Processing Black Tea by CTC System: An Overview and Report of Black Tea Processing in Kertowono Plantation, East Java, Indonesia

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Abstract. The processing of black tea in Indonesia generally consists of the ortodox rotarvane and CTC (Crushing, Tearing and Curling) system. However, recently CTC system in tea processing is the most successful and most popular system in Indonesia including in Kertowono Plantation, East Java, Indonesia. Public, especialy buyer, needs to know the processing of black tea using CTC system is conducted in order to produce specific and good quality black tea. The processing of black tea by using CTC system in Kertowono plantation is started from picking, receiving, whitering, milling, fermenting, driying, sorting, packing and storage. CTC system does not apply wet sorting, and the milling process is carried out through three steps, namely tearing, pressing and rolling to produce more refined tea powder. Kertowono plantation maintains the processing of black tea by CTC system since it is more efficient and effective than that by ortodox rotarvene system; the enzymatic oxidation of polifenol compound is more, so the produced black tea is more perfect.

Key words: black tea, CTC system, processing, Kertowono Plantation.

Introduction

Based on morphological characters like leaf size, leaf pose, growth habit etc. tea is classified into three main varieties Assam *(Camellia assamica)*, China *(Camellia sinensis)* and Cambood *(Camellia assamica*, sp. Lasiocalyx). Studies on chemical composition of these varieties show distinct difference in compositional pattern. Assam variety is rich in polyphenolic constituents, more precisely the tlavanols and

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caffeine whereas China variety is rich in carotenoids. Among the various catechins (tlavanols) the contribution of epigallo catechin gallate (EGCG) is the highest which is more than 50% and an important biochemical marker of Northeast Indian tea. Tea shoots contain 10-30% (dry weight basis) flavanol compounds. Oxidative transformations of these catechins take place during oxidation (fermentation) stage of black tea processing and forms theaflavins (TF) and thearubigins (TR), the prime quality attributes ofCTC black tea. Hence, quality ofCTC black tea is dependent on amount offlavanols of harvested shoots, activity of oxidase enzyme and also on the processing conditions (1).

The black tea processing is a complex conjugation of some biochemical reactions. The mechanized system of black tea processing is the backbone of the tea industry. Hence, processing technology is being constantly upgraded with improved machinery and better quality control methods. India and particularly Tocklai Experimental Station has creditable record of development and innovation of tea machinery. After withering rolling (maceration) is another important stage of black tea processing, where the basic requirement is leaf size reduction with a degree of cell disruption. Maceration machines i.e., rotorvane and CTC rollers operate most effectively within 68-72% moisture of withered leaf. Excessive moisture in the green leaf may clog both the rotorvane and CTC rollers. Also, the quality of processed leaf depends upon the hardness of the shoots, withering percentage, closeness of roller setting, etc. These, in turn, have direct impact on the output of the machine, frequency of roller sharpening, power requirement and more importantly, quality of made tea. Moreover, the space requirement and energy consumption or in particular, the electrical wastage of the CTC machine is also very high (2).

Micronizer, the food processor is a compact machine, in which the fundamental mechanical forces like shearing, impact or attrition are appl ied. At a fixed setting, the machine gives rated output, which is independent of leaf quality and any other external parameter, other than the feed rate. The added advantage of SEPTU Micronizer would be that it occupies less floor area as compared to existing CTC machines. An attempt was made to document the performance of the Micronizer as a tea processing machine and compare the results with that of a CTC machine. Rolling machines are applied for leaf maceration especially for Darjeeling orthodox tea production. The process results in exposure of cell sap leading to intermixing of chemical constituents and enzymes. Rolling time and pressure applied playa critical role in processing. Extensive work has been carried out at Tocklai Experimental Station for making the orthodox process of manufacture a continuous one. Recently, an experiment was conducted to improve the performance of a single action orthodox rolling table roller with higher output and lower power consumption (1).

Methodology

This paper is a report of field study on tea processing with sampling in Kertowono Plantation, East

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Java, Indonesia. Information explored by direct observation in the field carefully since process of harvesting in the garden, receipt of raw materials at the plant to dry sorting process, organoleptic testing and packing. During the observation, the authors also received an explanation from some of the competent factory workers are mastered the process in detail and aspects related to the processing of black tea. The paper is also overviewed and riched with relevant reference about tea.

Results And Discussions

Indonesia Tea Companies

After its independence, Indonesia took over tea estates from the Dutch and turned them into state-owned companies. While changes have been made, the companies still use the same technologies and machinery left by the Dutch. The private sector also enters into the tea business, in both upstream and downstream of the sector. As data from Statistik Indonesia 2004 reveals, 143 estates, state-owned and private combined, are operating in Indonesia. Ten largest tea plantations are state-owned, resulting from mergers of smaller plantations. Following is a list of ten largest tea companies in Indonesia (3).

Table 1. The Big Ten of Plantation Companies in Indonesia

Rank	Company	Location
1	PT. Perkebunan Nusantara VIII	West Java
2	PT. Perkebunan Nusantara IV	North Sumatra
3	PT. Perkebunan Nusantara VI	West Sumatra/ Jambi
4	PT. Perkebunan Nusantara XII	East Java
5	PT. Tatar Anyar Indonesia	West Java
6	PT. Hasfarm	South Sulawesi
7	PT. Melania Indonesia	West Java
8	PT. Lam Teh	West java
9	PT. Perkebunan Nusantara VII	Lampung / South Sumatera
10	PT. Mitra Kerinci	West Sumatra/ Jambi

Kertowono garden was opened in 1875 by Plantation Company NV VAN TICDEMAN KER CHEN (TVK) with quinine plant. Tea planting and nursery started in 1910 as one of the diversification efforts plantation commodity. In 1942-1945 most of the tea plant and quinine dismantled for planting crops, and after the Japanese left Indonesia, the tea plant was expanded by replacing most of the cinchona plant.

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Main commodities grown in the Kertowono garden is tea that processed through process of CTC (Crushing, Tearing and Curling), while in the Kajaran garden is Edel and Bulk Cocoa. Byproduct commodity (Horticulture) that cultivated is coconut as shade for cacao and macadamia. Main commodities marketed by means exports to foreign countries on five continents in order to gain foreign exchange.

The destination countries of black tea exports from PT. Plantation Nusantara XII (Persero) Kertowono gardens is United States, Germany, the Netherlands, England, Belgium, Russia, Egypt, Pakistan, Singapore, Australia, and New Zealand.

Figure 1. Kertowono Garden and Tea Factory

PT. Perkebunan Nusantara VIII produces five commodities: tea, rubber, Cinchona, cocoa, and oil palm. Of the total amount of tea the company sells, 99% are produced in its own plantation, and only 1% is bought from smallholders. Data provided by the company's marketing department, tea production relies on 21 estates with orthodox machinery, located in Pasir Malang, Kertamanah (also with CTC machines), Malabar, Purbawindu, Pasir Yunghuhn, Santosa, Talun, Sedep, Sinumbra, Sperata, Rancabolang, Papandayan, Cisaruni, Dayeuh Manggung, Ciater, Montaya, Goalpara, Pasir nangka, Tanawatee, Pangheotan and Panglejar and 11 estates with CTC., located in kebun Arumsari, Kertamanah, Walini, Arum, Bukanagara, Gunung Mas, Harendong, Kondang, Sukawana, Parakansalak and Tambaksari (4).

Tea is a plant of multi use. The Stalk is a material for handicraft, while the leaf is consumed after being processed into various tea products, as shown in the above graph. In Indonesia, nearly 90% of farmer tea is processed into green tea and later into jasmine tea, while 10% into black tea. Green tea is produced in bulk mainly in West Java, while jasmine tea is produced mainly in Central and East Java, regions with high concentration of consumer of jasmine and green tea, thus making up the largest market share for both. Of tea produced by state-owned plantations (PTPN), 82% is processed into black tea and only 18% into green tea. The black tea is mostly of the orthodox kind and a small portion of CTC and 90% of the black tea is for export. The categorizing of CTC and orthodox is based on processing method. CTC (Crushing, Tearing and

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Curling) method uses machines which can crush the veins of leaf, tear and curl the leaf and make it soluble. While the orthodox method has longer process (spreading and withering, milling and drying, sorting and packaging) and needs more workers than CTC. CTC is soluble; therefore it is often used in instant tea. Orthodox has pungent aroma for powder tea. Teabags are mixture of CTC and Orthodox (4).

General Processing of Black Tea

After the harvest, the leaves are first withered by blowing air over them. Then black teas are processed in either of two ways, CTC (Crush, Tear, and Curl) or Orthodox. The CTC method is used for lower quality leaves that end up in tea bags and are processed by machines, producing a reasonable quality product. Orthodox processing is done either by machines or by hand processing, used for high quality loose teas, for connoisseurs. Next, the leaves are oxidized (also called "fermentation") under controlled temperature and humidity. Since oxidation begins at the rolling stage itself, the time between these stages is a crucial factor as the level of oxidation determines the quality of the tea. Then the leaves are dried with hot air to arrest the oxidation process. Finally, the leaves are sorted into grades according their sizes (whole leaf, brokens, fannings and dust), using sieves. The tea can be further sub-graded according to other criteria, and is then ready for packaging (5).

Tea originates and grows in subtropical highland regions of cool weather. Countries with such regions, such as India, Sri Lanka, Kenya, China, Indonesia and Turkey, are well known as tea producer. Global tea production totaled 3,233,216 tons in 2004, 70% share of which is black tea and the remaining percentage green tea. While 85.5% of Indonesia's tea export is still in the form of bulk black tea, the market for the same commodity has been shrinking everywhere, except for a few countries (United Arab mirates, Russian Federation, Japan, and Poland) where its market still grows (5).

Crushing, Tearing, Curling (CTC) System

When a satisfactory withering has been obtained, the leaf is ready for rolling, which twists the leaf, breaks it up and expresses the juices. The CTC process of rolling is a comparatively rigorous one for the leaf, which is forced through a machine having two steel cylinders. The cylinders move in inverse direction at a speed of 700 RPM and 70 RPM with marginal learance between them. The leaf as it passes consecutively through a bank of three to four such machines gets much reduced in size and its cell get ruptured for accelerated as well as intensive fermentation. The whole process leaves the leaf granulated. It gives much better thicker liquor and yields more cups of tea per kg of leaf as compared to the Orthodox type of tea (5).

CTC (crush, tear, curl) differs from orthodox production solely in that, after rolling and before fermentation, the tea is uniformly shredded with a CTC machine, so shortening the overall production time by approx. 50%. This method yields powerfully flavored, quick brewing teas which, while they are not of very high quality, are particularly suitable for producing tea bags (5).

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Market Potential

The processed tea (CTC Black Tea) produced by the only unit at Sarupathar (Assam) under Dhansiri under Golaghat District is being sold like hot cakes in Sarupathar locality. The Cottage made CTC Tea has great demand among the users due to its special manufacturing process, which imparts its quality and aroma. Besides, cottage organic Tea (CTC and Orthodox), Bio-Tea may be produced, which will have great market potential. So a couple of cottage tea factory could be set up in concentrated tea growing areas which will have a steady market for its products (5).

Figure 2. Black Tea with CTC Process

Manufacturing of Tea by the CTC Process in Kertowono Plantation

A high standard of plucking is important for good CTC manufacture, not only to ensure teas of a satisfactory liquoring standard, but also to prevent the CTC rollers from becoming prematurely blunt by cutting into coarse leaf, stalk and woody material.

Withering

Green leaf is given a light withering, corresponding to about 28-32% outturn of made tea to withered leaf, in troughs. It is important that the wither should not get harder than an upper limit of 32% to ensure a satisfactory make, even if a drastic reduction in the duration of wither is necessary. The withered leaf is then passed over a withered leaf sifter with a No.4 (or a larger mesh) to eliminate sand and small stones that may have got picked up accidentally in the field and in the weighing sheds (5).

Cutting

The leaf is fed into a pre-conditioner such as 15" (380 mm) retorvane and then given 3 or more successive cuts in CTC machines arranged in series. It is advisable to use a bar magnet on the conveyor to

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the first CTC machine connected to remove iron particles, which might damage the rollers. Arrangement sketches, details or roller adjustments, rolling programmes etc., are given in other circulars (5).

Fermenting

The period of fermentation is generally shorter than with conventional manufacture, ranging from 1 hour and 15 minutes to about 2 hours and 10 minutes depending on the rate of fermentation of the leaf. Fermentation machines with a forced draught of air could be used, but it also possible to ferment the leaf on tables, by reducing the spread to 25 mm – 32 mm (1 to $1^1/_4$ inches) in height. Fermented dhool can then be fed into drier directly. It is however, advisable to pass it first through a ball-breaker as this operation minimizes the formation of agglomerates which inevitably find their way into the off grades (5).

Drying

The drying process is carried out in either a fluid-bed drier (FBD) or in a conventional ECP drier. However, FBD is considered to be *sine quo non* for CTC manufacture. If FBD is used the in let temperature should be maintained at 121 – 126 ^oC and the weir end temperature at 88 – 93 ^oC with a weir height of 8.9 – 10.2 cm. If ECP drier is used the period of drying should be 21 minutes with an inlet temperature of 93 – 99 ^oC and exhaust temperature of 52 – 54 ^oC (5).

Grading

The grading operation is simplified by the absence of abig bulk, and by the manucfature of only a limited number of grades. Genarally, either a Vibro Screen or a Chota Sifter or a Trinick Sorter with mesh sizes of 10, 12, 16, 30 and 40 is used. When a chota sifter or a vibro screen is used, tea particles passing over the 12 mesh are crushed, resifted and classified in secondary grades. BP1 is taken through 12 and over the 16 mesh. What passes through 16 and over the 30 mesh is PF1 and through 30 and over 40 is PD. What passes through 40 meshes is D1 (5).

Some variation is expected in the sieve size description of grades and even procedure according to trade requirements, but the procedure outlined here is that which is most commonly followed. Crushed teas, rejects from the winnower (if used for subsequent cleaning operations) and the electrostatic stalk extractor are used to form the off grades BP1, F1, F2 and D2 (5).

The trays in a Trinnik soter should be fixed in an ascending order of perforation sizes (No. 30, 24, 16, 12) and grades separated as explained above. For example, BP1 is taken through No. 12. Trinnick sortes could be used with only 4 sizes of meshes fitted, if necessary. Bright infusions with good liquoring colour and strength are necessary attributes of a good CTC tea, but the dry leaf appearance standard is not as

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important a factor as with orthodox (5).

Areas Suitable for Production of CTC Tea

Increasing popularity of the tea bag in Europe and the demand for quick brew teas have resulted in the formation of a very considerable market for cut/tear/curl (CTC) teas. A negligible proportion of this type of tea is manufactured in Sri Lanka and it has now become very necessary for us to take a serious view of this expanding market. Strong, coloury liquors are essential characteristics, but dry leaf appearance is not as important as sales factor as it is with teas of orthodox manufacture (5).

The requirements of this speacilized market for CTC tea are, at the moment, supplied by India and East Africa. CTC tea production in India is based largely in the low elevational districts of Assam, Dooars and West Bengal in the North East, and in more limited quantities, from the plain tea producing areas of Kerala and Madras State in the South. Districts such as Darjeeling, Nilgiris and the Anamalais which produce flavoury teas in season and high quality teas for most of the year retain almost exclusively the orthodox system manufacture. East Africa, on the other hand, experiences no pronounced flavoury season as in the Uva and Dimbula-Dickoya districts of Ceylon, and produces mainly the CTC variety (5).

Looking into the factors which have demarcated CTC producing areas from districts producing orthodox black teas in other countries, it would seem that estates in the low and low-mid elevations of Sri Lanka would be those best suited for producing the type of CTC tea that would find its way into the tea bag. Rush and other off-season teas from high and upper-mid elevational teas could also be converted into CTC but these estates would then have to be geared for dual manufacture and the very best of these could even be placed in a disadvantages position, under prevailing market conditions, by not offering the trade an uninterrupted supplay of a given line of manufacture (5).

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