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Assessment of some Promising Tea Cultivars of North Bengal (Dooars & Terai) for Improvement of the Quality Aspect to Sustain the Tea Industry in Future

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Abstract—*Tea industry plays a very important role in building the economy of the state of West Bengal and the country, with a large population directly or indirectly dependent on this tea industry. North Bengal is producing almost one fourth of the total productions of tea and the recent aim is to further improve the quality to generate more income by exporting the product. Search for improved planting materials with high quality potential is the need of the hour to achieve this target. To fulfil this task initially after first hand screening of around 400 tea germplsms, three germplasm were selected on the basis of morphological characters and compared with control tea clones for bio-chemical parameters like total polyphenol, caffeine, total catechins. Among the germplasms, clone 107/17 exhibited higher total catechins, caffeine and polyphenol contents which is an indicator of quality, besides recording the highest yield in both 2016 and 2017 cropping seasons.*

Keywords*: Tea, DUS, Polyphenol, Catechins, Amino acids, Caffeine, HPLC.*

1. INTRODUCTION

Tea [*Camellia sinensis* (L.) O. Kuntze], is a woody perennial crop that provides one of the most important beverages around the World and an important revenue source for the tea producing countries in the world. (Wight 1959; Barua,1963). It is widely cultivated in countries of Asia (India, China, Sri lanka, Japan, Vietnam and Indonesia) and Africa (Kenya, Nigeria, Uganda and Malawi). (Olaniyi et al, 2014). 700 of valuable chemicals are found in tea which include flavonoids, caffeine, amino acids,vitamins(C, E and K) and polysaccharides etc and are associated with human health (Mondel et al., 2007). Phenolic compounds structurally differ from simple molecules, such as phenolic acids, and from highly polymerized compounds, such as proanthocyanidins (tannins), which occur in plants and are common in many foods (fruits, vegetables, cereal grains) and beverages (wine, beer, teas). Green tea has been known for its effectiveness on diseases such as high blood pressure and high blood sugar. The antioxidants present in the tea together with other health related properties help in boosting memory, lowering body weight and preventing stroke. (Punch July 6, 2013). Tea is good for cell-mediated immune function of the body. The beneficial role of tea on intestinal microflora is well proven that it provides immunity against intestinal disorders. It also protects cell membranes from oxidative damage. The composition of catechins in commercial teas varies based on different varieties such as white, green, oolong and black. Green tea represents about 20% of the total tea productions in the world and is primarily popular in Japan and parts of China, however its popularity is growing in other parts of the world due to its wide availability and reported health benefits. The production process for green tea is similar to white tea, and therefore, it also contains a relatively high concentration of catechins (Castro et al 2010). More than 500 thousand hectares of area is under tea cultivation in India. West Bengal is the second highest tea producing state following Assam. More than 140 thousand hectares of land in West Bengal is under tea cultivation covering three specific agro- climatic regions viz. Terai, Dooars and Darjeeling.

Most Tea gardens are going for quantity over quality to sustain themselves by using few selected popular clones only, as a result the genetic variability of the tea population has been narrowed down drastically making it more susceptible to pest and diseases. It is therefore necessary and the need of the hour to develop new varieties time to time.

2. MATERIALS AND METHODS

Three promising varieties of tea germplasm were selected in the experimental plot of TRA. These varieties are evaluated for different parameters like yielding pattern, morphology, bio-chemical constituents to assess their performance over popular control varieties viz. TV1, TV18 and TV25. Yield data of these 6 cultivars have been collected during the cropping seasons in 2016 and 2017. Morphologically they are characterized according to DUS (Distinctiveness, uniqueness and stability) characterisation recommended by UPOV, India. (UPOV. 2007. TG/Tea (proj.5))

The selected varieties have been evaluated bio- chemically wherein the polyphenol content, total catechines and caffeine content are being estimated. Green leaf at 7 days interval is harvested from the field and leaves are deactivated by steaming method. According to Folin - Ciocalteau method-ISO/CD 14502-1-2: 2001 protocol polyphenol content is then extracted from 0.2 gm of crushed green leaf through centrifugation (twice) using 70% methanol .After mixing 3% phenol reagent and Na_2Co_3 samples are left to stabilize for an hour. The samples are then subjected to UV spectophometer alalysis under 765 nm wave length. The estimation of polyphenol has been done in four flushes (first, second, rain and autumn).

Total catechines and caffeine content of each cultivar is measured using HPLC method, following the standard ISO 14502-2:2005 method. Same manufacturing procedure describe above was also followed here. Polyphenols were extracted using 70% methanol. The samples then refrigrated(4^0 C) overnight for stabilization. The total catechines (Gallic acid, +C, EC, EGC, EGCG, and ECG) and caffeine content are measured using HPLC under 278 nm wavelength. Area of HPLC peak measured as per standard formula followed for catechine and caffeine estimation. In both cases (polyphenol and HPLC) dry matter% were estimated for calculation.

Considering the yield level, green leaf has been harvested from 30 bushes and for 30 plucking rounds, over each cropping seasons in 2016 and 2017

3. RESULTS AND DISCUSSION

Distinctiveness, uniqueness and stability (DUS) test conducted as per recommendation of International union for the protection of new varieties of plants (Table 1). The different parameters under this are very helpful to distinguish one variety from the other, which is necessary for identification.

The results of the present study indicated that clone 107/17 with high pubescence is a phenotypical sign of quality and its higher density of pluckable shoots indicated its high yield potential compared to other varieties while cultivars 480/7 and 480/17 having light leaf color is also considered as an indicator of quality. Amongst the cultivars selected, cultivar 107/17 showed highest yield for the two consecutive years followed by 480/17 and 480/7 respectively. (Table 2)

Polyphenol content of the selected six cultivars were expressed as % of dry weight. The results of the analysed data showed TV1 with highest polyphenol followed by cultivar 107/17. (Table 3).

The gallic acid content was found to be higher in cultivar 480/7 where as the cultivar 107/17 showed the maximum catechins followed by TV1 and 480/7. However TV1 has the highest caffeine content (Table 4).

From the results of the current study, it is clearly visible that clone 107/17 is not only a high yielding variety but also rich in polyphenol, catechins and caffeine which indicated its improved quality. Cultivar 480/7 showed high yield and cultivar 480/17 showed better in quality. These new clones are due for commercial evaluation and may be helpful to the tea industry of Dooars to maintain its high yield pattern with quality in near future.

4. ACKNOWLEDGEMENT

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Table 1: DUS characterization

Clone	**Growth habbit Erect Semierect Horizontal**	**Young leaf colour Yellow green Dark green Purple green**	**Mature leaf colour Yellow green Dark green**	**Petiole: Anthocyanin Pigmentation Absent Present**	**Leaf shape Lanceolate Elliptic Ovate**	**Leaf size Small Medium Large**	**Leaf upper surface: Bullation Absent Present**	**Leaf apex shape Acute Acuminate**	**Leaf base Attenuate Obtuse**	**Leaf margin Serrate Biserrate Blunt**	**Leaf blade attitude Erect Semi erect Horizontal**	**Leaf pubescence: Density Sparse Medium Dense**	**Leaf blade: shape in cross section Folded upward Flat Recurved**	**Branch Zigzaging Absent Present**	**Leaf blade: undulation of leaf edges Absent/weak/ Medium/ Strong**
480/7	Semi Erect	Yellowish Green	Dark Green	Absent	Lanceolate	Medium	Absent	Acuminate	Attenuate	Serrate	Semi Erect	Medium	Folded	Present	Weak
480/17	Semi Erect	Yellowish Green	Dark Green	Present	Lanceolate	Medium	Absent	Acuminate	Attenuate	Bi-Serrate	Erect	Medium	Recurved	Present	Weak
107/17	Semi Erect	Yellowish Green	Dark Green	Absent	Lanceolate	Medium	Absent	Acute	Attenuate	Bi-Serrate	Semi Erect	Dense	Folded	Present	Strong
TV1	Erect	Yellowish Green	Dark Green	Absent	Lanceolate	Medium	Absent	Acuminate	Attenuate	Serrate	Erect	Medium	Recurved	Present	Weak
TV25	Semi Erect	Yellowish Green	Dark Green	Present	Elliptic	Medium	Absent	Acuminate	Attenuate	Serrate	Semi Erect	Sparse	Upward Flat	Present	Medium
TV18	Semi Erect	Yellowish Green	Dark Green	Present	Lanceolate	Medium	Absent	Acuminate	Attenuate	Serrate	Semi Erect	Sparse	Upward Flat	Present	Medium

Table 2: Yield potential (Greenleaf)

Cultivars	Kg 2016(UP)	Kg 2017(UP)	Kg Mean
480/7	36.16	24.16	30.16
480/17	36.09	24.7	30.4
TV25	41.19	32.66	36.93
107/17	49.15	40.52	44.84
TV1	27.86	25.44	26.65
TV18	32.62	24.78	28.7
CD	11.42	8.45	6.33
CV	16.66	15.96	7.33

.UP= Un pruned

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Table 3: Polyphenol content (%)

CULTIVAR	First Flush	Second Flush	Rain Flush	Autumn Flush	Mean
480/17	26.31	24.45	24.80	21.36	24.23
480/7	24.83	23.25	23.92	20.98	23.24
107/17	26.51	25.42	25.98	21.72	24.91
TV1	27.43	26.23	26.21	22.47	25.58
TV18	25.10	24.56	25.25	20.58	23.87
TV25	25.96	24.55	22.85	19.28	23.16

Total polyphenol content (% of dry weight) of selected cultivars in different harvesting point (flush wise).

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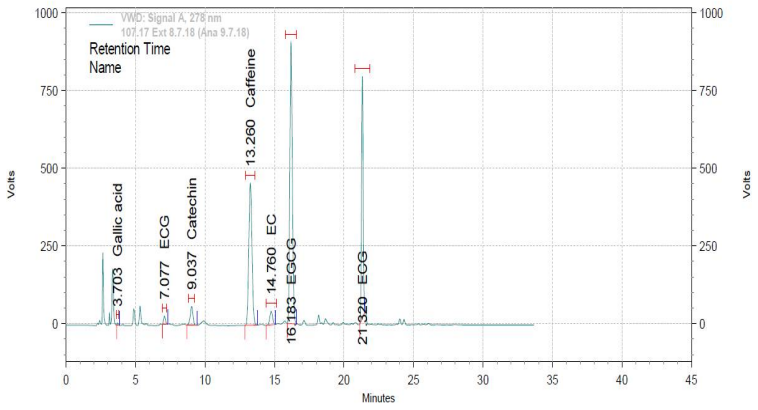
Table 4: Gallic acid, caffeine and total catechines (% dry weight)

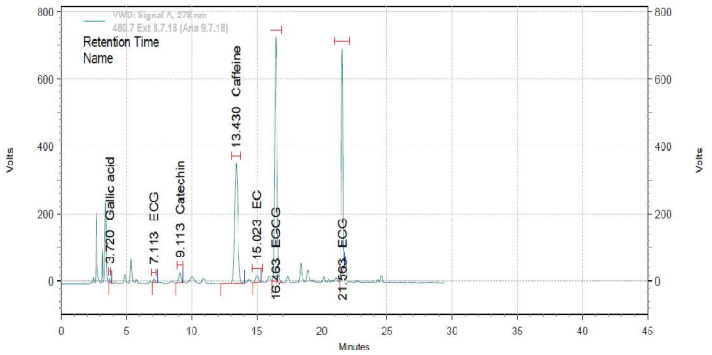
Cultivar	Gallic acid	Caffeine	Fractions of Total catechin					
			Catechin	EGC	EC	EGCG	ECG	Total Catechines
107/17	0.149	4.468	2.241	3.352	1.880	11.836	5.549	24.858
480/7	0.164	3.687	1.400	2.266	1.247	9.511	4.847	19.271
480/17	0.144	4.260	0.920	5.588	2.059	11.622	3.319	23.508
TV-25	0.154	3.650	1.080	4.301	1.362	13.097	2.862	22.702
TV-1	0.150	4.599	1.723	3.241	1.690	11.138	4.952	22.744
TV-18	0.156	4.545	0.935	3.361	1.125	13.042	2.163	20.626

Abbv: - EGC- Epigallacto catechin, EC- Epicatechin, EGCG- Epigallactocatechin-3-gallate, ECG- Epicatechin-3-gallate

HPLC profile of different tea clones under study: Content of GA, caffeine and catechins(% dry weight) of selected cultivars.



107/17



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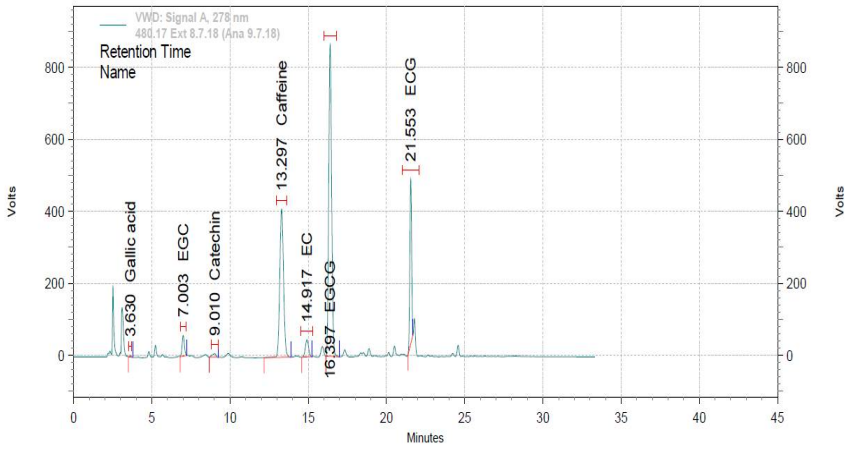

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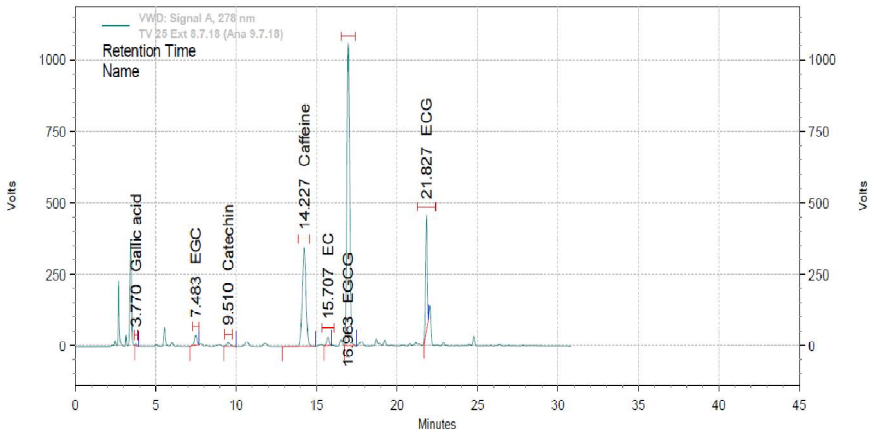

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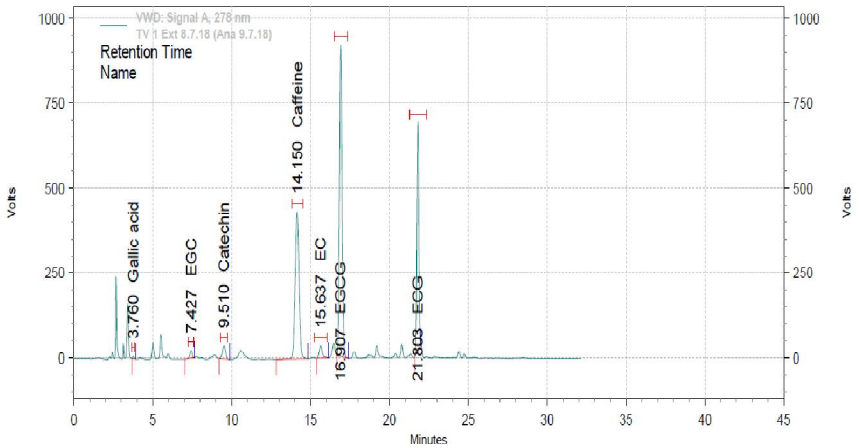

TV1

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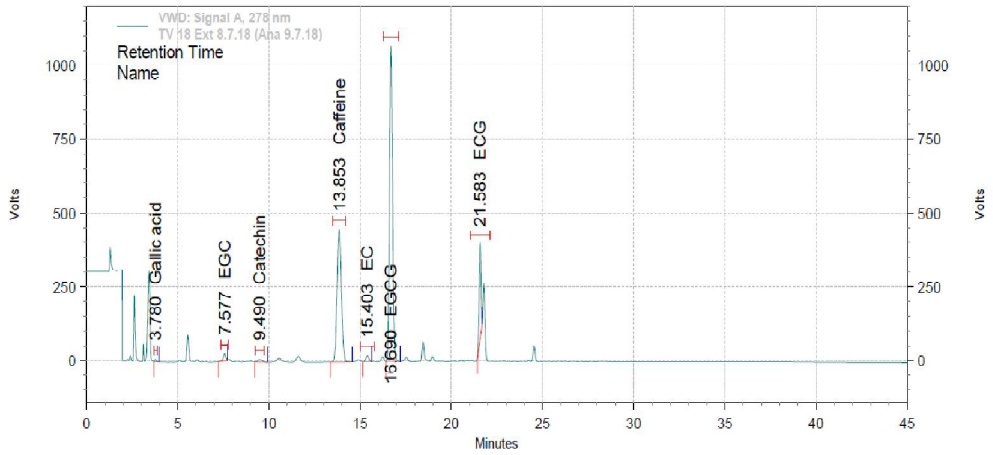

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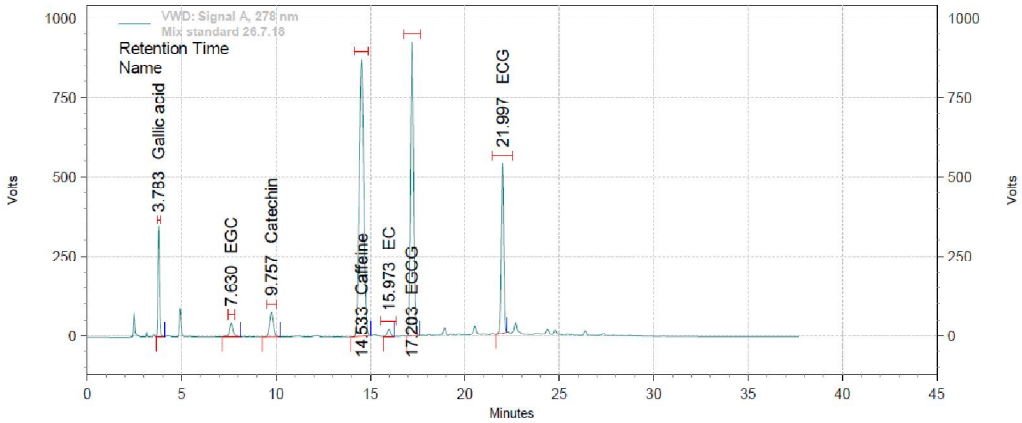

Mix standard

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