Impact of Science on the Economics of Tea Industry

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Chapter 43

ROLE OF NABARD TO PROMOTE TEA INDUSTRY

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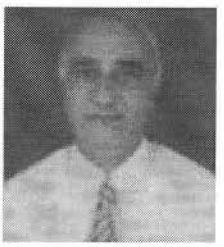

Prof. M.R. Sharma, presently working as Principal Technical Advisor in the rank of Executive Director in National Bank of Agriculture and Rural Development (NABARD). He had a brilliant academic career, was a merit scholarship holder during his studies, topped in M.Sc. and earned his Ph.D. degree in Horticulture. He served in several agricultural universities in various capacities, and became head Horticulture Dept in Gujarat Agricultural University before joining NABARD in 1982.
Dr. Sharma received many awards from Dept of Agriculture (Punjab & Haryana) and Agricultural Universities for his performance in the field of agriculture and rural development. He received Gold Medal during the National Science congress held at Allahabad for his contribution in the field of agriculture.

INTRODUCTION

India is the world's largest producer, consumer and exporter of tea, accounting for 30% of total production, 20% of world consumption and 18% of global exports. The total area under tea in the country is 434376 ha. The production in terms of made tea during 1997 was 811 mkg and is estimated to be 845 mkg during 1998. The predominant traditional tea growing states include Assam, West Bengal in northeast and east, and Tamilnadu and Kerala, in south. Tea is cultivated to a limited extent in Himachal Pradesh, Tripura, Uttar Pradesh, Sikkim and Karnataka. Apart from being a dependable foreign exchange earner, it provides gainful employment to a large number of people. It provides direct employment to more than a million workers belonging mainly from tribal and weaker sections of the society. About 50% of the labour force consists of women workers.

A major part of the country's tea production is from organised sector comprising of corporate holdings and proprietary gardens. The small tea gardens are mostly concentrated in Nilgiris district of Tamilnadu, Idukki district of Kerala and Kangra valley in Himachal Pradesh. Though small gardens account for 91% of the number of holdings, they account only for 9% of area and 7% of production under tea (Table 1).

Table 1. Size-wise percent distribution of gardens, area and production

Size group	No. of gardens	Area	Production
Less than 100 ha.	91.40	9.00	7.00
101 to 200 ha.	2.50	11.00	9.00
201 to 400 ha.	3.30	31.00	31.00
Above 400 ha.	2.80	49.00	53.00

The trends in production, consumption and export of tea during the past 6 years (as per ITA estimates) are indicated in Table 2.

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The views expressed in the paper are of the author's views and not of the organisation.

Table 2. Production, consumption and export of tea (mkg)

Year	Total production	Domestic consumption	Exports
1993	735.00	560.00	175.00
1994	731.00	580.00	151.00
1995	754.00	595.00	159.00
1996	780.00	625.00	155.00
1997	811.00	N.A.	N.A.
1998	845.00	640.00	205.00

The above information suggests that a major part of country's tea production (75-80%) is being retained for internal consumption. Though the per capita consumption of tea in the country is very low and stagnant at 630 gm, the growth rate in domestic demand has been 3-5% mainly on account of increasing population. It has been assessed that with the current trend in domestic demand and likely increase in per capita consumption (10 gm/annum), by 2005 AD, the total tea production in the country would just be sufficient to meet internal consumption and by 2015 AD, India may have to import tea to meet its domestic requirement a change in the status from largest exporter to net importing country. The imperative need for maintaining the exports and meeting the growing domestic demand calls for a quantum jump in the present levels of production. This could however, be achieved by adopting a long term strategy comprising area expansion in traditional and non-traditional areas and productivity improvement of existing tea gardens especially in traditional areas.

GLOBAL SCENARIO

If we see the global scenario in tea production, the cultivation of Tea is spread over all the continents except North America. The total area under tea is approximately 2.5 million ha, and the estimated production was 2667 mkg. The year wise production is given in Table 3.

Table 3. World tea production (mkg)

Year	Production	Year	Production
1973	1425	1994	2540
1983	2055	1995	2517
1991	2579	1996	2610
1992	2436	1997	2667
1993	2550	1998	2924 (tentative)

Source: Internet

The major tea producing countries are India, China, Sri Lanka, Kenya and Indonesia. The percentage share of these countries during 1984-94 is given in Table 4.

Table 4. Percentage share of world tea production

Country	1984	1994
India	29.2	29.7
China	18.9	23.5
Sri Lanka	9.5	9.7
Kenya	5.3	8.4
Indonesia	5.8	5.2
Total	68.7	76.5

It is evident from the above table that India could not register any increase in the percentage share of world production, while China has exhibited an increase of 4.6%. Like India, Sri Lanka had also shown very negligible increase in the percentage of world share. It might be due to the increase in the domestic consumption of tea.

India, China and Sri Lanka were known as traditional countries for growing of tea but during the recent past many other countries have also joined the race such as Kenya, Turkey and Malaysia. Due to the availability of fertile and virgin soil coupled with favourable agro-climatic condition, these countries had made a remarkable progress in increasing the tea production and productivity level.

The tea producing countries are making the gainful use of financial input in the field of tea production.

World Bank has played an important role in providing the credit input to increase the production and productivity level and also to bring the major change in tea processing.

The domestic demand of India has been increasing sharply. It is estimated that 1.3 mkg of tea is consumed everyday in India. From a retention level of 25% in 1947 for domestic consumption, the level has increased to 70% in 1990. The growth rate of production has not been able to keep pace with the internal demand. During the 10 years period 1977-79 to 1987-89, against the growth rate of internal demand of 4.53%, the rate of increase in production has been merely 2.85%. In absolute terms, against average internal demand of 14.4 mkg per annum, the production increase per annum has been 12.9 mkg, which eventually eroded exportable surplus gradually for domestic consumption.

There is no denial that export of tea brings valuable foreign exchange, which was to the tune of Rs.1028.70 crores during 1990. But it is necessary that domestic need be also met fully. The domestic demand, at the present growth rate of consumption, will be in the order of 750 mkg by the turn of the century. To maintain the level of export even at 25% of the production, i.e. at 250 mkg, there is a need to have a quantum jump in the level of production from 762 mkg (1995) to 1000 mkg in 2000 A.D.

The global supply and absorption of tea is given in Table 5. The domestic consumption vis-à-vis production growth rate since 1950 is also given below in Table 6. It has become very clear that we could not increase our export due to the increase in our domestic consumption.

Table 5. World supply and absorption of tea (mkg)

Year	Supply	Absorption	Surplus / Shortfall
1984	1469	1416	53
1985	1512	1456	56
1986	1491	1494	3
1987	1538	1496	42
1988	1644	1596	48
1989	1678	1631	47
1990	1756	1702	54
1991	1744	1687	57
1992	1641	1628	13
1993	1837	1753	84
1994	1747	1701	46

Source: ITC Annual Bulletin of Statistics 1995.

Table 6. Growth rate of domestic consumption and production

	Compound growth rate (%)	
Decade	Domestic consumption	Production
1950-60	6.73	2.19
1960-70	5.16	2.31
1970-80	5.12	2.98
1980-90	3.75	2.51
1960-90	4.62	2.58
1990-91	5.03	2.46

STRATEGIES TO ACHIEVE THE GOAL

To achieve the above level of production, the long term perspective plan of the industry will be to have both horizontal as well as vertical expansions resulting in increase in production and productivity. Consolidation of the existing plantations by taking up systematic replantation to the desired level of 2% and expansion plantation in the suitable available areas, and modernisation of age-old processing machinery are some of the strategies for future development.

As there is already tremendous pressure on land in the traditional areas, there is a need to exploit the potential of non-traditional area, which has been estimated by the National Committee on Long Term

Strategy and Plan for Tea at 20000 ha by the turn of the century. The perspective plan for 10 years' period, i.e. 1991-2000 A.D., submitted by Tea Board to the Ministry of Commerce, Government of India has also projected a target of 1000 mkg. An arduous task is ahead both for the industry and the institutions to mobilize resources and even for the Tea Board, which could get a budgetary support to achieve the target.

ROLE OF NABARD

National Bank is an apex institution for providing refinance assistance to eligible banks for their lending under agriculture, allied activities including Agro-processing and Non-farm Sector. In accordance with national priorities, objectives and strategies, National Bank has been extending refinance facilities to the financing banks for meeting MT/LT credit requirements of tea planters for wide-ranging developmental activities including new plantation, replantation, rejuvenation, infilling, irrigation equipments, construction of labour quarters, processing machinery, etc. Refinance assistance is also provided for purchase of neglected estates.

Darjeeling Interest Subsidy Scheme, which was introduced by the Government of India in 1983 to revamp the sick tea units/estates of Darjeeling Hill areas, has received special attention of the National Bank. Eight schemes were withdrawn by financing banks before/after sanction by National Bank. There are four on-going schemes at present having total refinance commitment of Rs.12.65 crores. As on 31.3.1991, against a phased commitment of Rs.9.96 crores, a sum of Rs.4.96 crores has been disbursed to various banks. National Bank has been supporting integrated schemes of plantation and machinery items without insisting on specific ratio between the investment of plantation and other items of development keeping in view the overall technical feasibility and financial viability of the schemes. Of late, National Bank has also decided to consider supporting exclusively purchase of tea machinery for expansion/modernization on the merit of each case. The above approach adopted by National Bank will go a long way in the modernization of the age-old tea factories of various tea estates, thereby improving the productivity, production and sales realisation. National Bank has sanctioned quite a good number of schemes in different states of the country.

INITIATIVES TAKEN BY NABARD TO PROMOTE TEA INDUSTRY IN THE COUNTRY

National Bank for Agriculture and Rural Development has been playing a very important role to promote the development of tea in the country by providing refinance assistance, organising seminar and workshops, preparing technical brochures and organising interface meetings in different parts of the country where the tea is being grown. At present, tea is being grown mainly in nine states such as Arunachal Pradesh, Assam, Tripura, West Bengal, Himachal Pradesh, Karnataka, Kerala, Orissa and Tamilnadu. In order to increase production and productivity level the main emphasis is given for supplying the quality planting material, replanting, new planting, gap filling, rejuvenation of the old orchards, modernising the processing factory and following the other scientific management system etc. The state wise refinance made in tea sector from 1992-93 to 1998-99 is given in Table 7.
(next page)

Table 7. State-wise refinance disbursement from 1992-93 to 1998-99 (Rs. in lakhs)

State	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99
ArunachalPradesh	38.59	30.14	45	75.08	130.53	64.82	99.97
Assam	743.1	1,136.36	743.96	1,626.49	1,090.71	388.23	54.23
Tripura	33.13	77.65	19.79	26.76	24.24	5.15	0
West Bengal	483.66	531.08	490.17	311.88	150.09	138.69	14.61
Himachal Pradesh	—	35.11	3.84	—	1.42	0.24	0
Karnataka	37.71	30.17	21.54	5.23	20.3	0.84	0
Kerala	151.19	110.29	134.49	129.43	104.64	126.72	94.51
Orissa	31.08	36.29	—	57.78	—	—	—
Tamil Nadu	215.28	284.64	772.53	41.22	91.14	107.73	86.91
Total	1,733.74	2,271.73	2,231.32	2,273.87	1,613.07	832.42	350.23

THRUST AREAS

Following thrust areas are viewed by National Bank for Agriculture and Rural Development (NABARD) to increase the production and productivity level of tea in the country.

- Introduction of high yielding and quality planting materials to be made available to the tea growers.
- To rejuvenate the old orchards by adopting physical, chemical and biological interventions.
- Increasing the new area under tea plantation in the states where potential exists, specially in non-traditional area of Arunachal Pradesh, Mizoram, Nagaland and some parts of Himachal Pradesh.
- Modernising the existing processing machineries, which are outdated, in order to ensure the manufacturing of quality tea. It has been proposed to give top priority to modernising processing machinery of tea.
- Gap filling in the estates to bring the optimum plant population. It will help to increase the yield.
- Drainage can play a very important role in order to improve the production level of the tea. It has been observed that in some states the productivity level is declining due to the poor drainage system. Good drainage can ensure the increase in production and productivity level.
- Arrangement for providing shading by planting suitable shading plants in the estates.
- During the drought period the photosynthetic activities of the plants are badly affected. Keeping in view the production and enhancing the photosynthetic activities of the tea, the sprinkler irrigation should be made available to the tea estates.
- It has been observed that most of the tea gardens are very old and the productivity level has decreased drastically. There is need to uproot old bushes and replace them with new bushes which are having potential to reproduce good yield. The replanting process should be done in phased manner.
- In order to encourage the small tea growers the emphasis should be given to make a buy-back arrangement of the green leaves from the small growers with the bought-leaf factories.
- Establishment of the Tea Technology Park in the major tea growing areas should be considered so that the technology developed may be transferred to the beneficiaries for their benefits.
- Strengthening the backward and forward linkages in tea development.
- Making the timely credit facilities available to the farmers.
- Giving the top priority for R&D fund, which should be utilised to solve the need based

problems of the Industry.

- At present we are having a 21-22% recovery percentage from green leaf made tea. There is a good scope for genetical manipulation to increase the percentage from 21 to 25% so that green leaf to made tea ratio may be improved.
- There is a need to have a re-look on the cost of production of tea to make it beneficial enterprise.
- Development of the specific logo should be developed to market the tea in domestic as well as in foreign market.

The steps to increase tea production and area wise production are given in Annexures - I & II respectively.

DEVELOPMENT NEEDS AND NABARD ASSISTANCE

The refinance assistance is available from NABARD for the following activities:

1. New Planting (Extension) and Replanting: This may include jungle clearance, land development, foot-paths, roads, drainage, irrigation facilities and maintenance expenses till economic bearing.
2. Rejuvenation act in filling and interplanting: This may include cost of systematic pruning, intensive cultivation with higher fertilizer application, improved drainage, etc.
3. The integrated project of Tea Plantation Development covering the following:
   a. New planting or replanting or rejuvenation
   b. Extension of tea processing factory and purchase of additional processing machinery.
   c. Construction of labours' / supervisors' quarters.
   d. Construction of estate roads and fencing.
   e. Purchase of farm machinery like tractors and purchase of trailers, jeeps, trucks etc.

GOVERNMENTAL ROLE

The Tea Board of India has already taken a series of important steps, which are definitely aimed at helping the tea industry. Even then, in order to help the Indian tea industry in the present crisis, the State and the Central Governments may like to consider the following:

1. To provide Interest Subsidy on bank loan for uprooting and replanting old uneconomic tea bushes;
2. To share the financial burden of labour welfare measures such as free ration, housing, schooling, medical facilities, etc. Appropriate subsidies may be provided for such purposes.
3. Central Government may impose effective measures to control dumping of imported inferior quality tea for export purpose.
4. To provide support price for small tea plantation sector. Mechanism to assess the price of green leaf linking with the price realised in auction may be formulated to ensure quality plucking at small plantation sector.
5. To go for aggressive generic promotion to capture the markets, both rural and urban, national and international.
6. To initiate actions for regularisation of the section of tea plantation, both small and big, to facilitate them to avail benefits from the Tea Board and banks.

FUTURE STRATEGY FOR DEVELOPMENT

Government should spell out a long-term policy for the industry taking into consideration the following aspects:

1. Priority should be given on exports basically to earn foreign exchange.
2. The production should be increased to such a level that in addition to our export requirements, it will be able to meet the domestic requirements also so that its sale is not to be regulated by the government.
3. Aggressive marketing strategy has to be developed to promote tea within the country and

abroad. We must tap new markets. In this respect role played by Tea Board in promoting Darjeeling logo is highly commendable.

4. Develop alternative packaging, which should be cost effective without sacrificing the quality of packing and tea stores.
5. Large areas have been acquired as surplus from tea gardens. Areas adjoining to gardens may be reverted back to them for extension plantations.
6. Degraded forest areas near tea estates may be made available for tea cultivation as it gives fast round coverage, better employment, checks erosion and adds organic matter to the soil besides providing employment to weaker sections / tribals/women. A stipulation can be made that at least 20% of such area will be brought under social forestry and produce kept at the disposal of state government for meeting the social objectives of fuel supply.
7. There have been representations from the tea industry for amending the State Agriculture Income Tax Acts to bring their rates of tax on par with central rates. Similarly, there is clamour for sanction of rehabilitation allowance, excise relief etc., to the tea industry. In order to maintain the competitive edge of the tea industry, these proposals should be considered in depth.
8. The tea industry should plan investment in lean period by utilising the tea deposits with NABARD as margin money and tap institutional credit for meeting balance expenditure.
9. If R&D support is required for which funds are constraints, NABARD will be willing to consider the proposals on merit.
10. Replacement and updating of old tea machineries, better quality, saving in processing cost and more efficient production.
11. Advocating the concept of tea production organically.
12. Use of bio-pesticides and integrated insect-pest management.

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P.T.O.

ANNEXURE - I

STEPS TO INCREASE TEA PRODUCTION

Increase in productivity	Area Expansion	Improvement in Processing Facilities	Improvement in infrastructure facilities
Irrigation	Extending tea area in the existing gardens, which are in the periphery etc.	Modernisation of existing tea machinery in tea factories to increase efficiency	Development clonal nurseries for supply of high yielding clones.
Drainage	Extending the area in approved non-traditional areas	Full capacity utilisation of tea factories, if necessary by encouraging small tea growers	Improving availability of power, fuel, transport, communication, etc. in the tea growing areas to help increase production / productivity and minimise wastage
Shade	Improving area under Small Tea Growing	Establishment of "Bought Leaf Factories" in the potential areas for small tea growing	
Rejuvenation	Encouraging Small Tea Growers around existing tea plantations for full capacity utilisation of tea factories		
Infilling			
Interplanting			
Replanting			
Planting with high yielding clones of tea			

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ANNEXURE - II

TEA - AREA WISE PRODUCTION IN INDIA - 1998

AREA	PRODUCTION (IN TONNES)
Assam Valley	406,447
Cachar	56,336
Darjeeling	10,730
Terai	31,606
Dooars	153,368
Tripura	6,642
Tamil Nadu	125,086
Karnataka	5,671
Kerala	70,618
Others	3,901
TOTAL	**870,405**

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Chapter 44

TEA RHIZOSPHERE: MICROBIAL DIVERSITY, CHARACTERISTIC FEATURES AND COMMENTS ON MICROBIAL COMMUNICATION IN THE RHIZOSPHERE

Anita Pandey* and Lok Man S. Palni**

Dr. Anita Pandey obtained her Ph.D.in Microbiology from Indian Agricultural Research Institute, New Delhi. She worked as 'Scientist Fellow' in the Division of Biotechnology at Institute of Himalayan Bioresource Technology, Palampur, for two years. Since 1992, she is working as Scientist in the Division of Environmental Physiology and Biotechnology at GB Pant Institute of Himalayan Environment & Development, Almora. She is engaged in research on microbial diversity in the soils of the Indian Himalayan region, characterization of microbes with special reference to phosphate solubilisation, nitrogen fixation, biocontrol, development of microbial inoculants for cold regions, biological hardening of tissue culture raised plants, and extremophiles.She has received the ICFRE cash award (1996-97; team member) for research related to Taxus baccata.
She is recipient of National Young Bioscientist award for the year 2003, conferred by Department of Biotechnology, Government of India. . The award was given in the area of microbial diversity on National Science Day.

SUMMARY

Based on over a decade's research carried out on tea rhizosphere of young to established (4 to 123 years old) tea bushes of chinery as well as assamica types, growing in well maintained and abandoned gardens and in locations representing monsoonal, subtropical to temperate areas of the Indian Himalayan region, several characteristic features have been identified. Occurrence of a negative rhizosphere effect exerted by the established tea bushes, in contrast to the normal stimulatory effect exhibited also by the young tea bushes, is the first and foremost feature associated with tea plants. Preponderance of large populations of antagonists, consisting of species of Bacillus, Streptomyces, Trichoderma and Penicillum, and lowering of the soil pH are other important characteristics associated with the tea rhizosphere. Based on both petri dish assays as well as bioassays, a few promising bacterial strains have been selected as potential inoculants for field applications in the tea gardens. This presentation deals with the characteristic features as well as microbial diversity associated with the tea rhizosphere, with comments on potential applications in the tea industry. Also included is a brief commentary on microbial communication in the rhizosphere which may have implications in the selection and / or designing of bioinoculants.

The findings have been discussed under four broad sections: (a) the rhizosphere effect exerted by tea bushes, (b) microbial diversity associated with the tea rhizosphere, (c) potential applications - based on the possibility of isolation, screening and use of microbial inoculants for improving productivity and overall growth of tea, and (d) the microbial communication in the rhizosphere. The research findings emanated from the work conducted on tea soils collected across various Himalayan locations, namely, (a) Banuri Tea Experimental Garden, Palampur, Himachal Pradesh, (b) Mansambal Tea Estate, Palampur, H.P., (c) Temi Tea Estate, Temi, Sikkim, (d) Singell Tea Estate, Kurseong, West Bengal, (e) Pant Tea Estate, Bhowali, Uttaranchal, and (f) Kausani Tea Plantations, Kausani, Uttaranchal.

Keywords: India; tea; rhizosphere; rhizosphere effect; microbial diversity, microbial communication.

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RHIZOSPHERE EFFECT EXERTED BY TEA BUSHES

The rhizosphere effect exerted by tea bushes has been estimated on the basis of the populations of three main groups of microorganisms, namely bacteria, actinomycetes, and fungi in the soil samples collected from various locations. The rhizosphere : soil (R:S) ratios can be worked out by dividing the counts of microbial populations in the rhizosphere by their counterpart populations in the corresponding non-rhizosphere soil. The important findings that emerged from these experiments can be summarized as follows: (a) the rhizosphere of established tea bushes suppressed the microbial populations giving values of R:S ratios consistently below one, clearly indicating an overall "negative rhizosphere effect" contrary to the normal stimulatory effect exerted by the roots of other plants, including the young tea bushes, on soil microorganisms, (b) while bacteria appeared to be the most suppressed group in the established rhizosphere of tea, actinomycetes and fungal populations got suppressed to a lesser extent, (c) the negative rhizosphere effect seemed to be more pronounced in *assamica* type in comparison to the *chinery* type, and (4) the negative rhizosphere effect looked somewhat more pronounced in case of well maintained tea gardens vis-a-vis abandoned garden sites (Pandey and Palni, 1996, 2002-03).

The environment surrounding the root system of plants is termed as the "rhizosphere". It has a major effect on the health and productivity of crops. It is, however, a complex system wherein a series of interactions take place under the influence of either biotic or abiotic factors or both. Microbes constitute a major component of the rhizosphere; the composition differs greatly from that of the surrounding soil. Hiltner (1904) was first to use the term "rhizosphere" to describe the zone of intense microbial activity around roots. The overall positive influence of plant roots on "soil microorganisms" came to be known as the "rhizosphere effect" and the R:S (rhizosphere : soil) ratio is an index of the overall influence of plant roots on soil microorganisms (Katznelson, 1946). The term "negative rhizosphere effect", indicative of suppressed microbial populations around the roots of established tea bushes, has been used for the first time to describe such observations made. This has been foremost characteristic feature of the rhizosphere of established tea bushes (Pandey and Palni, 1996).

One of the important likely factors contributing towards the development of a negative rhizosphere effect could be the secretion of exudates containing antimicrobial substances, by the roots of older tea bushes, to which bacteria appear to be the most susceptible group. A marked reduction (up to 53%) in the colony forming units was observed when bacterial cultures isolated from the soil samples collected from the tea rhizosphere soil were plated on tryptone yeast extract agar supplemented with the rhizosphere soil extract of established tea bushes. This indicated the presence of antimicrobial metabolites in the water extract of rhizosphere soil, originating from the root exudates of tea. The lowering of pH in the rhizosphere soil with concomitant increase in the age of tea bushes, also coinciding with the suppression of rhizospheric microbial populations, may be another factor contributing towards the development of a negative rhizosphere effect (Pandey and Palni, 1996, 1999, 2002-03; Pandey et al., 2001).

MICROBIAL DIVERSITY ASSOCIATED WITH TEA RHIZOSPHERE

The microbial diversity present around the established rhizosphere of tea bushes may result from the interactive influence of many factors, viz, long lived nature of tea bushes, the negative rhizosphere effect, specific climatic conditions, presence of antimicrobial factors in the exudates of tea roots, lowering of soil pH, and the cultural practices associated with tea plantations, etc., (Pandey and Palni, 2002-03). A culture collection consisting of more than 300 microbial isolates, all originating from the tea rhizosphere has been developed. The isolates have been subjected to

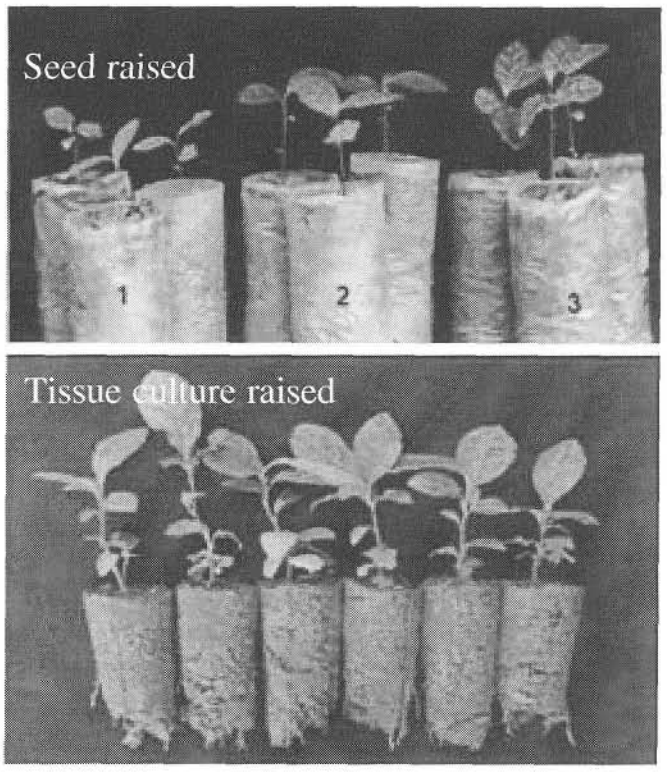
cultural, morphological, biochemical and physiological characterization. Results from these experiments clearly indicated the dominance of *Bacillus* species amongst the bacterial isolates of the established tea rhizosphere. While *B. subtilis* and *B. mycoides* appeared to be the most dominant forms, *B. licheniformis, B. cereus* and *B. megaterium* were other important species (Pandey and Palni, 1997, 1999, 2002-03). This would seem to be related to the endospore forming ability of the genus *Bacillus* and survival under adverse conditions, including low temperature (Sneath, 1984; Slepeckey and Hemphill, 1992). *Pseudomonas corrugata* is an isolate of the soil samples collected from young tea rhizosphere (Pandey and Palni, 2002-03). Species of *Penicillium* and *Trichoderma* dominated the rhizospheric fungal flora of established tea bushes. The dominant species of *Penicillium* and *Trichoderma*, isolated from different locations included *P. erythromellis, P. janthinellum, P. lanosum, P. raistrickii, T. konengii* and *T. pseudokonengii* (Pandey and Palni, 1999; Pandey et al., 2001). The populations of the two most dominant fungi, i.e., *Penicillium* and *Trichoderma* species appear to be inversely correlated with the populations of two most dominant bacteria, *Bacillus subtilis* and *B. mycoides* (Pandey et al., 2001). A large number of actinomycetes, forming brown to gray hard pustule like colonies that secrete brown to black diffusible pigment in the agar were also isolated from the soil (Pandey and Palni, 2002-03). Based on the colony morphology, microscopic observations and biochemical characteristics, these were grouped under the genus *Streptomyces* (Shirling and Gottlieb, 1966; Collins and Lyne, 1980).

The findings described thus far are reflective of the two major categories of biological interactions, (a) plant- microbe interactions, and (b) microbe-microbe interactions; both appeared to be antagonistic in nature. The roots of established tea bushes seemed to encourage greater colonization by antagonistic populations, showing strong antimicrobial activity (Pandey and Palni, 1997, 2002-03; Pandey et al., 1997). The microbial species in all the three groups (bacteria, actinomycetes and fungi) are known to produce strong antimicrobial metabolites, including antibiotics. The microbial activity in the established tea rhizosphere seems to be very intense; it presents an example of the occurrence of natural biocontrol system, offering opportunities for the isolation and selection of potential bioactive agents for subsequent field applications.

POTENTIAL APPLICATIONS

The potential applications of above findings are numerous. One possible use is as a bioinoculant in appropriate formulation for improving the early establishment and growth of seed raised, tissue culture raised and cutting raised tea plants (Fig.1).

Fig. 1. Seed-raised-tea A: control (1), inoculated with *B. subtilis* (2), and inoculated with *Pseudomonas corrugata* (3) seedlings. B: Tissue culture raised tea plants inoculated with *B. subtilis* at time of lab to land transfer. C: Cutting raised tea plants inoculated under net house prior to field transfer.



Based on a number of Petri dish assays and bioassays, two bacterial species (*Bacillus subtilis* and *Pseudomonas corrugata*) have been initially selected as promising inoculants. The selection criteria, among other things, included root colonization, growth promotion and disease controlling ability of selected microbes. Further characterization is also carried out in respect of antifungal and phosphate solubilizing activity and their ability to survive at low temperature (Pandey et al. 1997, 2002).

In case of seed raised plants of tea, cracked seeds are coated with the bacterial inoculant(s) in a charcoal based formulation. This resulted in improved growth of treated, i.e., inoculated plants in comparison to un-inoculated control plants (Pandey et al., 2000). The inoculations also proved useful in respect of tissue culture raised plants of tea; the plants were first transferred to autoclaved soil and then inoculated with a suitable liquid formulation of the bacterial species, during lab to land transfer. The bacterial inoculants became the primary colonizers and provided the first line of defense to tissue culture raised tea resulting in near 100% survival against 45-50% survival observed in control plants. The analyses of rhizo-plane and rhizosphere soil (of control and inoculated plants) indicated that the major cause of mortality during lab to land transfer of tissue cultured plants of tea was fungal attack, mainly by *Fusarium oxysporum* (Pandey et al., 2000, 2002). With a view of introducing the selected bioinoculant(s) in tea plantations, bacterial suspensions of selected strains have been inoculated in the rhizosphere region of young seedlings and cutting raised plants of tea under net house conditions. The introduced bacteria were found to successfully colonize the rhizosphere as well as stimulate the general micro flora. Root colonization efficiency of the bacterial inoculants, using antibiotic resistance markers has been worked out (data not presented). The plants were finally transferred to the field one year after the inoculation. These experiments have been conducted with a view of eventually introducing the selected bacterial inoculant(s) in the ongoing newer tea plantations, at various sites in Uttaranchal in collaboration with the Uttaranchal Tea Directorate. The inoculations are expected to provide protection against minor as well as major pathogens and support the tea bushes in terms of nutrition and subsequently cutting down on the use of chemical fertilizers. This is also important in terms of Uttaranchal having been launched as a largely green or organic state.

MICROBIAL COMMUNICATION IN THE RHIZOSPHERE

Bacterial species employ complex intercellular communication mechanisms which facilitate adaptation to changing environmental conditions. Microbial sensing and response mechanisms in the form of cell to cell communication *via* the use of small signaling molecules have recently been described by Whitehead et al. (2001). It is important to note that bacteria can behave not only as individual cells but, under certain conditions where their numbers reach a critical level, they can modify their behaviour to act as multicellular entities that live as consortia and exploit the elaborate system of intercellular communication generally termed as quorum sensing (QS), a term initially used by Fuqua et al. (1994). It relies on the production of low molecular weight signaling molecules (the autoinducers), the extracellular concentration of which is related to the population density of the producer organism. Broadly these signaling

molecules are of two main categories: (i) amino acids and short peptide pheromones commonly utilized by gram-positive bacteria, and (ii) fatty acid derivatives such as acyl homoserine lactones (AHLs), utilized by gram-negative bacteria. A recent review (Sharma et al., 2003) indicates that besides operation of QS in the rhizosphere, it is likely that some cross talk between bacterial forms also takes place. Plant growth promoting rhizobacteria, such as pseudomonads, bacilli, etc., can influence the operation of QS systems in plant pathogenic forms. At threshold cell-density level, bacteria produce substances which can inhibit the proliferation of pathogens. Further understanding of QS in the rhizosphere will facilitate sustained exploitation of bioinoculants in soil health, plant productivity, bioremediation in environmental applications, etc., that often determine the fate of a microorganism introduced in the natural ecosystem.

In the domain pertaining to molecular ecology of the rhizosphere ecosystem, it is interesting to note that the population structure of microbes present in the rhizosphere is often controlled by the products of certain target genes, which in turn are affected by cell-density-dependent signals. The operation of QS system in the rhizosphere appears to hold much promise in the control of diseases caused by zoosporic, e.g., damping-off of many seedlings. Further knowledge of QS in the rhizosphere would not only help in the delivery of appropriate and effective bioinoculants, but also in better understanding of cell-density-dependent control of *in situ* biological equilibrium, a feature of considerable relevance in minimizing competition with indigenous microorganisms for the limited resources available in this unique ecosystem. While there appears to be complete lack of information in respect of QS in the rhizosphere of tea plants, this brief review has been included to catalyze interest in the subject of those working on microbial diversity and dynamics in the tea rhizosphere.

ACKNOWLEDGEMENTS

The Department of Biotechnology and The Ministry of Environment and Forests, Govt. of India, New Delhi are thanked for financial support. Prof. N.K. Jain (Secretary – International Society of Tea Science) is thanked for giving the opportunity to share views on the microbiology of tea rhizosphere.

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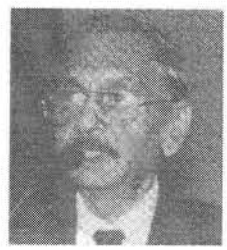
Chapter 45

CHA, CHAI, TEH, TEA AND THE PRODUCER

Mohijit Sen*



Mr. Mohijit Sen does not need much of introduction to people in Calcutta and in tea. He is now the Director of International Tea Research of Singapore. Till recently he was Advisor to the Tea Research Institute for Tea and Cinchona in Gambung, Indonesia. He continues to be consultant to several tea companies in Indonesia and Vietnam. He started his career with James Warren and Co. in 1956 moving to J. Thomas. He was the Founder Director of the Contemporary and Paramount Tea before moving to South East Asia. Most of all Mohijit is known for the SEN VAC Tea Processing Machine, which has been literally Mohijit's baby. He is the inventor of this machine, for which he has received the NRDC Republic Day Award, United Nations World Intellectual Property silver medal: and RW Bangur award from Bharat Chambers of Commerce for modernization of manufacturing technology

PRODUCTION

The last two years have been, perhaps in the last two decades, the most difficult years for tea growers the world over. Basically, production increases have overtaken the growth of consumption, leading to surpluses in the market and tea prices have gone into a whirlpool.

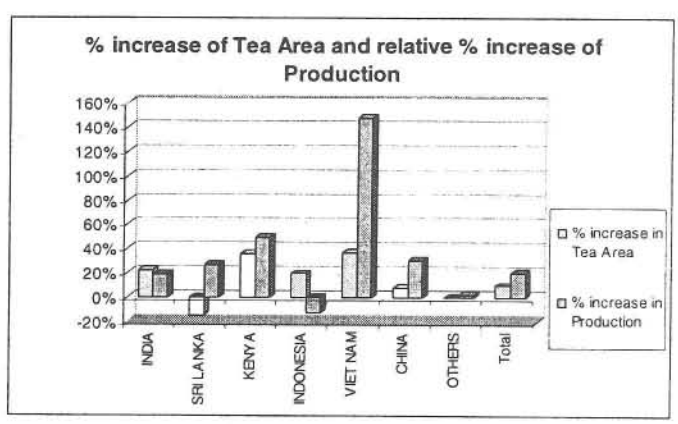
Since 2001, while the better teas were somehow absorbed, large stocks have been carried forward comprising mainly the poor quality teas and such teas, whether green or black, have been difficult of sale. It is reported that about 50% of Vietnam 2003 black tea crop, is lying unsold and they plan to close production in November this season.

Being an agricultural commodity, weather in growing areas has a great influence on the quantity of production, but there have been substantial increases in the area under tea cultivation too. There is a belief amongst many international buyers and producers that the current over-supply is a passing phenomenon due to good growing weather. A look at the J. Thomas Annual Statistics book, and the ITC statistics, shows the following:

Tea Area (ha)

Country	1990	2001	Growth	Increase %
INDIA	416,269	510,492	94,223	22.6%
SRI LANKA	221,758	188,971	- 32,787	-14.8%
KENYA	97,020	131,581	34,561	35.6%
INDONESIA	134,934	160,991	26,057	19.3%
VIET NAM	59,900	82,000	22,100	36.9%
CHINA	1,061,864	1,140,700	78,836	7.4%
OTHERS	405,968	405,003	- 965	-0.2%
Total	2,397,713	2,619,738	222,025	9.3%

The total increase of 222,000 ha is like having another major producing country being added to the map. This appears to be the basic cause for the oversupply.



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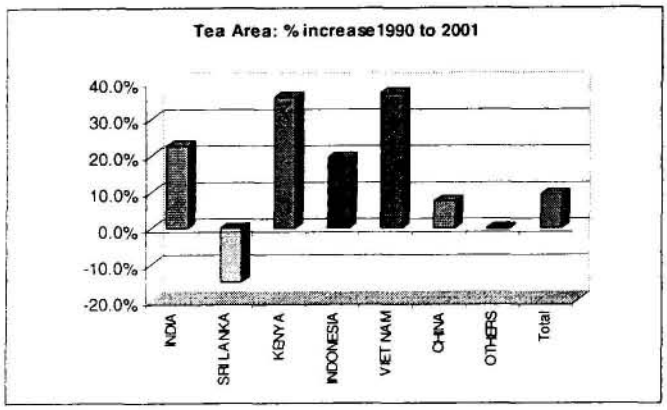
Relative increase of Production has been as follows:

World Production (Tonnes)

	1990	2001	Growth	% increase
INDIA	720,338	853,710	133,372	18.5%
SRI LANKA	233,165	295,093	61,928	26.6%
KENYA	197,008	294,631	97,623	49.6%
INDONESIA	145,159	127,190	- 17,969	-12.4%
VIET NAM	32,200	80,000	47,800	148.4%
CHINA	540,100	701,699	161,599	29.9%
OTHERS	654,225	669,103	14,878	2.3%
Total	2,522,195	3,021,426	499,231	19.8%



NOTE: With regard to the figures related to Indonesia, The Production figures relate to the State owned Companies only. Privately owned Companies and green tea factories would account for another 30-35%, thus the actual production is about 40,000 tonnes higher, which should be added to the world production.

The growth has been 20%, or average 2% increase per year, and the average yield of the new areas added has been 2,249 kg/ha. In terms of quantity increase of black tea, India has been the leader, followed by Kenya. These two Countries alone, have added 230 mkg to the tea kitty. Clearly science has been helping the tea planter to reach new levels of productivity — it is another matter that this additional quantity now cannot be absorbed; ITC estimates the 2001-2002 growth of consumption at only 0.02%.

Historically, it is known that whenever production increases suddenly, whether due to good growing weather or increase of area, without relative increase in manufacturing facilities, it results in an increase in the quantity of Poor Quality Teas produced during the year. The quality fluctuations of tea in Kenya and Indonesia are a clear example of this phenomenon. During the lean season the quality is good; but as the "rush leaf" comes in, quality drops sharply, and by end of the rush there is a huge accumulation of sub-standard teas, which takes months to get rid of. This is purely due to lack of adequate manufacturing capacity.

In this context, it should be noted also that a majority of the new entrants, be it bought-leaf factories in India, Kenya, or new countries like Vietnam, has come into the production scene at the "lowest cost level", with minimum investment on modern machinery and without adequate market research on type and quality requirements. *They have just joined the herd, so to say.*

In Kenya, KTDA factories, which handle bought leaf from small growers, generally receive an excellent quality of green leaf. But with a 50% increase of crop and only fractional increase in manufacturing capacity, they just cannot cope when the rush comes in and the quality fluctuation is becoming larger every year.

In Vietnam the same techniques, which have come down as family tradition through generations for making green tea, have been adopted, to include oxidisation to make black tea. Result is a tea that is neither green nor black orthodox, but a mixture of the two. Capacity enhancement, where this has taken place, has been made largely with green tea machinery from China, which is not suitable for black tea manufacture.

In northeast India, small growers and bought leaf factories have mushroomed in the last 10 years. By and large the quality of raw material they receive, though clonal, is very poor and so is the quality of the finished product (there are exceptions of course). Most factories have been built with second-hand or old machinery, with the object of churning out black CTC teas to join the herd at the domestic markets.

The same herd cannot keep growing without causing over-population, and over-population will eventually lead to some starvation deaths.

New entrants must find new pastures, or devise them perhaps by value addition. They have to make the "quality" that is required, whether in the domestic or export markets.

QUALITY

When we talk of quality, what this really means. The dictionary describes the word quality as "attribute, degree of excellence, rank, characteristic". As may be noted, these are all relative terms; this also means:

1. The meaning of quality is not static. It changes with time and events.
2. The perception of quality is different in different regions, or with different people.

Tea is the most diverse of plantation crops. The same raw material, using different manufacturing methods, makes:

1. Green tea varieties: Sen-Cha, Ten-Cha, Gyokuru, Matsu-Cha (Ceremony tea), Kamairi Cha
2. Semi-fermented varieties: Oolong, Pouchong, White Tea
3. Black tea varieties: Lapsang Souchong, Keemun, Orthodox, CTC,

All of the above are split into various grades and some are flavoured with flowers; thus the variety available to the consumer is huge. Each different method of manufacture has been scientifically documented and shown to have different chemical profiles. In addition it is also documented that the different methods of manufacture further differ in their chemical profile and consumer preference, according to region of growth and "jat" of leaf. Therefore, some regions are more suited for one type of manufacture than others; in China different districts follow different methods to benefit from the natural advantages. These regions have "brand names" of their own, like our Darjeeling.

The variety in tea is vast, and each of these has its own meaning of quality. There is no best tea in the world. The perception of quality differs from country to country, regions within the same country, age or generation, trends and fashion.

The only comparison to this diversity is perhaps in the world of music. What is "top quality Pop" to my son, is a lot of noise to my ears. To me there's nothing like the oldies. In Punjab, it is Bhangra, though this may now change.

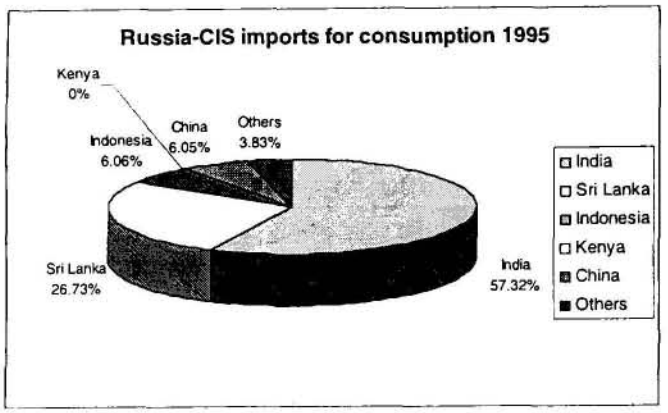
Russian youngsters have turned from the traditional classical, to Jazz and Pop, like ducks to water. Moscow is now full of discos and MacDonald's.

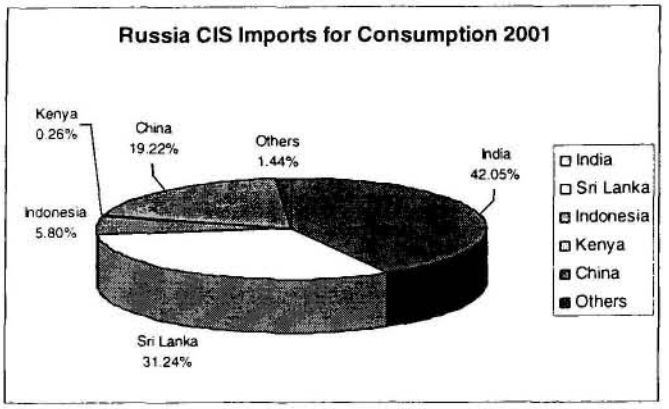
What this demonstrates is that the perception of quality is not static. It changes with time, events and trends, more so now than ever before because the world is becoming smaller. There is globalisation of markets. The new generation, thanks to the computer, is now better informed than ever before and is very clear about what it wants.

In the change of perception of quality of tea, Russia is the first big example that comes to mind. The following is the Russian import scenario:

Imports for Consumpton by Russia and CIS

	1995	2001
India	81,467	82,210
Sri Lanka	37,987	61,070
Indonesia	8,617	11,341
Kenya	0	502
China	8,602	37,576
Others	5,448	2,813
Total	144,116	197,513





The change in the pattern of imports is quite marked. Though authentic figures are available till 2001, it is known that Russia has further increased its imports from Sri Lanka, Indonesia and Kenya during 2002 and 2003.

Is this change in the import pattern due to financial considerations only? No, compared to the Soviet days when there was a government to government barter and the consumer had little say, today they have a choice.

Generally, in regions where tea is taken with milk, the consumer prefers the coloury CTCs; but where it is taken straight, the sweeter, lighter, brighter orthodox is preferred. These do not "cream down" and are visually more attractive. Further with globalisation, other factors also come into play. First is cost, or value-for-money to the consumer (cuppage), and more important the convenience.

Western Russia and CIS are turning to tea-bags in a big way. Sri Lanka and Indonesia, both major orthodox producers, make very little whole leaf or large brokens. Their orthodox is largely roll-rotorvane-rotorvane, making a large percentage of Fannings and small Brokens without losing the orthodox character. These have higher "cuppage" and are fast liquoring, ideally suited for tea-bags. The Russian purchases from these countries are mainly BOP, BOPF and PF grades, which are suitable for small packets and tea-bags. The fact that Russia is buying light- bright Kenyan CTCs also is a sign of change.

In this context, it is should be mentioned that export of tea-bags from India to Russia has doubled in the last 4 years; it was 617 tonnes in 1998 and 1,359 tonnes in 2001.

Similar changes have occurred in other countries also. Another major change in the perception of quality is the pesticide residue. Many countries now demand a certificate that the tea they buy conforms to the EU limits before they import.

Convenience tea — be it tea bags, rounds, or ready-to-drinks, vending machine tea — are the growing markets today. The new generation is impatient and this market will continue to grow, particularly with globalisation and economic growth in the developing nations. The spread of fast-food culture is evident everywhere.

Hence, the definition of quality is shifting towards smaller grades, which produces bright and visually attractive liquors that brew quickly. It is a pity though that a lot of this "convenience Tea" is made from fibre and low quality tea.

It is not that the demand for traditional varieties and speciality teas is going to disappear, it will remain, but its share in the basket is changing and the producing nations will have to adjust to these changes. Perhaps the time has come when

adjustments to the manufacturing methods and machinery has become necessary.

NEED OF THE HOUR

So, having looked into the recent production and quality scenario, what are the options available to the producer in this depression?

1. First, I would say the non-quality should be removed from the market. By non-quality I mean what is not tea — green, black or any other, should NOT be sold as tea. Stalk or fibre is wood and cellulose and not tea, though an unavoidable by-product. There should be a worldwide ban on sale and, particularly export, of tea containing beyond a certain specified limits of crude fibre, ash and other undesirable constituents. Such a specification already exists for black tea, as ISO 3720 (third edition 1986-09-01) and its annex, ISO 6079, which limits of pesticide residues, as formulated by the WHO. Importing countries also, should not allow import of teas not conforming to ISO 3720.

   ISO 3720 also clearly excludes herbal preparations from being called tea. This will, therefore, also remove "herbal eas" from the supermarket tea shelves.

   This proposal was made at the Meeting of the Inter-governmental Group on Tea of the FAO at Rome in May 1989, but some countries were unwilling to accept it. India follows the ISO 3720 specifications and the Indian Prevention of Food Adulteration Act, which conforms to ISO 3720, under which selling of sub-standard tea for human consumption is a criminal offence, covers the tea. Any other producing country has not done this.

   It is ironical, that while most producing countries are not following ISO 3720, they are following much stricter norms dictated by EU and the USA than the Annex ISO 6079, on pesticide residue.

   According to the UCTAD study of 1988, if ISO 3720 is implemented, it will remove between 10 and 15% of sub-standard teas from the market, which is sold to mainly to RTD and some tea bag makers. This will undoubtedly improve prices and bring stability to the tea market. Also, I would like to add that similar standards should be formulated for green tea and instant tea.

   This matter, I feel, should be taken up with urgency as it involves survival of many tea estates and livelihood of several hundred thousand workers. It is ironical that bio and rights conscious western countries are demanding that tea factories are ISO 9000 series certified; plus some countries a new certification that ensures minimum living and working condition of workers, before they buy tea from any factory when its very survival is threatened by an oversupply of stalk and fibre.

2. It is likely that ISO 9000 series certification will become compulsory for exports to EU from 2005, and I would like to suggest that adherence to ISO 3720 is made compulsory to the ISO 9000 series certification. This will be an additional persuasion to countries objecting to ISO 3720. In addition I would also suggest that importers insist on ISO 3720/9000 series certification from producer exporters and, if the teas are imported as blended or packaged tea, from the blender/packer or merchant exporter that the teas used are so certified.

3. Next would be to put a brake on uncontrolled growth on types of tea with which the market is already saturated. This would naturally have to be done by each country separately. In India nobody predicted or expected the sudden

growth that has come from small holders and bought leaf Factories in the northeast.

Prior licensing of bought leaf factories should, I feel, become statutory. This is not so at present. Before granting the licence to set up a factory, the Tea Board should see to the type of tea to be made by the factory. For example, the following types of manufacture may be readily allowed:

4. **Any Factory Making Value Added Tea**
Darjeeling: High elevation flavoury teas
Dooars, Terai and Lower Assam: Sri Lanka mid-elevation or Indonesian type roll-rotorvane orthodox for export. Russia and tea bag makers prefer this type now a days. Dooars can easily make this type of tea and its liquors would be better than the others as the quality of leaf in Dooars is better than Indonesia or Sri Lanka. This type does not have a high quality leaf and there is no stalk problem; cost is same, or a little lower, than making CTC.

Upper Assam: Traditional orthodox and tippy teas
Central Assam: CTC
Cachar: Sri Lanka "low-grown" type orthodox.
South India: Indonesia/Sri Lanka type orthodox, but with not more than 20% Dusts.

4. Next requirement would be to create new "pastures" or markets. In India, the ready-to-drink field is wide open. I had the good fortune to witness the growth of Sosro in Indonesia during the last five years. Sosro introduced the "Tehbotol" in 1998, and today the Tehbotol is perhaps as popular as water. Price of a small bottle of mineral water is Rupiah 800, Tehbotol 1200 and Coke 2400. A majority of the population, when having a meal whether in a roadside dhaba (Warung) or restaurant, order Tehbotol with their meal. It gives them assurance that, since it is tea, the water has been boiled.

5. Then there are new tea drinks all over southeast Asia; "Bubble Tea" is very popular with the young generation, then "Fruit-tea" that the children love. Unfortunately most of these are now being manufactured from tea waste brews instead of ISO 3720 certified teas. Joint ventures in these fields, using ISO certified Teas should be encouraged.

6. If the tea-bag can be made cheaper, it has huge potential in India as the "convenience factor" increases. The filter paper comprises 50% of the cost, which is now imported from the west. Research in this field is required.

7. Vacuum packing of bulk or retail packs, including tea bags, would be cheaper than traditional packing. With vacuum packing of high value bulk teas, a future's market could become possible due to it longer shelf life.

8. In India, children are still discouraged from drinking tea due to grandmother's perception of it being habit forming. It is now proven as a health drink, children should be encouraged.

The tea industry must become more dynamic.

Chapter 46

ISSUES AND STRATEGIES

T. C. Chaudhuri*

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It is important to bring to the notice of all concerned in the tea industry, following certain issues related to quality aspects of tea and for drawing up future strategies.

STIMULANT FOOD

Tea is a stimulant food and it is categorized under 'stimulant food items' (FAD 6) by the Bureau of Indian Standard (BIS) for fixation of minimum quality parameters and their limits. The parameters included in the BIS standard for tea are: water extract value, alkalinity values of different status, water-soluble ash, and crude fiber. The specifications for tea are documented in the BIS standard IS 3633: 2003 – Tea. The methodologies for estimation of various parameters are also given in detail in different Indian Standards (IS). The green tea and instant tea specifications have also been covered in the IS specifications in details (IS 15342: 2003 – instant tea in solid form – specification, IS 15344: 2003 – green tea – specification).

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The quality parameters fixed by BIS have also been adopted by the PFA as 'Safety' under the Prevention of Food Adulteration Act 1954, and Rules 1955. The PFA standard is mandatory; failing to comply with it will be dealt under Food Safety Laws. It is essential that samples of teas be randomly checked for such stipulations.

PESTICIDE RESIDUE

The pesticide residue limits have also been covered in the revised standard of BIS for tea published in 2003. The number of pesticides in the standard is likely to increase in the future from present three for which MRLs have been fixed. Similar standards have also been adopted by the PFA, and MRLs for five other chemicals have been fixed for tea. Different individual countries, like EU, US, Russia and Japan, fix the international regulations for MRL. The requirements under different standards might vary, but for effecting export to any particular country, the specifications of that country needs to be conformed.

Although there is an attempt for harmonization of standards under WTO/CODEX, it may take time to harmonize the limits. India has also started

generating data on MRL and submitting the same to the CODEX. However, produce of India needs to be covered under IS standard for the larger interest of the Indian consumers of tea.

ALLIED REGULATORY ISSUES

It is essential to have information about various regulatory items prevailing in different tea importing countries. The specifications on phytosanitory aspects like packagings are becoming stricter by the day in the tea importing countries. Accordingly certificate on quarantine aspects like pest infestation in the packaging material is a prerequisite. Furthermore, the packaging substances of tea are changing after the introduction of different polythene based and jute materials. The use of such substances in tea is important and as such migrations of packaging substances have been specified under EU regulations.

The newly introduced requirement like 'non genetic manipulation' certificate is demanded under WTO Rules, although no teas are produced so far from the genetically manipulated material. A few countries have also fixed stipulations on the presence of 'radio isotopes' in tea. Finally, it may be said that additional requirements will be increasing in future.

REGISTRATION OF CHEMICAL COMPOUNDS

It is mandatory that chemical compounds used in tea against pests, diseases and weeds are registered by the Central Insecticide Board (CIB), and simultaneously by the Registration Committee of the Ministry of Agriculture to obtain label declaration. It is often noticed that non-registered chemicals are applied to control pests, diseases and weeds. Since this is a serious issue, all concerned must take note of the issues and follow the guidelines to get all the compounds registered, if they are to be recommended for use in tea pests and diseases.

TEA AS FOODSTUFF

It is now asked after the recent judgment of the Honb'le Supreme Court, whether tea can be covered within the definition of foodstuff. It may be replied that tea is a stimulant food item under Indian Food Standard. The chemical characteristics of tea are supportive of tea as a stimulant beverage. The high content of polyphenols and the presence of caffeine in tea undergo chemical reactions within the body once tea is taken in, and then chemically stimulate the body physiology into activation to do more work.

In tea (solid) various chemical constituents are as follows: protein 10-15%, fibers 15-26%, polyphenols in fresh leaf 20-30% (but in black tea, it is oxidized up to 85-90% of the total 20-30%) and caffeine 95% of total 2-5 % in green leaf. Similarly, carotenes 95% of total 1.5-2.0 %, lipids 90 -100 % of 2-8%, amino acids 90-95% of 3-5%, carbohydrates 90-100% of 6-8% in green leaf and minerals 3-5% (after Ramaswamy, 1991).

Fractions of polyphenols, as per available scientific reports, do help in health benefit aspects of human body like prevention of diseases. Minute quantities of minerals, carotenes, amino acids and carbohydrates, besides proteins, help in improving body functions. Total of all these contents cause health benefit components which account for about 20%, cannot be ignored when compared with other food items.

It may be difficult to claim that these chemicals significantly play a role in growth, repair or maintenance of body like other food items. Certainly minimum contributions are there. But due to the presence of caffeine, tea is a stimulant item of food, which is also essential for the body to a limited extent.

Some issues connected to tea quality and requirements have been discussed. For smooth trading of tea, cooperation from the tea producers is essential so that the produce conforms to the specifications laid down in domestic as well as importing countries. These are also required to safe guard the health of the consumers of tea and for promoting tea as health drink.