Identification of Cultivars Suitable for Producing Quality CTC Tea

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ABSTRACT
Attempts were made to identify suitable tea cultivars to process better quality CTC (Crush, Tear and Curl) teas based on the fermenting rate of each cultivar. The fermenting rate was determined by optimum fermentation time using iodometric titration method. Optimum fermentation time of ten different cultivars was studied. DT1 and TRI 777 were identified as fast fermenting cultivars whilst TRI 2023, TRI 2025, TRI 2026, DN, TRI 2142 and TRI 2024 were found to be slow fermenting ones that complied with previous findings. Both tasters' score and chemical parameter quality data revealed that DT1, TRI 777 and TRI 2024 produced better quality CTC teas. These cultivars are known to produce quality orthodox teas as well. TRI 2025 and TRI 2026 that are known to be succulent cultivars produced CTC teas of two different qualities on the basis of theaflavins content. Moreover, the hypothesis that the succulent tea cultivars always produce better quality CTC teas could not be generalized.

Key words: CTC tea, iodometric titration, optimum fermentation time, TF-Theaflavins, TR-Thearubigins

INTRODUCTION
In 1931, McKercher produced a machine to speed up the process of rolling tea leaves (Laycock, 1986) in tea processing. Later this machine was developed as a Crush, Tear and Curl (CTC) roller machine. In Sri Lanka, CTC machine was first used in late 1960's in several Mid country factories to reduce the cost of tea processing for the low priced mid grown teas (Samaraweera, 1991).

Unlike in Orthodox tea manufacture, very soft withered leaves (moisture content about 70%) are used in CTC type of tea processing. The excess moisture in the withered leaf helps reducing heat generated during CTC rolling and also acts as a lubricant to reduce the friction between rollers. Due to severe maceration, CTC leaves undergo quick fermentation compared to orthodox rolling. Orthodox grades are of relatively large wiry type leaves, black in color with definite twist.

However, CTC grades are even, smaller and grainy in appearance with a narrow particle size distribution. Millin, (1987) reported that aromatic flavor compounds concentration was drastically reduced in CTC tea and therefore CTC teas were generally poor in quality compared to orthodox tea. Quality of made tea is largely determined by the appearance of made tea, color and strength of tea liquor. In addition, color of infused leaves and brightness of tea liquor are also considered. Moreover, black tea quality can be assessed by chemical methods, which analyze the contents of theaflavins (TF) and thearubigins (TR).

According to FAO reports (Anon, 2004) the demand for CTC teas, which are extensively used in tea bags, in the world market is gradually increasing as against orthodox teas. Cultivars, which are favorable for quality orthodox tea manufacture, may not necessarily be suitable for CTC type of tea processing. Therefore, it is advantageous to screen different tea cultivars for their suitability for the production of quality CTC teas.

Tender and undamaged shoots are essential to produce good quality teas. Fermentation time and other operations involved in tea processing are also vital to produce good quality teas. Quality of made tea cannot be optimized without determining optimum fermentation time, which varies from one cultivar to the other (Samaraweera and Ranaweera, 1988). Optimum fermentation time can be defined as the time gap between rolling and drying operations where important biochemical reactions are occurred.

The objective of this study was to determine the optimum fermentation time of ten different tea cultivars with a view to identify suitable tea cultivars for producing better quality CTC teas.

MATERIALS AND METHODS

The study was carried out with ten popular tea cultivars *viz.* DT1, TRI 777, TRI 2023, TRI 2024, TRI 2025, TRI 2026, TRI 2142, DN, CY9 and K145 planted in St. Coombs estate, Talawakelle (elevation 1372 m amsl), Sri Lanka. Tender green leaves in equal amounts (12 kg) from two tea cultivars were plucked for one trial and spread separately for withering. Duplicate samples of 50 g from each cultivar were oven dried at 103 °C for 6 hrs to determine the moisture content of green leaves following a method similar to ISO 1573 (1980). Withering process was carried out for 12-15 hrs. The moisture content of withered leaves was also determined by similar method used for green leaf. Withered leaves were subjected to three passes through the miniature CTC rollers. Speeds of two rollers were 700 and 70 rpm. Length and diameter of each roller was 4" x 8" respectively. Rolled tea leaves were spread on trays with 2½" thick layer for fermentation by controlling RH (hygrometric difference was maintained below 3 °F) using humidifiers.

Fermenting dhool of each cultivar was divided into 6-10 fractions depending on the period of fermentation. Every 15 minutes intervals during fermentation, 6 g of dhool sample from each fraction was extracted and analyzed for the oxidizable matter using iodometric titration method (Mohamed and Priyanthi, 1993). This method was used to determine the optimum fermentation time based on which, the rate of fermentation of different tea cultivars was estimated. The balance fraction (≈550 g) of fermented dhool was dried in a miniature Endless Chain Pressure (ECP) drier for 21 minutes regulating inlet and exhaust temperatures at 200 °F and 130 °F respectively. Duplicated, coded made tea samples were sent to two professional tea tasters for their sensory evaluation. Made tea samples were also analyzed for chemical quality parameters such as theaflavins (TF), thearubigins (TR), total colour and brightness of the tea liquor using method of Roberts and Smith (1963). Experiment was repeated three times for each cultivar.

RESULTS AND DISCUSSION

Moisture contents of fresh leaves and withered leaves of ten popular tea cultivars are presented in Table 1. The average moisture contents of fresh leaves and withered leaves of ten cultivars varied from 76.75-80.16 and 67.81-71.7% (w.b.) respectively. The selected cultivars were categorized according to their fermenting rates (Table 2). Tea cultivars with an optimum fermentation time of more than 135 minutes were considered as slow fermenting cultivars whereas the cultivars with an optimum fermentation time of less than 120 minutes were considered as fast fermenting cultivars. In this study, only DT1 and TRI 777 were the fast fermenting cultivars whereas TRI 2023, TRI 2025, TRI 2026, DN, TRI 2142 and TRI 2024 were slow fermenting cultivars. Similar results were reported by Samaraweera and Ranaweera (1988) in a study carried out to determine fermentation rate of different tea cultivars using chloroform test.

TF and TR contents are the important parameters in assessing the quality of black tea (Roberts, 1958). Roberts and Smith, (1963) reported that TF to TR ratio was about 1:10 at the optimum fermentation time for CTC teas. The chemical quality parameters of each cultivar at the time of optimum fermentation are presented in Table 3 and it shows that TF to TR ratio was around 1:10. Therefore, the iodometric titration method can be used to estimate the optimum fermentation time for different tea cultivars satisfactorily. Table 3 and Figure 1 show that DT1, TRI 777 and TRI 2024 can produce higher quality teas and they developed more color compared to other cultivars. Richards (1967) reported similar results for orthodox teas. TRI 2023, TRI 2026, DN and CY9 can produce CTC teas with a brighter liquor.

Table 1. Moisture % of green leaves and withered leaves of ten tea cultivars

Cultivar	Average moisture (%) green leaves	Average moisture (%) withered leaves
TRI 2142	80.16	70.30
TRI 2025	80.01	68.83
TRI 2024	79.03	69.60
TRI 2026	79.01	69.43
DT1	78.55	69.15
K145	78.43	71.20
TRI 2023	78.09	67.81
DN	77.79	67.90
TRI 777	77.22	68.56
CY9	76.75	71.70

Table 2. Optimum Fermentation time (range) and the fermentation rate of ten cultivars

Cultivar	Optimum Fermentation time (minutes)	Fermentation rate
DT1	90 - 105	Fast
TRI 777	105 – 120	Fast
K145	120 – 135	Moderate
CY9	120 – 135	Moderate
TRI 2024	135 – 150	Slow
TRI 2142	135 – 150	Slow
DN	135 – 150	Slow
TRI 2025	150 – 165	Slow
TRI 2026	150 – 165	Slow
TRI 2023	165 – 180	Slow

Leaves of TRI 2025 and TRI 2026 cultivars are succulent *i.e.* more moisture is present in green leaves (Table 1). When comparing the quality of made tea on the basis of TF content, TRI 2025 did not produce quality CTC tea, whereas TRI 2026 produced good quality CTC tea (Table 3 and Figure 2). The cultivars such as TRI 777 and K145 are not so succulent but TRI 777 produced quality CTC teas whereas

K145 did not produce quality tea on the basis of TF content. Therefore, this proves that there is no relationship between the quality and the succulent character of the cultivar for CTC type of manufacture. Further from tasters' evaluations (Figure 1), it is illustrated that DT1 and TRI 777 which are known to produce good quality orthodox teas can also produce quality CTC teas.

Cultivars such as TRI 2025, CY9, and K145 did not develop desirable coppery colour during fermentation even after 3 hrs of extended fermentation time. Wet dhool of such cultivars when placed in an constant climatic chamber setting environment temperature at 32 ^{0}C, color was developed within two hours period. This implies that if the manufacture was carried out at higher ambient temperatures, these cultivars too could develop coppery color and thus could shorten fermentation time. DT1, TRI 777 and TRI 2024 developed coppery colour very fast even at 20-24 ^{0}C.

Table 3. TF, TR, TC, BR percentage ranges** of made tea produced from ten cultivars

Cultivar	*TF%	*TR%	$^{+}$TC	$^{+}$BR%
DT1	1.62-1.65	16.47-16.86	5.93-6.16	25.89-27.22
TRI 777	1.48-1.51	18.14-18.91	6.58-6.78	22.84-23.12
K145	1.13-1.26	13.01-13.69	4.25-4.40	24.88-28.90
CY9	1.50-1.62	15.36-16.92	5.22-5.69	28.23-28.55
TRI 2024	1.61-1.64	16.71-16.95	6.23-6.25	25.18-25.36
TRI 2142	1.28-1.35	14.85-15.28	4.95-5.19	23.18-25.36
DN	1.39-1.46	12.44-15.56	4.43-4.49	30.43-30.78
TRI 2025	1.17-1.23	14.79-15.40	4.84-4.99	22.84-23.40
TRI 2026	1.75-1.79	16.43-16.76	4.65-4.71	32.27-33.60
TRI 2023	1.40-1.65	16.13-16.77	4.34-4.55	28.14-32.55

*TF = Theaflavins, *TR = Thearubigins, $^{+}$TC = Total Colour, $^{+}$BR = Brightness
**These values were assessed at optimum fermentation time for respective cultivar

Therefore, results indicated that the cultivars recommended for producing quality orthodox tea (Anon, 1976) could also produce quality CTC teas.

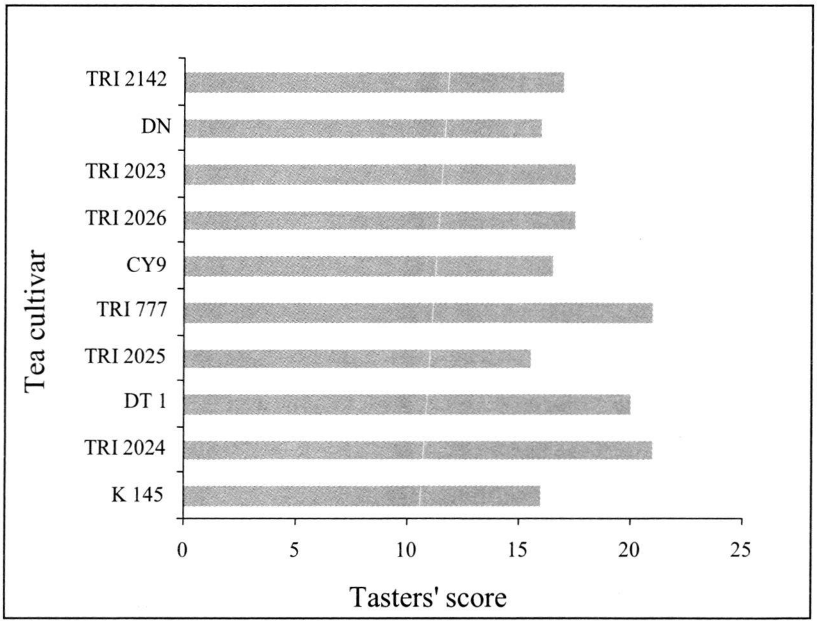

Figure 1. Tasters' scores for liquor color of ten tea cultivars

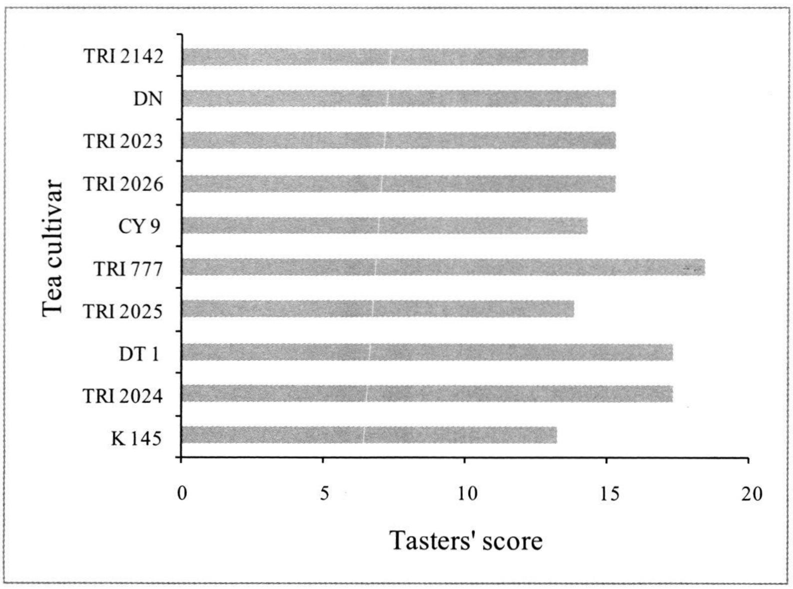

Figure 2. Tasters' scores for overall liquor quality of ten tea cultivars

CONCLUSIONS

Optimum fermentation time of ten different tea cultivars was studied using iodometric titration method. Results show that the cultivars known to produce good quality orthodox teas can also produce quality CTC teas. Moreover, it disproved the hypothesis that the tea cultivars with succulent leaves always produce good quality CTC teas.

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