for green tea manufactured through boiling and pan firing of second flush followed by boiling and drying leaves during the second flush (35.88%).The lowest (20.03%) total phenol content was observed for green tea of third flush processed through steaming and drying. Detection of higher amount of total phenol in the present study than those (30-40 %, 11.9-25.2% and 29.93%) reported earlier [23,24 and 25 ,respectively] might be due to expression of total phenol in terms of catechol (molecular wt. 110.1 g/mol), instead of gallic acid (molecular wt. 170.12 gm/mol).These results are in agreement with the earlier observation [26] that the second flush tea shoots contained higher levels of phenolic compounds .It was might be due to active synthesis of major constituent available during longer daytime and brighter sunlight of summer months [27].

For commercially made green tea, the highest (1.16mg/g) and the lowest (0.97mg/g) chlorophyll content (Table 5) was observed during the third and the fourth flush, respectively. The highest (1.00 mg/g) and lowest (0.480 mg/gm) chlorophyll content was observed for green tea of second flush processed through steaming and pan firing and green tea of first flush processed through boiling and drying, respectively. The present data on chlorophyll content was found to be comparable with those (1.18-2.41mg/g, 1.12 -1.89mg/g and 1.59-2.15 mg/g) reported earlier [28, 29 and 30, respectively] . All green tea samples showed the maximum amount of chlorophyll during rainy season (third flush) and the present finding was well supported by earlier findings [28 and 29] .

CONCLUSION

Biochemical composition of green tea as affected by boiling and drying revealed retention of nutritionally important components such as ascorbic acid and total phenol than steaming. So, boiling and drying method was observed as the best processing method for green tea manufacturing. Green tea leaves plucked during second flush showed better result in the content of ascorbic acid and total phenol. It was observed that the content of constituents of green tea leaves plucked during third flush were lower than those of other flushes. Rolling of tea leaves for minimum time with lesser force may reduce the loss of important constituents (such as chlorophyll and ash) during green tea processing.

REFERENCES

1. Anonymous. (2017). The Tea Board of India, 63rd Annual Report 2016-17, Kolkata, India.
2. Biggs, E.M., Gupta, N., Saikia, S., and Duncan, J. (2008). Tea production characteristics of tea growers (plantations and small holdings) and livelihood dimensions of tea workers in Assam, India . *Data in Brief*. **17** :1379–1387.
3. Goowalla, H. (2015). A study on the problem and prospect of small tea growers in Assam with special reference to Jorhat district. *International j. scientific engineering and applied science*.**1**(4): 2395-3470
4. Lui, G., Karan, M., Sharma, P. D., Rakesh, D. D., Vyas, S., and Vasisht, K. (2008). Quantitative analysis of green tea polyphenols in Indian cultivars. *International centre for science and high technology*. **8**: 19-27.
5. Koo, P.A., Clifford, M. N., Crozier, A., Day, A. J., Donovan, J.L., and Manach, C., Williamson, G. (2004) . How should we assess the effects of exposure to dietary polyphenols in vitro. *Am J. Clin Nutr*. **80**: 15-21.
6. Tsuneki, H., Ishizuka, M., Terasawa, M., Wu, J.B., Sasaoka, T., and Kimura, I. (2004).Effect of green tea on blood glucose levels and serum proteomic patterns in diabetic (db/db) mice and on glucose metabolism in healthy humans. *BMC Pharmacol*. **26**: 4-18
7. Chaudhury, M., Bhawani, S., Fong, S. S., and Mohamad I. (2010). Spectrophotometric analysis of caffeine. *International J. analytical chemistry*.**16**: 5-8.
8. Rahman, M. M., Kalam, M.A., Salam, M.A., and Rana, M. R.(2013). Aged leaves effect on essential components in green and oolong tea. *Int. J. Agril. Res. Innov. and Tech*. **3** (2) : 54-58.
9. Harlan, V., Musa, A., and Yakasai,I .(1995). Spectrophotometric method for determination of catechins in green tea and herbal formulations. *Nig. Journ. Pharm. Sci*. **16**(1): 25-30.
10. Caffin, N., D'Arcy, B., Jiang, Y., Shi, J,. and Singanusong, R. (2005) .Seasonal Variations of Phenolic Compounds in Australian-Grown Tea (Camellia sinensis). *J. Agric Food Chem*. **53** : 6477-6483.
11. Owvor, V. and Obanda, G. 2007. Green tea (*Camellia sinensis*) catechins and vascular function. *British J. of nutrition*. **102**(12): 1790-1802.
12. Baruah, S., Bordoloi, A. K., Gogoi, R. C., Gogoi, M. K. and Hazarika, M. (2012). An integrated approach to the extraction of natural tea color, flavor and evaluation of antioxidant properties of tea. *Two and a Bud*. **59**(2): 126-129.
13. Werkhoven. (1988). Tea Processing. FAO, Rome.
14. A.O.A.C.(1970). Official Methods of Analysis.10th Ed. Association of Analytical Chemists, Washington D.C.
15. Bray, H. G. and Thorpe, W. V. (1954). Analysis of phenolic compounds of interest in metabolism. *Methods Biochem. Anal*. **1**: 27-52.
16. Arnon, D.I.,(1949). Copper enzymes in isolated chloroplasts. Polyphenoloxidase in *Beta vulgaris*. *Plant Physiol*. **24**: 1-15.

17. Akande, I. S., Samuel, T. A., Agbazue, U., and Olowolagba, B. L. (2011). Comparative proximate analysis of ethanolic and water extracts of Cymbopogon citratus (lemongrass) and four tea brands. *Plant Sci Res*. **3**(4): 29-35.
18. Xie, R.S., Alam, S., Saleem, M., Ahmad, W., Bibi, R., Hamid, F. S., and Shah, H. U. (2012). Withering timings affect the total free amino acids and mineral contents of tea leaves during black tea manufacturing. *Arabian J. of Chemistry*.**16**: 37-46.
19. Adnan, M., Ahmad, A., Ahmed, A., Ahmed. I., and Khalid, N. (2013). Chemical composition and sensory evaluation of tea (camellia sinensis) commercialized in Pakistan. *Pak. J. Bot*. **45**(3): 901-907.
20. Jayawardhane, S.A.D.P.S., Madushanka, K.P.C., Mewan, K.M., Jayasinghe, S.K., Karunajeewa, D.G.N.P., and Edirisinghe, E.N.U. (2017) .Determination of Quality Characteristics in Different Green Tea Products Available in Sri Lankan Supermarkets. *Kooragodage Mudith Mewan*. **10**:15-31.
21. Maheshwari, R., and Ramchandani, R.(2018). Effect of concomitant administration of coenzyme Q10 with sitagliptin on experimentally induced diabetic nephropathy in rats. *Renal failure* .**39**(1):130-139.
22. Somanchi, M., Phillips, K., Haile, E., and Pehrsson, P. (2017). Vitamin C content in dried and brewed green tea from the US retail market. *The FASEB Journal*. **31**(1):956-965.
23. Balentine, D. (1997). Tea and Health. Crit. Rev. *Fd Sci. Nutr*. **37**: 691–692.
24. Cornad, A., Mark, R. B., Clive, D., and Philip, G. H. (2011) .Factors Affecting the Caffeine and Polyphenol Contents of Black and Green Tea Infusions. *J. Agric. Food Chem*. **49**: 5340-5347.
25. Baruah, S., Bordoloi, A. K., Gogoi, R. C., Gogoi, M. K. and Hazarika, M. (2012) .An integrated approach to the extraction of natural tea color, flavor and evaluation of antioxidant properties of tea. *Two and a Bud*. **59**(2):126-129.
26. Pal, S., Ghosh, D., Saha, C., Chakrabarti, A. K., Datta, S. C. and Dey, S. K. (2012). Total polyphenol content, antioxidant activity and lipid peroxidation inhibition efficacy of branded tea (Camellia sinensis) available in India. *IJTS*. **36** : 13-20.
27. Harbowy, M. E., and Balentine, D. A. (1997) .Tea Chemistry. *Crit. Rev. Plant Sci*. **16**: 415-480.
28. Hazakira, M., and Mahanta, P. K. (2000).Composition Changes in Chlorophylls and Carotenoids During the Four Flashes of Tea in NE India. *J. Science and Food Agriculture*. **35**: 298-303.
29. Gogoi, A. S. and Borua, P. K. 2017. Profiling of total polyphenols and pigments in tea (camelliasinensis (l.) O. Kuntze) in various seasons for manufacture in black tea and green tea. *International J. of Food and Nutritional Sc*. **6**(2): 123-134.
30. Pervin, M., Unno, K., Ohishi, T., Tanabe, H., Miyoshi, N., and Nakamura, Y. 2018. Beneficial Effects of Green Tea Catechins on Neurodegenerative Diseases. *Molecules*. **23**(6) : 1297-1315

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