

Tea cultivation and black tea production in INDIA-Perception, Science and Practice

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Abstract

India produces around 950 million kgs of black tea of which over 80% is CTC and remaining quantity is orthodox and green tea. Quality perception of black tea which is ever-changing is based on niche market. Discovery of new planting materials, changes in cultivation practices have led to different product categories. It has become important to modify processing techniques from time to time to produce black tea to suit consumer requirement. The method of orthodox tea production in hills of Darjeeling and plains of Assam have considerable variability. Similarly method of CTC tea production in North East India and South India also varies to a considerable extent. Cultivation practices including inputs like fertilizer influence the concentration of substrates of tea leaf whereas processing techniques followed bring optimum changes in substrate to produce tea of consumers' choice. Tea cultivation and black tea production in India have well defined standards to produce unique Indian black tea.

1. Overview and Indian scenario

Tea (*C. assamica*; *C. sinensis*; *C. Assamica* sub sp. *Lasiocalyx*; Wood and Barua, 1958), has been cultivated as a evergreen, perennial, cross-pollinated crop that grown in many countries ranging from as far as 49°N, outer Carpathians to as far as 30°S, Natal, South Africa and from altitudes varying from sea level in Japan to 2700 m above mean sea level (amsl) in Olenguruone, Kenya and Gisovu, Rwanda (Barua, 2008). The plant is widely adaptable to geographical areas and thrived well about 52 countries in the world. Tea plant

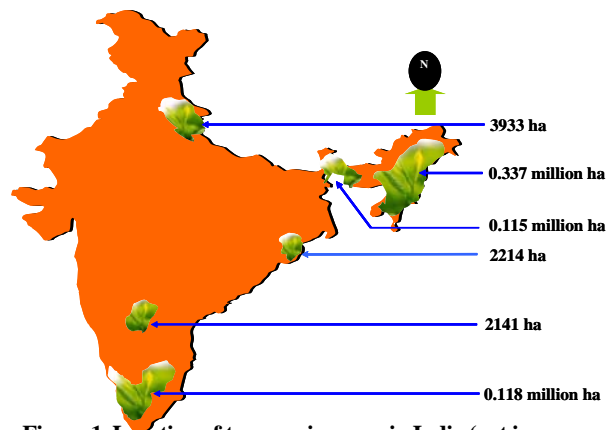


Figure 1. Location of tea growing area in India (not in scale) for the year 2008 (Source: Tea Board of India, 2010)

grows best in tropical and subtropical areas having adequate rainfall, good drainage and acid soils (Barua, 2008). Tea growing area in India mainly distributed in North East India (27°1' to 27°28'N and 88°9' to 95° E), South India (8°30' to 13°5'N and 76°58' to 80°16' E), and some parts of Bihar (25°22' N and 85°7' E), Himachal Pradesh (31°6'N and 77°10'E), Orissa (20°9' N and 85°30'E) and Uttaranchal (30°19'N and 78°3'E). In the world, tea plant occupies about 2.7 million hectares of cultivable land out of that 0.58 million ha is covered in India (0.46 million ha in South India and 0.12 million ha in North India) representing 16.4% of the total tea growing areas of the world (Tea Board of India, 2010). Figure 1 shows the location and total area covered in major tea growing area in India for the year 2008. In North East India, Brahmaputra valley, Barak valley and Dooars region are the major tea growing region. Among the different varieties of tea plant, indigenous tea varieties have covered large part of the tea areas in India and tea industry in India is around 160 years old. Since independence tea production has grown over 250%, while land area has just grown by 40%. Tea industry in India directly employs over 1.1 million workers and generates income for another 10 million people approximately. Women constitute 50% of the workforce.

Black tea in India comes from the young shoots comprising of two leaves and the terminal apical bud of *Camellia assamica* and its hybrids. The important conventional teas are black tea, green tea, and Oolong tea based on their respective manufacturing techniques. Production of oolong tea in India is insignificant. Black and green tea are produced and consumed in different regions of India. All the

black tea and green tea in India are obtained from same plant (*Camellia assamica*) but their taste and aroma differ depending on the variables involved in processing. Tea is perceived as social and refreshing drink). The range of tea offered by India is from plains Orthodox to CTC (Crush, tear, and curl) and Green Tea. The taste ranges from the aroma and flavour of Darjeeling tea to the strong Assam and Nilgiri tea that remain unparalleled in the world. World tea production, is 78% is black tea, 20% is green tea, and 2% is oolong tea (Kuroda and Hara, 1999). India produces around 950 million kg of black tea of which over 80% is CTC and the remaining part is orthodox and green tea. Assam black tea contributes 45% of total Indian tea production followed by south India (25%), Dooars (15%), Terai (8%), Cachar (5%), Darjeeling and other region (2%). Starting with 2000 as first reference year, Figure 2A demonstrates that both small and big tea growers increasing progressively. Figure 2B revealed that, tea growing area in NE India increases significantly, however no significant change of tea growing area in South India was observed between the year 2006 and 2007. It can readily be seen that, production and retention of tea in India significantly increased (Figure 2C). But there was a declining trend of Indian tea export to the world. This may be attributed to the fact that consumption pattern of tea inside the country has been increasing. Figure 2D shows the contribution of Indian tea to the production and export of world tea export.

Table 1 depicts the over all status of tea in India for the year 2008. Tea industry is of vital importance to the India's economy and people's livelihood. In all aspects of tea production, consumption and export, India has emerged to be one of the world leaders, mainly because it accounts for 31% of global production. India has retained its leadership over the last 150 years. Presently Indian tea industry has 1692 registered tea manufacturers, 2200 registered tea exporters, 5848 number of registered tea buyers and 9 tea auction centers. The total turnover of the tea industry is around 2.25 billion USD and total net foreign exchange earned per annum is around 0.42 billion USD.

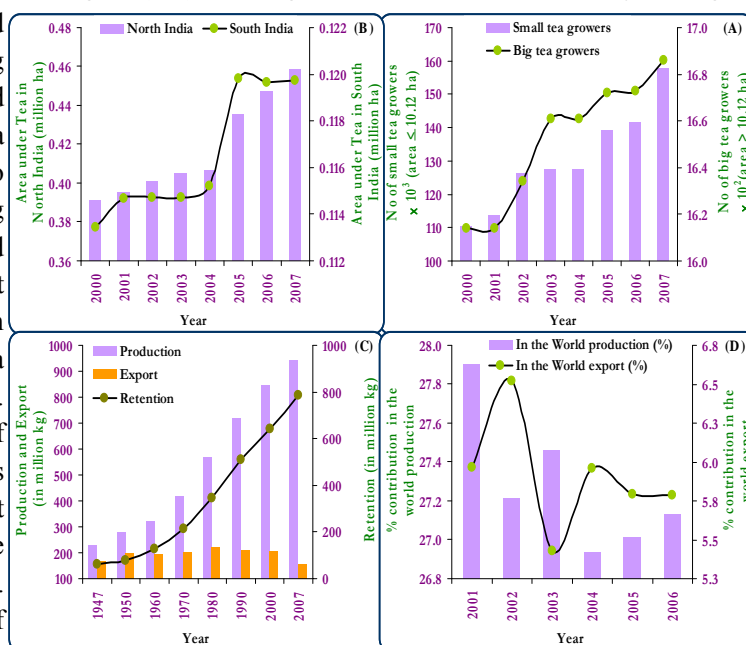


Figure 2. (A) Number of tea growers in tea plantation in India (from 2000 to 2007); (B) area under tea in India; (C) production, export and retention of tea in India after post independence and (D) Indian tea in world perspective.

Table 1. Overall status of tea industry in India (2008; source: Tea Board of India, 2010)

Parameters	Statistics
Average yield rate (kg ha ⁻¹)	1693.00
Total production (in million kg)	980.82
% of world production	26.16
Exports of tea (million kg)	203.12
% of world export	12.29
Estimated value earnings (in US \$)	469.64
from exports (million US \$)	(1 US\$ = INR Rs.40.22)
Domestic consumption (in million kg)	802.00
Per capita consumption (g per person)	701.00

2. Tea agricultural practices in India

The major tea growing area in India is the north east India where impact of south west monsoon is spread over 3 to 4 months. In south India the tea growing areas experience two monsoons, south west as well as north east. Tea bushes are pruned during winter in NE India and during winter and spring in South India (Barua, 2008). The two monsoons largely influence the growth and cultural practices in the respective area. Tea growing areas in India have different planting materials (primarily *Camellia assamica*) and fertilizer practices that greatly influence the quality of black tea (Hazarik et al., 2001). Among the nutrients, nitrogen (N) is the most important nutrient for tea plants and the highest content

is contained in young harvestable tea shoots (Dev Choudhury and Bajaj, 1988; Dev Choudhury et al., 1990). Use of N fertilizers is widely practiced in India and increases productivity per unit area under good management in commercial tea plantations with recommended rates 100 kg N ha⁻¹ year⁻¹ in India (Dev Choudhury et al., 1990). Beside N, phosphorus (P) and potassium (K) are the major nutrients for tea plants.

3. Tea Research in India

Tea research in India is managed primarily by two major Associations, Tea Research Association (TRA) at Tocklai, Jorhat, Assam and other is United Planter Association at South India (UPASI).. Presently TRA is responsible for 75% of tea production in India whereas UPASI is responsible for 25% of the production. Most of the tea garden in major tea growing areas of India is the member of TRA and UPASI. Impact of research and development by TRA is well documented in NE India. The members of TRA who are exposed to technological development produce about 50% more than the non members. The impact of TRA research and development on member tea estate is clearly depicted in Figure 3.

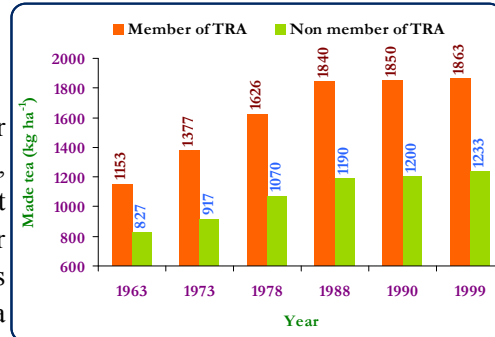


Figure 3. Yield of made tea (kg ha⁻¹) for TRA member and non member estates

4. Characteristics and chemistry of black tea

In India black tea is categorized as Assam black tea, Darjeeling tea, Nilgiri tea and Kangra tea. Assam black tea is a full-bodied and malty tea which is often served as a breakfast tea. This tea, most of which is grown at or near sea level, is known for its body, briskness, malty flavor, and strong, bright color. Assam teas, or blends containing Assam, are often sold as "breakfast" teas. English Breakfast, Irish Breakfast, and Scottish Breakfast Tea are common generic names of this tea. Darjeeling tea is delicately flavoured and offers a light cup. It is the only tea in the world that produces the famous Muscatel flavour. Nilgiri Tea combines the fine flavour of high grown teas with a brisk liquor, which makes for its singular character. Most Nilgiri teas are high grown and come in orthodox variety. However, tea estates at lower altitudes produce the CTC variety. Kangra tea is grown in the Kangra Valley, nestled in the Himalayan foothills in North India. This tea has characteristic of high grown teas like Darjeeling Tea.

The tea leaves are distinguished by their content of methylxanthines, and polyphenols especially flavonols of the catechin type. The differences in the manufacturing process appear to be the only distinction between different teas (Tamuly et al., 2006) Black tea contains several polyphenols such as bisflavonols, theaflavins (TF) and thearubigins (TR) (Ahmad et al., 1998). Black tea extract contains approximately 20-30% polyphenols (Sanderson, 1972). Among them TR is the most abundant compound with about 10-19% on a w/w basis, which is equivalent to approximately 30–60% of the solids in a black tea infusion. Kangra teas had the lowest theaflavins (TFs) and total colour (TC) and high caffeine, total soluble solids (TSS) and viscosity. Teas from Nilgiris, Cachar and Dooars had the highest TFs and TC. Assam teas had moderate TFs and TC high caffeine, moderate TSS and viscosities (Hazarika et al., 1983). Nilgiris and Annamalai teas had low caffeine, TSS and viscosities. Only Kangra teas had nonanal but no dihydroactinidiolide. Annamalai tea had the lowest n-hexanol and Nilgiri tea had the lowest geranyl acetate.

Table 3. Physico-chemical characteristics of black tea from different regions in India (Source: Borse et al., 2002; Bhuyan et al., 2009).

Region	Theaflavin (TF, %)	Thearubigin (TR, %)	Total colour (TC, %)	Brightness BR (%)	Total soluble solid (TSS, %)	Caffeine (CA, %)
Assam	0.27-0.45	14.6-8.57	3.94-2.30	2.52-8.53	0.6-0.8	2.84-3.92
Barak valley	0.67-1.30	7.81-15.30	3.48-6.57	12.40-27.46	35.61-42.12	2.65-3.64
Brahmaputra valley	0.97-2.20	10.56-18.35	4.66-7.92	16.06-26.36	37.44-46.34	2.57-3.92
Dooars region	0.89-1.43	10.58-16.13	3.82-6.41	13.11-23.22	36.14-44.05	2.92-4.64
Himachal Pradesh	0.14-0.18	13.5-9.48	1.56-1.78	5.23-7.41	1.0	3.72-3.69
Nilgiris	0.75-0.81	12.7-14.8	3.60-3.85	16.6-16.3	0.4	2.03-2.08

It is important to note that pesticide level in black tea in India is below MRL and heavy metal content is also below the permissible limit. Chemical characteristics responsible for the unique characteristic of different region also vary significantly. Table 3 present the level of some physical and chemical constituents in tea from different regions in India.

Strategies of Scientific Management practiced in India helps the practicing tea manager to access alternative technologies to cut costs, improve the product and raise profitability. Research development initiatives and out comes suggest strategies to reduce the cost in field and factory. Knowledge in tea chemistry is employed to define the tea quality and to improve it, increase price realization and enhance earnings by taking to value added products from tea. In order to produce quality black tea, efforts have been made to understand the chemistry of tea and tea processing by TRA.

Process requirements during manufacturing of tea have undergone a major shift over the years (Tamuly et al., 2005). This shift can be attributed to the fact that entire focus by eighties and nineties was to increase the production. In order to achieve that there was shift in the choice of planting materials, use of high fertilizer doses, closer spacing, cultural practices eg. prune/unprune and use of shade tree. These variations in cultural practices influence the chemical composition significantly. Studies of changes under different micro environments were not possible earlier due to lack of precise control of physical parameters. Recent studies on processing and quality of tea were carried in environmentally control manufacturing system and upscaling the same in the Model Tea Factory (MTF) at TRA.

5. Conclusion

There is no denial the fact that TRA is significantly engaged on modern research related to tea through out the NE India. However, black tea production continues to be a challenge for tea growers in India to retain the uniqueness. Therefore, it is paramount important to take special care so that it does not lose its focus 100 years of domain knowledge of tea at Tocklai, TRA would always remain the reference point for meeting the challenges of black tea production.

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