REPORT ON SURVEYS ON COFFEE HOLDINGS AND COFFEE MARKET CHAIN IN INDIA IN RELATION TO MOULD CONTAMINATION IN COFFEE

Submitted by

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Submitted to

COFFEE BOARD OF INDIA, BANGALORE

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FOOD & AGRICULTURAL ORGANIZATION OF UNITED NATIONS, ROME

JUNE 2005

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Introduction

In India coffee is an important plantation crop, which is mainly cultivated in the southern states of Karnataka (57%), Kerala (24%) and Tamil Nadu (9%) and to a lesser extent, in non-traditional areas like Andhra Pradesh, Orissa and North Eastern States (10%). The major coffee growing areas are the districts of Chickmagalur, Coorg and Hassan in Karnataka, Wynad, Idukki and Nelliampathys in Kerala and Pulneys, Shevroys, Anamalai's and Nilgiris in Tamil Nadu.

India cultivates both the commercially important species of coffee, viz., arabica and robusta varieties of coffee in an area of 3,55,102 ha in 2003-04, producing nearly 2,75,225 MT of coffee per annum. There are approximately 1,78,308 coffee holdings of which, nearly 98% of the holdings are small with less than 10 ha per household. These smallholdings occupy 71% of the total area under coffee and contribute about 60% of the country's total coffee production. The remaining 2% of the holdings, which are large, occupy 29% of the area and contribute 40% of the total production. The productivity of Arabica and robusta is 713 kg/ha and 1,175 kg/ha, respectively and the national average productivity is 944 kg/ha. during 2003-04.

India produces both washed and unwashed (cherry) coffees. Arabica coffee is predominantly processed by the "Wet Process" to produce plantation coffee, while robusta is mainly converted into cherry coffee. However, about 15-20% of country's robusta production is also processed by wet process method to produce superior quality robusta parchment, which commands a premium of about USD $ 300 per MT in the export market. India also produces Monsooned Coffee, a uniquely processed specialty coffee for the world market, which is favoured in preparation of espresso coffees.

The Indian coffee industry is largely export driven with more than 70% of the production being exported. Prior to 1996, the Coffee Board through two different auctions one each for domestic market and export market was marketing the entire coffee produced in the country. Under this arrangement the entire produce was collected through Coffee Board's Pool Depots and processed & stored in licensed coffee curing factories (secondary processing facilities). The coffees pooled to the Board's Depots were subjected to stringent quality control norms and payments were made to the growers based on cup quality. If the quality of a lot falls below Fair

Average Quality (FAQ), such lots were penalized through appropriate deductions and coffees above FAQ were rewarded with premium points. This system greatly helped in the maintenance of quality both for domestic and export markets.

In line with the spirit of liberalization of the Indian economy initiated during the early 1990's, the Indian coffee industry was liberalized in a phased manner during 1993-96, wherein the growers were given absolute freedom to market their coffees on their own.

Emergence of food safety issues coffee

Apart from the traditional quality criteria associated with coffee the new awareness of the human health risk posed by a mycotoxin viz., Ochratoxin-A contamination of coffee brings yet another consideration into the judgment of the acceptability of coffee in the market. OTA is reported to occur in coffees of most origins and in all major types as washed and unwashed arabicas and robustas, although there seems to be greater occurrence in unwashed or dry-processed coffees. The European Union has already prescribed maximum allowed levels of Ochratoxin-A in roasted and soluble coffee forms. Few countries have also adopted national standards for OTA in all forms of coffee including green coffee. These developments are leading to a situation where the buyers seek assurances that producers apply 'best practices' in line with the concept of Total Quality Management. Therefore coffee must be produced by adopting good hygiene practices through out the chain so as to keep the OTA contamination to a level that falls within acceptable limits.

India's initiatives on OTA risk management

Ever since the first report on rejection of coffee consignments from Africa owing to Ochratoxin-A contamination during 1994, the Coffee Board of India has been actively involved in various research activities to find out comprehensive solutions to the problem. The Research Department of Coffee Board of India was involved in a series of national level investigations and multi-country collaborative efforts to identify the causes for OTA contamination and its preventive strategies. The Coffee Board has been implementing the ICO-CFC-FAO enabled multi-country collaborative project "Enhancement of Coffee Quality through Prevention of Mould

Formation" since 2001. Under this project, extensive field surveys and field experiments were carried out to document the distribution of toxin producing moulds in the coffee chain, to analyse causative factors for mould contamination and identification of good hygiene and manufacturing practices for prevention of mould contamination throughout the coffee chain. An Analytical Laboratory was established at the Board's Head office in Bangalore for creating analytical facilities for OTA estimation, which would support the field studies as well as monitor the extent of OTA contamination in traded coffees.

It is widely recognized that the proper processing and handling of coffee at all stages of coffee chain is essential for maintenance of quality and minimise the risk of OTA contamination. Negligence in either processing or handling at any stage of the production-marketing chain can lead to mould contamination thus adversely affecting the quality of coffee. This could affect the acceptance of coffee both at the international and domestic market where the consumers are becoming increasingly quality conscious.

As mentioned previously, a code of practice for processing and handling of coffee for preventing the risk of OTA formation throughout the chain is already available. The knowledge accrued is also disseminated to various stakeholders of Indian coffee industry for the past few years.

Since the problem OTA contamination is relatively new to the industry, it was felt necessary to document the level of awareness among the stakeholders and constraints for adoption of recommended practices for prevention of mould formation in coffee. Accordingly, two separate surveys, one each on coffee farms and coffee market chain, were carried out for analysis of current practices and constraints with regard to OTA contamination in coffee. These surveys were commissioned by Coffee Board of India under the ICO-CFC-FAO Global Mould project "Enhancement of coffee quality through prevention of mould formation" during the year 2004. This report documents the findings of these two surveys and also contains recommendations of socio-economist for consideration of the decision making body.

PART I
SURVEY OF COFFEE HOLDINGS

Objective

The objective of the socio economic survey is to assess the impact of social, economic and cultural factors of the coffee growers on adoption of recommendations practices at the estate level, which are identified as the most critical for prevention of mould formation in coffee during on-farm processing.

Methodology

Coffee estates in India can be classified into marginal (< 2 ha), small (2 -10 ha), medium (10-25 ha) and large holdings (>25 ha). The extent of adoption of GAPs and GMPs may vary considerably across different size holdings due to considerations associated with resource endowments, access to information and awareness. The survey was carried out during the harvesting season of 2004-05, among all category (marginal, small, medium & large) of holdings in major coffee growing tracts of Karnataka (Chickmagalur, Coorg and Hassan), Kerala (Wynad) and Tamilnadu (Pulneys) to assess the extent of adoption of recommended GAPs and GMPs with emphasis on the incidental cost and the attendant benefits accrued. Constraints in adoption of recommended practices have also been documented.

Sampling Plan

A total of 137 coffee holdings were visited during the survey. The samples were drawn to represent all the size groups from each of the states, which is the primary sampling unit. Based on the volume of coffee production from different states, the sample size has been allocated for each state. The breakup of sample surveyed is as follows:

Table 1: Sample distribution in the study area

State & Region	Marginal (< 2 ha)	Small (2-10 ha)	Medium (10-25 ha)	Large (> 25 ha)	Total
Karnataka					
Coorg	3	24	7	6	40
Chickmagalur	5	23	5	3	36
Hassan	1	5	4	4	14
Kerala					
Wynad	**6**	**7**	**1**	**5**	**19**
Tamil Nadu					
Pulneys	**2**	**19**	**2**	**5**	**28**
Total	**17**	**78**	**19**	**23**	**137**

The sample farmers were post stratified into different size groups and the distribution of the sample is shown in table 1 above. Emphasis in the sample selection has been given to the dry process, in view of the increased evidence available of mould contamination in the dry processed coffees. The growers were interviewed by the survey team on their estates. A detailed survey format approved by the Project Executing Agency was used in collection of information. The format used in farm surveys is enclosed as Annexure 1. Where ever necessary physical measurements were also carried out on the site.

RESULTS OF SURVEY OF COFFEE HOLDINGS

A) Socio-economic profile of coffee growers

The socio-economic features of the coffee growers notably, size of land holding and experience, presented in Table 2, could have an important bearing on the production practices of the coffee growers. The average land holding size in respect of marginal, small, medium and large growers was about 1.40ha, 5.5ha, 17ha and 74ha respectively across all the regions. The marginal and small category farmers had less years of experience in coffee cultivation (22-24 years) as compared to the medium and large growers (31 years). It is interesting to note that the land holding structure was similar across regions studied.

Table 2: Socio-economic features of the coffee growers

		Size group			
District	**Variable**	**Marginal**	**Small**	**Medium**	**Large**
Chickmagalur	Age (years)	44.20	47.00	56.50	55.00
	Experience (Years)	27.20	22.00	32.50	30.00
	Land holding (Ha)	1.63	5.90	15.30	68.12
Hassan	Age (years)	33.00	48.20	46.75	52.00
	Experience (Years)	26.00	27.80	27.50	19.00
	Land holding (Ha)	2.02	7.02	19.83	72.64
Coorg	Age (years)	55.50	54.04	56.17	64.40
	Experience (Years)	20.00	26.32	31.50	38.25
	Land holding (Ha)	1.35	4.85	17.09	54.30
Pulneys	Age (years)	30.00	49.93	47.00	60.75
	Experience (Years)	6.00	21.93	31.00	31.67
	Land holding (Ha)	1.32	4.95	15.99	78.67
Wynad	Age (years)	47.00	51.67		94.00
	Experience (Years)	19.33	25.00		
	Land holding (Ha)	1.02	6.30	14.97	95.53
Overall	Age (years)	43.54	50.43	52.75	60.71
	Experience (Years)	21.82	24.06	30.69	30.45
	Land holding (Ha)	1.35	5.45	16.97	73.55

The details of the educational qualifications of the respondents are presented in Table 3.

Table 3: Educational qualification of the coffee growers

(percent of farmers with designated education levels)

	Size			
Qualification	**Marginal**	**Small**	**Medium**	**Large**
Post graduate	5.88	10.26	21.05	21.74
Graduate	11.76	30.77	21.05	60.87
Pre University	0.00	16.67	10.53	8.70
SSLC (10^{th} class)	23.53	24.36	31.58	4.35
Middle School (7^{th} class)	35.29	0.00	0.00	0.00
Primary (5^{th} class)	0.00	1.28	0.00	0.00
Illiterate	23.53	16.67	15.79	4.35
Overall	100.00	100.00	100.00	100.00

From the Table above it is apparent that a large percent of the marginal and small coffee growers are illiterate whereas most of the large farmers are graduates and a majority of the medium farmers have educational qualifications in excess of High school. This aspect needs to be borne in mind while catering to the training needs of these categories of growers.

B) Harvest and post-harvest practices adopted

i. Method of harvest

Generally one round of fly picking followed by the one round of main harvest and stripping was the predominant practice in all the Arabica holdings irrespective of size of holdings. Only in Pulenys region, all the Arabica growers adopted more than one round of harvest after fly picking, mainly due to uneven ripening of fruits influenced by climatic conditions (low temperatures coinciding with harvest season). In case of robusta, where dry process is predominant, the medium and large holdings practiced on main round of harvest followed by stripping. The marginal and small robusta growers, especially in Coorg and Wynad regions, predominantly practiced only one round of harvest by stripping when majority of fruits are ripe, due to high wage rates prevailing in these regions.

ii. Use of harvest/ picking mats

The practice of covering soil with mats at the time harvesting operation was popularised by Coffee Board in India since early 1990s as a phytosanitary measure against coffee berry borer, which found its way into the country in 1990. This measure was aimed at reducing the gleanings (fallen cherries on ground) which were identified as source of inoculum for the next cropping season.

The percentage of growers in different categories using harvesting mats has been studied and the results are presented in Table 4.

Table 4: Percentage of growers using harvesting mats

		Size			
Variety	District	Marginal	Small	Medium	Large
Arabica	Chickmagalur	0.00	0.00	0.00	0.00
	Hassan	0.00	100.00	0.00	0.00
	Coorg	0.00	0.00	0.00	100.00
	Pulneys	0.00	0.00	0.00	0.00
Robusta	Chickmagalur	100.00	42.86	0.00	100.00
	Hassan	100.00	0.00	100.00	0.00
	Coorg		100.00	100.00	100.00
	Wynad	100.00	42.86	100.00	60.00

As could be seen from the table, the use of harvesting mats is most commonly practiced in robusta estates and rarely in Arabica estates. This is because of the fact that Arabica harvesting is completed before flaring up of berry borer incidence and the extent of gleanings in Arabica coffee is less due to selective picking.

Wooven polythene mats and plastic sheets are commonly used as harvest mats in all the regions surveyed. Use of tarpaulin was found to be rare as the cost is high. The durability of woven polythene mats was 3-4 seasons while that of plastic sheet is 1-2 seasons. Many growers expressed that use of harvest mats is not economically feasible due to less durability of material and also due to absence of any direct benefits interms of better price to the final produce. They attributed the practice of using harvest mats in berry borer infested areas to the financial support extended by Coffee Board.

iii. Type of drying yards

The results presented in Table 5 gives the information on the type of drying yards used in coffee estates.

Table 5: Type of drying yard used for drying coffee (Percent)

District	Drying Yard Type	Marginal	Small	Medium	Large	Average
Chickmagalur	Cement	20.00	8.70	0.00	0.00	8.33
	Tiled	0.00	8.70	80.00	66.67	22.22
	Cement +Tiled	60.00	60.87	20.00	0.00	50.00
	Cement + mud surface	0.00	13.04	0.00	33.33	11.11
	Mud	0.00	4.35	0.00	0.00	2.78
	Cow dung smeared surface	20.00	4.35	0.00	0.00	5.56
Hassan	Cement	0.00	0.00	0.00	25.00	7.14
	Tiled	0.00	20.00	75.00	75.00	50.00
	Cement +Tiled	0.00	0.00	25.00	0.00	7.14
	Cow dung smeared surface	100.00	40.00	0.00	0.00	21.43
	Stone surface	0.00	40.00	0.00	0.00	14.29
Coorg	Cement	66.67	45.83	71.43	16.67	47.50
	Tiled	0.00	12.50	14.29	33.33	15.00
	Cement +Tiled	33.33	25.00	0.00	16.67	20.00
	Cement + mud surface	0.00	0.00	14.29	33.33	7.50
	Cow dung smeared surface	0.00	4.17	0.00	0.00	2.50
	Tiled +Tarpaulin	0.00	8.33	0.00	0.00	5.00
	Mud	0.00	4.17	0.00	0.00	2.50

Pulneys	Cement	100.00	89.47	100.00	80.00	89.29
	Tiled	0.00	5.26	0.00	20.00	7.14
Wynad	Cement	16.67	85.71	100.00	80.00	63.16
	Cement +Tiled	66.67	14.29	0.00	0.00	26.32
	Mud	0.00	0.00	0.00	20.00	5.26

As could be seen from the above table, about 70-80% of growers were using cement or tiled yards or both for drying their coffees. This is especially true in case of medium and large growers, irrespective of the regions. A small percentage of marginal and small growers, especially in Chikmagalur, Hassan and Coorg regions were drying their coffee either on compacted soil or cow dung smeared soil surface. Although they were aware of quality loss due to such practices, they blamed it on their poor financial conditions.

iv. Practices during drying of coffee

a*) Duration of drying:*

There was no major difference reported in the drying time required for drying of coffee across all the regions and category of growers. The time required for drying was recorded as 5-7 days for parchment coffee and 10-12 days for cherry coffee. All the coffee is dried under the Sun at the estate level itself in all the regions surveyed. Only in Pulneys region, the growers shift the fresh parchment coffee for drying in plains because of mild climate prevailing in the coffee hills during harvest (Nov-Feb.) period.

b) Heaping, sorting and mixing:

The drying practices of cherry was studied and it was found that only a minor percent of about 5% growers adopted sorting of fruits before drying of cherry. On the other hand about 46% growers practiced heaping of cherries for 1 to three days before spreading them for drying. About 52% of growers also mixed the fruits of different days harvest during cherry preparation. These practices were more or less similar in cherry preparation across all the regions and category of growers (Table 7).

Table 7: Practices followed during dry method of processing (Cherry preparation) (Percentage of growers adopting the practice)

Region	Sorting	Mixing	Heaping
Chickmagalur	4.76	60.00	69.23
Hassan	0.00	66.67	66.67
Coorg	11.11	28.57	23.53
Pulneys	0.00	100.00	50.00
Wynad	0.00	33.33	66.67
Total	**4.92**	**46.00**	**51.92**

c. Raking of fruits during drying

The method and frequency of raking adopted by arabica and robusta coffee growers is presented in the Table 8. Raking is predominantly done manually by either by foot or by using wooden/plastic rakes. The parchment coffee was raked by foot while for cherry coffee wooden or plastic rakes were used. The average number of rakings varied from 3 to 6 per day across all the regions and category of growers, with no major difference being recorded between cherry (robusta) and parchment (Arabica) preparation.

Table 8: Methods and frequency of raking

Variety	Method/ frequency of Raking	Data	Size				
			Marginal	Small	Medium	Large	Average
Arabica	With foot	%practicing	80.00	53.33	20.00	62.50	54.17
	Wooden or plastic rakes	%practicing	20.00	16.67	20.00	12.50	16.67
	Both (with foot & wooden/ plastic rakes)	%practicing	0.00	30.00	60.00	25.00	29.17
	Frequency of raking	Times/day	4.75	4.60	3.50	4.60	4.50
Robusta	With foot	%practicing	63.64	43.75	50.00	37.50	47.37
	Wooden or plastic rakes	%practicing	27.27	46.88	16.67	50.00	40.35
	Both (with foot & wooden/ plastic rakes)	%practicing	0.00	3.13	16.67	12.50	5.26
	Frequency of raking	Times/day	3.00	5.70	4.89	4.30	4.30

d. Covering the drying mass at night

A majority of the growers (>82%) covered the coffee at night especially in Hassan, Chickmagalur and Coorg regions. In Pulneys and Wynad only 69% and 56% of the growers followed this practice respectively. However, when they anticipated rain almost all the growers covered the coffee.

e. Moisture testing

The methods adopted by the coffee growers for testing the moisture content of coffee for ascertaining the completion of drying is presented in Table 9. The two most common methods adopted are the test weight method followed by the traditional biting method. In Pulneys region, the biting method is more commonly adopted than test weight method. Use of moisture meter is not very popular.

Table 9: Methods used to determine the moisture level in coffee (Percent)

Method	Chickmagalur	Hassan	Coorg	Pulneys	Wynad	Overall
Rattling + Biting method	16.66	15.38	34.15	65.52	36.84	33.71
Test weight	80.56	69.23	53.66	34.48	63.16	60.22
Moisture meter	0.00	7.69	4.88	0.00	0.00	2.51
Test weight+ Meter	2.78	7.69	7.32	0.00	0.00	3.56
Total	100.00	100.00	100.00	100.00	100.00	100.00

f. Collection of Gleanings

The practice of collecting gleaning was in vogue in all the districts studied as is evident from table 10. On an average around 50 percent of the growers collected gleanings, with the planters in Wynad practicing it extensively and those in Coorg practicing it rarely. The time gap between picking and collecting gleanings varied between 15 days to around 20 days across all the regions.

Table 10: Practice of gleaning in coffee plantations of India (Percent)

	Size				
District	Marginal	Small	Medium	Large	Average
Chickmagalur	40.00	56.52	40.00	33.33	50.00
Pulneys	50.00	68.42	50.00	100.00	71.43
Hassan	100.00	60.00	50.00	50.00	57.14
Coorg	0.00	8.33	14.29	0.00	7.50
Wynad	83.33	100.00	100.00	100.00	94.74
Grand Total	52.94	48.72	36.84	56.52	48.91

v. Method and storage of coffee after primary (estate) processing

The storage practices followed by the growers is studied and presented in Table 11. From the table it can be seen that coffee is either stored in warehouses or in farm stores in the residences on the grower. The large and medium growers stored their coffee in warehouses of curing factories located outside the plantation areas (about 63% and 44% respectively), whereas the marginal and small growers predominantly stored the dried coffee in the residence itself (about 92% and 52% respectively). It was observed that the coffees were not stored along with fertilisers and other chemicals.

Table 11: Places of storage of coffee after drying (number of holdings adopting a particular method of storage)

Place of storage	Region	Size of holdings				
		Marginal	Small	Medium	Large	Average
Warehouse of curing works	Chikmagalur	1.00	6.00	1.00	1.00	9.0
	Coorg	--	6.00	4.00	2.00	12.0
	Hassan	--	--	--	--	--
	Wynad	--	2.00	--	4.00	6.0
	Pulneys	--	5.00	2.00	5.00	12.0
	% to the total	**7.7**	**30.1**	**43.8**	**63.2**	**35.8**
Farm store	Chikmagalur	--	6.00	2.00	--	8.0
	Coorg	--	2.00	2.00	4.00	8.0
	Hassan	--	--	3.00	1.00	4.0
	Wynad	--	1.00	--	1.00	2.0
	Pulneys	--	2.00	--	--	2.0
	% to the total	**--**	**17.7**	**43.8**	**31.6**	**22.0**
Residence	Chikmagalur	2.00	8.00	1.00	1.00	12.0
	Coorg	2.00	8.00	1.00	--	11.0
	Hassan	1.00	3.00	--	--	4.0
	Wynad	6.00	2.00	--	--	8.0
	Pulneys	1.00	11.00	--	--	12.0
	% to the total	**92.3**	**51.6**	**12.5**	**5.3**	**43.1**

The period of storage of coffee before sale depends on the prices prevailing and the future expectations of price. The period of storage during the immediate preceding year was reported to vary from one to five months.

vi. Method of disposal of coffee

The channel of sale of coffee chosen by the growers depends on the several economic and non-economic factors such as price, discharge of obligation of loan received from the traders, convenience, etc. The prevailing marketing channels in the study area are presented in Table 12. The local agent was found to be the main outlet for the sale of coffee by the growers as evidenced by the fact that about 78 per cent of Wynad coffee growers, 77 per cent of Pulneys growers, 74 per cent of Coorg growers, 65 per cent of Chickmagalur growers and 46 per cent of the Hassan growers sold their coffee to the local agent. This channel was especially popular with the marginal farmers who sold their entire production through this channel. Besides this, some of the farmers sold coffee to the curing works. Sale through the Coffee Curing Works was popular as a large chunk of the coffee was sold directly to the curing works by the small, medium and large growers especially in Karnataka. However a small proportion of the growers use multiple channels to market their produce.

Table 12: Disposal pattern of coffee by the growers

		Size				(Percent)
Region	**Sale points**	**Marginal**	**Small**	**Medium**	**Large**	**Average**
Chickmagalur	Curing works	0.00	26.09	25.00	50.00	23.53
	Local agent	100.00	60.87	75.00	0.00	64.71
	Local agent + curing works	0.00	13.04	0.00	50.00	11.76
Hassan	Auction	0.00	0.00	33.33	0.00	7.69
	Curing works	0.00	20.00	33.33	75.00	38.46
	Local agent	100.00	60.00	33.33	25.00	46.15
	Local agent + curing works	0.00	20.00	0.00	0.00	7.69
Coorg	Curing works	0.00	10.00	33.33	40.00	17.65
	Local agent	100.00	85.00	50.00	60.00	76.47
	Local agent + curing works	0.00	0.00	16.67	0.00	2.94
	Main buyer	0.00	5.00	0.00	0.00	2.94
Pulneys	Curing works	0.00	5.88	0.00	0.00	3.85
	Local agent	100.00	88.24	50.00	40.00	76.92
	Local agent +main buyer	0.00	0.00	0.00	20.00	3.85
	Main buyer	0.00	5.88	50.00	40.00	15.38
Wynad	Auction	0.00	0.00	0.00	20.00	5.56
	Curing works	0.00	0.00	0.00	40.00	11.11

	Exporter	0.00	0.00	0.00	20.00	5.56
	Local agent	100.00	100.00	100.00	20.00	77.78

C) Awareness on Mould contamination in coffee

More than 90% coffee growers surveyed are aware about mould contamination in coffee. When quizzed as to whether they had encountered any problem with mould, it was found that roughly a fourth of those surveyed had encountered a problem with mould (Table 13). The problem was reported more in cherry coffee producing areas like Wynad, Coorg and Hassan regions.

Table 13: Mould problem encountered by coffee growers (percent)

Size group	% No	% Yes	Total
Marginal	73.33	26.67	100.00
Small	73.02	26.98	100.00
Medium	82.35	17.65	100.00
Large	77.78	22.22	100.00
Grand Total	75.22	24.78	100.00

The growers are aware that practices like storing with high moisture, heaping and rewetting during drying etc., leads to mould formation in cherry coffee based on their experience (Table 14). The growers informed that they try to avoid these undesirable practices as far as possible. But when there is a constraint for drying space, they practice heaping of fruits as they would believe that by heaping the fruit skin gets ruptured and the cherries dry faster. Majority of growers are also aware that mould affects quality of coffee, but are not aware of its implications on food safety concerns.

Table 14: Sources of mould formation as perceived by the coffee growers (Percent)

Sources of mould	Chickmagalur	Hassan	Coorg	Pulneys	Wynad	Overall
Unhygienic drying condition	53.33	66.67	28.95	22.73	0.00	34.19
Non racking of drying berries	10.00	16.67	2.63	9.09	6.67	7.69
Unhygienic storing condition	33.33	41.67	18.42	40.91	6.67	27.35
Exposing to rain and mist	13.33	16.67	7.89	22.73	20.00	14.53
Storing at high % of moisture	63.33	66.67	50.00	31.82	53.33	52.14
Storing harvest in heaps	3.33	0.00	13.16	4.55	0.00	5.98
Thick spread of berries	16.67	8.33	7.89	4.55	6.67	9.40
Non-use of Dunnage	13.33	0.00	2.63	0.00	6.67	5.13
Non use of clean gunny bags	10.00	0.00	0.00	0.00	0.00	2.56

D) Awareness on GAPs & GMPs for prevention of Moulds in Coffee

About 65% of the coffee growers contacted claimed that they are aware of GAPs & GMPs, but they are not able to practice many of them due to economic considerations. Also, there is no discounting/ incentives scheme for discrimination of coffees in the local market chain. They are willing to adopt mould reduction practices, provided they received a better price for their coffees or at least the additional cost incurred in the production is covered (Table 15).

Table 15. Farmers requirement for producing mould free coffees (percent)

Size	Better Price	Cover cost	Novel practices
Marginal	23.08	100.00	0.00
Small	6.38	100.00	20.00
Medium	0.00	100.00	0.00
Large	7.14	100.00	25.00
Total	8.33	100.00	12.50

Only a small percentage of small and large growers said they are adopting novel practices, for producing quality coffee, which receives a slight premium from their regular buyer.

PART II
STUDY OF COFFEE MARKETING CHAIN IN INDIA

Objectives

The specific objective of this study is to determine the stages of coffee marketing chain where there is greatest risk of contamination with OT-A producing moulds and to examine ways to provide incentives to farmers and small traders to encourage & support quality & safety issues in the coffee chain.

Structure of coffee marketing chain in India

The coffee marketing chain in India is depicted in Figure.1.

Before looking into the structure of coffee market chain, it would be worthwhile to have a look at the characteristics of the industry itself.

- Indian coffee industry is characterised by predominance of marginal and small growers. Of the 180,000 coffee holdings in India, about 77.5% are marginal holdings (<2ha); 21% small holdings (2-10ha); 1% medium size holdings (10-25ha) and only less than 1% are large holdings (>25ha).
- The marginal and small holdings together occupy about 72% of the planted area and contribute 60% towards the total coffee production. The medium and large holdings occupy about 28% area but contribute 40% towards total production.
- India produces both Arabica and Robusta coffee in a 40:60 ratio and processes them either by wet or by dry method. Nearly 80% of Arabica is processed by wet method and in case of robusta only about 20% is processed by wet method.
- Most of the sale, especially at marginal and small grower level, takes place at the farm gate in the form of parchment coffee or cherry coffee, except in certain regions like Wynad, where the dry processed robusta (cherry) is cured (hulled) at estate level to produce estate pounded coffee.
- Despite the predominance of marginal and small growers, there is no active growers co-operative existing in the country for marketing of their produce. This leads to a situation where the exporters mainly depend on agents / middle men for procurement of coffee for their operations.

- There are about 75 coffee curing factories spread all over the coffee regions. Among them few provide warehousing and curing services to coffee growers on payment basis and few of them purchase coffee directly from the growers and either sell it to exporters or export such coffees directly.
- There are nearly 100 registered coffee exporters, but only about 20 of them share more than 80% of coffee exported from the country.

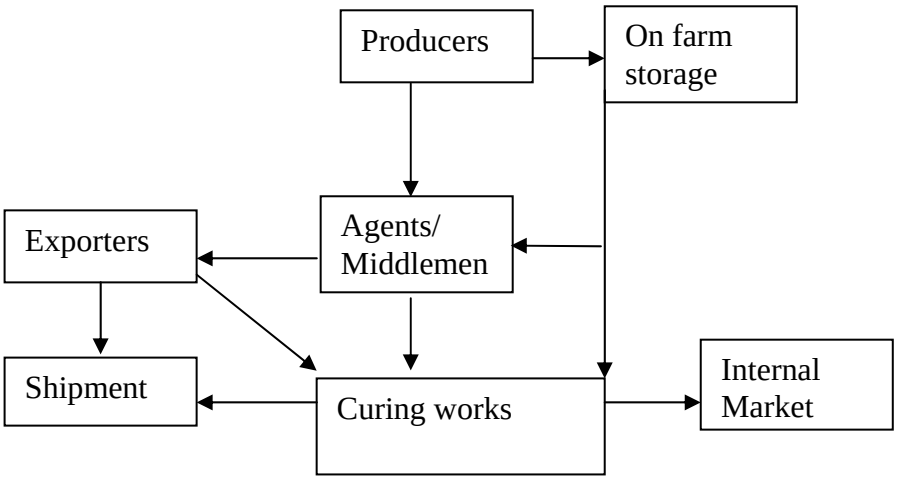

Figure 1: Structure of coffee marketing chain in India

The coffee market chain in India would essentially form a pyramid with growers constituting the base and the exporters at the top. After harvesting, the coffee is processed in two different ways viz., wet method and dry method to produce parchment coffee and cherry coffee respectively. The parchment or cherry are later dried and stored on the estate for varying period till further sale.

The middlemen or local agents of exporters, purchase parchment and/ or cherry coffee from growers, especially from marginal and small growers. The coffee collected by these middlemen is then sent to the curing works. Deductions are made as per the existing quality standards by the curing works or exporters. The cured coffee is sold in the domestic market or exported. The medium and large growers usually get their coffees cured at Curing factories and either participate in the domestic auctions or sell their coffee directly to the exporters. Few large growers and corporate plantations directly export their coffee.

Methodology

A stratified random sampling procedure has been employed in selection of the sample. Beginning with the exporter the coffee marketing chain was traced backwards to the growers. At each stage, the key players were identified, management practices followed were documented and a sample of the coffee handled by them was collected. The coffee samples were analysed for various parameters like moisture content, water activity, ochre mould infection and OTA. The stakeholders were interviewed with the help of a structured questionnaire. The information collected during the interview include both factual (on the costs incurred, the area and production, to whom they sell the coffee) as well as perceptual (such as the importance of moisture in mould formation, the factors that cause moulds and the like). The format of questionnaire is presented in Annexure 2.

Selection of participants/locations

For the purpose of study, major Arabica and robusta growing states viz., Karnataka (Chikmagalur, Hassan and Coorg) and Kerala (Wynad) were identified which together contribute nearly 80% towards the country's production. The exporters who are active in these major regions were selected so as to cover both Arabica and robsuta trade. The Chikmagalur and Hassan regions were predominantly Arabica areas while Coorg and Wynad were predominantly robusta areas.

Three major coffee exporters viz., M/s. Amalgamated Bean Coffee Trading Co.Ltd., M/s.Madhu Jayanthi International and M/s.Ramesh Exports, who have sizable export and domestic market presence, were identified for the survey. Of the three exporters selected for the study, two of them have major coffee operations in Karnataka state and the other one had Kerala as the main supply centre. The coffee curing works belonging to these three exporters were also visited during the survey to collect samples as well as information on storage, shipment etc.

The profile of selected exporters is furnished in Table 16 below:

Table 16: Profile of coffee exporters surveyed

Particulars	**Exporters**		
	Exporter 'A'	**Exporter 'B'**	**Exporter 'C'**
Quantity of coffee traded MT (av. of 3 years)			
Arabica Parchment Arabica Cherry Robusta Parchment Robusta Cherry	6,996 1427 1895 6558	1445 1094 705 4518	4382 758 2001 3770
Total coffee traded/exported in MT (av. of 3 years)	16,876	7,762	10,911
Mode of sales of coffee	Exports	Exports/ domestic market	Exports
Major export destinations	Belgium, Germany, Italy	Belgium, Greece Italy, Switzerland	Germany, Italy, Japan, Switzerland
Major regions of operations	Chikmagalur & Hassan	Wynad	Chikmagalur & Coorg
Major source of coffee collection	Company depots/ Local agents	Local agents	Local agents, Curing works
Criteria for purchase of coffee	Moisture, smell, physical appearance, out turn etc.	Moisture, smell, physical appearance, out turn etc.	Moisture, smell, physical appearance, out turn etc.
Criteria for discounting/ rejection of coffee	Excess moisture, Poor colour, mouldy smell	Excess moisture, Poor colour, mouldy smell	Excess moisture, Poor colour, mouldy smell
Own curing works	Yes	Yes	Yes
Do you re-dry and sort coffee at receiving point	Yes	Yes	Yes
How is information on price & quality issues conducted along the chain	Through suppliers	Through suppliers	Through suppliers

In the next step, the local agents/ middlemen who supply coffee to these exporters were identified based on reference given by the exporters. A total of eight local agents/ middlemen were identified covering Chikmagalur, Hassan, Coorg and Wynad regions. Among them three each were operating for two exporters and two were operating for the third exporter. These local agents/ middlemen were also interviewed regarding their trading operations and samples were collected for analysis.

With the help of these local traders, three coffee growers, one each in the small, medium and large farmer category, were identified. A total of 24 coffee growers were selected representing all the regions and also Arabica and robusta. The selected growers were interviewed and coffee samples were collected at the farm gate.

The coffee samples collected at each stage were tested for the moisture content and water activity on the spot. Observations on oven moisture content, ochre infection and cup quality were recorded at Coffee Board's laboratories. If any sample was found positive for ochre mould infection, such samples were analysed for OTA contamination at the Analytical Laboratory of Coffee Board.

Interviewing stakeholders

The interviews with the stakeholders were unstructured. The stakeholders were initially appraised of the importance of the project concerning coffee quality. The project team visited their fields/drying yards/storage place to have a first hand knowledge of the actual conditions prevailing in the field. The stakeholders were questioned on all aspects that may have an impact on the coffee quality and the associated costs and returns with each practice being followed at the stakeholder level.

Sampling

Investigations were conducted during May-June, 2004 when there is an active trading of coffee. Depending on the level of operation of the stakeholder and the incoming lot size, a composite sample of about 1kg was drawn for smaller lot sizes up to 1.8 tonnes (small truck) by sampling every bag. For larger lots of 30 bags and above, (usually 8 tonnes or 18 tonnes for small and large lorries) a sample of about 2 kg was collected. The samples were sealed in air-proof plastic bags. The origin of the lot, its technical description (eg. parchment, clean coffee, dry cherry etc.) was marked on the sample bags. Also, the mode of transport (e.g. motorcycle, pickup truck etc.), size of lot and method of packaging (e.g. gunny bags, in bulk, sisal sack etc.) were recorded.

Results of Survey of coffee market chain

A) Practices at Local Agents/ middlemen level

a. Testing for moisture:

Among the 8 local agents/ middlemen interviewed only 50% of them had moisture meters and were testing coffees for moisture content at receiving point. 25% of agents depended on biting test for on the spot moisture determination. In other cases they depend on curing works for moisture testing.

b. Premiums/ Discounts for quality

Since all the local agents are acting on behalf of exporters, the policy of incentives/ discounts are decided by the exporting company and the agents merely implement it while purchasing coffee from growers. Excess moisture content and mouldy smell are two major criteria for discounting coffees.

In case of moisture, the tolerance limits for washed coffee and cherry coffee are put at about 1% higher than prescribed limits (10% for parchment and 11.5% for cherry with a tolerance of +0.5%). If it exceeds the tolerance level, such coffees are discounted by weight at the rate of 0.5kg per bag (of 50kg) for every increase in moisture content by 1% beyond tolerance level. It was observed that the local traders were effecting deductions for contaminated coffee.

With regard to mouldy coffee, only 25% of local agents informed that they pay a premium for mould free coffee while 50% said that they would discount such coffees. Complete rejection of lots with mouldy smell was adopted only by 25% of the local agents.

c. Bagging storage & care during transportation

The local traders did not always use clean bags for storing coffee and many a times re-used bags for storage.

About 42 percent of the traders did not store the coffee on their own as they were acting at the behest of the traders. Only $1/4^{th}$ of the agents stored coffee in special godowns and $1/3^{rd}$ of the agents stored coffee in their residences. The storage of coffee at local agents is only for shorter period, as they wait for collection of required quantity for transport to nearest curing factory of exporters. Only 25% used clean bags for storage of coffee.

All the agents interviewed depended on mini lorry or regular lorry for transportation of coffee. Only 50% of the local traders interviewed had provided covering to the coffee during transportation. However all of them protected the coffee from rainfall during transportation.

Awareness about mould contamination among local agents/ middlemen

The awareness levels of mould contamination were high among the local agents. Barring one agent all the others were fully aware of the causes of mould contamination. A majority of the local traders were of the opinion that insufficient drying coupled with adverse weather conditions was responsible for mould contamination.

B) Practices of selected growers at estate level

The practices adopted by the coffee growers selected under market chain survey have been studied, especially with reference to harvest and post-harvest practices and storage and disposal of coffee.

a. Method of harvesting:

The method of harvesting varied with the variety of coffee. In the case of Arabica areas (Chickmagalur and Hassan), majority of the growers did one round of fly picking followed by main harvest and stripping. In the case of robusta, majority of growers follow one round of stripping when majority of fruits are ripe (Table 17). This method of only one round stripping is bound to lead to fruit drop, which needs to be gleaned in due course.

Table 17: Type of harvesting of coffee (Percent)

Type of picking	Chickmagalur	Coorg	Hassan	Wynad
Arabica				
Fly picking, main harvest & stripping	63	NA	83	NA
Main harvest & stripping	37	NA	17	NA
Robusta				
Fly picking, main harvest	NA	50	NA	12
Main Harvest & stripping	NA	0.00	NA	0.00
Only stripping	NA	50	NA	86

b. Use of harvest mats

The practice of using harvest mats was not popular in arabica areas (Chickmagalur and Hassan) with only 25 percent and 33 percent of growers using harvest mats (Table 18). However, in Coorg and Wynad regions, which are predominantly robusta growing areas and are infested with coffee berry borer, about 86-100% growers used harvest mats. The cost of the mats varied between Rs.1/- per mat to Rs. 2.50 per mat that had an economic life of between 1 to 2 years. The gleanings were collected between 10-28 days after harvest.

Table 18: Use of harvest mats (percent)

Practices	Chickmagalur	Coorg	Hassan	Wynad
Use Of Harvest Mats (percent)	13	100	33	86
Cost of Harvest Mats (Rs. per mat)	2.40	1.00	2.50	2.50
Economic Life of Mats (Years)	2	1	2.25	2.0
Gleanings collected at ---- days after harvest	20	30	15	15
Use Broca Traps (%)	0	0	17.00	0.43

c. Steps during cherry preparation (dry processing)

Sorting of fruits for cherry preparation is not widely practiced as evidenced from table 19 and gleanings were mixed with the main harvest. A large number of planters heaped the harvested berries from between 1 to 4 days. Drying was carried for about 10 to 15 days.

Table 19: Dry processing practices

Dry Processing Practices	Chickmagalur	Coorg	Hassan	Wynad
Sorting Cherry (percent)	0.00	0.00	17	0.00
Mixing floats & gleaning with main cherry lot	75	50	83	14
Heaping harvested fruits before drying (Percent)	75	100	83	100
Duration Heaping (Days)	2.75	1.00	2.59	3.57
Day for Cherry Drying (Days)	14.38	13.00	12.00	10.14

d. Type of drying yards

The facilities in the drying yard are important for hygienic preparation of the coffee. The type of drying yard maintained on the estate is shown in table 20. A majority of estates had cement-drying yards and some had plastered and mud yard. Stone slab lined and tiled yards were also found.

Table 20: Type of drying yards

Drying Yard Type	Chickmagalur	Coorg	Hassan	Wynad
Tiled/ Brick surface	25.00	0.00	16.67	0.00
Cement	50.00	100.00	33.33	57.14
Mud Yard	12.50	0.00	0.00	28.57
Plastered Mud Yard	12.50	0.00	16.67	14.29
Stone Slabs	0.00	0.00	33.33	0.00
Grand Total	100.00	100.00	100.00	100.00

e. Method of testing moisture content

Before storage the moisture in the coffee should be brought down to the optimum level. Rattling and biting test is most commonly adopted by growers at field level (52%), followed by test weight method (39%). Only about 4% growers used moisture meters.

f. Storage of coffee on the farm

On farm storage for parchment is about 75 days and in cherry the storage varies from 62 days to 165 days. Storage is usually done in a separate store houses on the farm for a period ranging between 70-90 days in case of parchment coffee and 40-168 days for cherry coffee. Storage in residence is also practiced by few growers, but the duration is for a short period only (About 30 days). On an average only about 22 percent of the growers interviewed were found to be using dunnages.

g. Awareness about mould contamination

Awareness among the growers about the causes of mould contamination is documented in Table 21.

Table 21: Awareness of growers about mould contamination in coffee (Percent)

Data	Chickmagalur	Coorg	Hassan	Wynad	Grand Total
Awareness about mould contamination	100	50	33	71	70
Deduction For Poor Quality	100	0	100	100	91
Premium received for Quality	0	0	0	0	0
Willingness to adopt GMPs if premium received	100	100	83	100	96

The awareness levels were high in Chickmagalur and Wynad compared to Coorg (50%) and Hassan (33%). The plight of the growers was that while they were

penalised for mould-contaminated coffee they did no receive a premium price for mould free coffee. All the growers interviewed expressed this view. The growers were unequivocally of the view that price incentives for producing mould free coffee would encourage farmers to adopt clean practices to avoid mould. Almost all the growers were willing to adopt mould free production practices if a price premium was paid to them for the coffee in the either through the market mechanism or through direct payment to growers for mould free coffee would induce growers to undertake clean production practices and get in to the practice of producing mould free coffee.

h. Adoption of Good Manufacturing Practices by coffee growers

Good Agricultural Practices go a long way in producing mould free coffee at the farm level. The extent of adoption of good agricultural practices has been documented for different regions in Table 22. The salient observations on adoption of GMPs by growers are as follows:

- Majority of growers do not use harvest mats. On an average half the growers interviewed used harvest mats while the other half did not. Adoption rates of this practice were more in Coorg and Wynad as compared to Chickmagalur and Hassan.
- The practice of treating gleanings as a separate lot was divided and it was only in Hassan where the practice was popular.
- Harvested berries were not always stored in bags. On the average the practice was adopted in only a third of the gardens. Care was taken not to mix the various lots harvested.
- The harvested coffee berries were spread uniformly at the optimum level of thickness and raked at regular intervals.
- Growers usually took care to protect the drying coffee from rain and mist
- The practice of using dunnage during storage of coffee was followed in only about 30 percent of cases.
- The storage of coffee was as per hygienic conditions using clean gunny bags and proper methods of storage were being widely followed. However, the practice of storing the coffee against the wall was followed by one half of the growers interviewed, which was not a desirable practice.

Table 22: Extent of adoption of Good Agricultural Practices (Percent)

Practice	*Region*				
	Chickmagalur	**Coorg**	**Hassan**	**Wynad**	**Average**
Use of Harvesting mats					
No	75.00	0.00	66.67	14.29	47.83
Yes	25.00	100.00	33.33	85.71	52.17
Treating Gleaning as separate lot					
No	37.50	0.00	66.67	85.71	56.52
Yes	62.50	100.00	33.33	14.29	43.48
Hygienic condition of drying yard					
No	37.50	0.00	16.67	42.86	30.43
Yes	62.50	100.00	83.33	57.14	69.57
Not Mixing Lots of Various MC					
No	12.50	0.00	0.00	14.29	8.70
Yes	87.50	100.00	100.00	85.71	91.30
Optimum Spread of Berries					
No	12.50	50.00	33.33	28.57	26.09
Yes	87.50	50.00	66.67	71.43	73.91
Protecting drying lot from Rain and Mist					
No	25.00	50.00	33.33	71.43	43.48
Yes	75.00	50.00	66.67	28.57	56.52
Use of Dunnage in Store rooms					
No	50.00	100.00	83.33	71.43	69.57
Yes	50.00	0.00	16.67	28.57	30.43
Hygienic storing conditions					
No	25.00	0.00	0.00	0.00	8.70
Yes	75.00	100.00	100.00	100.00	91.30
Avoiding contact of bags with walls					
No	50.00	50.00	50.00	57.14	52.17
Yes	50.00	50.00	50.00	42.86	47.83

i. Constraints in adoption of GMPs

The lack of adoption of mould prevention practices by coffee growers can be traced to additional costs involved in adoption of GMPs and absence of premium for mould free coffee in the market. About 43 percent of the growers reported that in

addition to the high cost associated with adoption, lack of labour is another important reason for not undertaking these measures. They felt that an incentive of Rs. 100 per bag would induce adoption and a discount of Rs.10/- per bag would discourage the production of low quality coffee and a standardisation of quality parameters to ensure greater compliance (Table 23).

Table 23: Reasons for non-adoption of GMPs at estate level

Additional cost of adopting GMPs for mould prevention would be Rs.200 to Rs.300 per tonne
Willing to adopt if a premium of Rs.100 per bag
Feels that a premium of Rs.10/- bag for prescribed Moisture content can induce planters
During pooled marketing era administered by Coffee Board, good quality coffees were rewarded with premium. In today's liberalized market, no price differentiation between good quality coffee and poor quality coffee.
Market is unstable and traders control the market
Govt. should standardize the price for quality coffee
Moisture estimation at curing works is not satisfactory
Good quality coffee should be purchased separately by some agency
Planters do not get any premium as local Agents appropriate it

In cases where badly-handled and well-handled coffees receive the same price, then operators will not spend additional time or make any investment to improve their practices. Notably there are cases where national coffee institutions have successfully worked with the different stakeholders to link incentives for quality to safe production practices – since the measures that reduce risk of OTA contamination also lead to general quality improvement.

C) Practices at exporters level (Curing Works)

The curing works (factories/ mills) are important functionary in the marketing of coffee in India. The coffee that is procured by the traders is transferred to the curing works and in some of the cases the growers sell their coffee directly to the curing works. Curing works are therefore the next link in the coffee marketing chain.

In the current survey, all the exporters either owned a Curing factory or used the services of curing factory for secondary processing and storage. Atleast one curing works belonging to each exporters was selected in all the major regions covered under the survey for collecting information on current practices at secondary processing level. There is at least one major curing work in each location. ABC in Chickmagalur, Chimco in Coorg, Jayanthi in Wynad and Subbiah & Sons in Mysore.

a. Types of coffee handled:

All the curing works surveyed handle all types of coffee viz., wet and dry processed Arabica and robusta. Only in Wallyar Curing Works, Kerala Estate Pounded (EP) robusta coffee is the common type of coffee handled.

b. Type of drying yards

The drying yards in the curing works did not constitute a risk as they had cement or tiled drying yards. In one case drying was by done by machine.

c. Method of moisture estimation

The method of testing moisture in al the curing works was scientific as all the curing works used moisture meters for the purpose. The moisture meter used in the curing works was either the Kappa moisture meter of the Sinar moisture meter which are calibrated every season either at the Analytical Laboratory, Coffee Board of India, CFTRI Laboratories at Mysore or M/s.Sriram Research Laboratory & Institute, Bangalore.

d. Containerisation of coffee at curing works

Containerisation is a desirable way of transporting coffee as it offers complete protection against rain and minimises the handling of coffee as it can be transferred directly to the port for export or even send to distant destinations in the country. Containerisation of consignments was being done only at the curing works in Coorg and Kerala and not at Chickmagalur and Mysore. In Chickmagalur where the largest quantity was being handled containerisation was not in practice though the cost of containerisation was between Rs.1/- to Rs.3/- per kg of coffee.

e. Awareness on OTA contamination

About 2/3rd managers interviewed were fully aware about the issue of OTA contamination in coffee, and 50% managers were just aware of the problem. (table 24).

Table 24: Awareness regarding OTA contamination in the curing works (Number of managerial/ supervisory personnel)

Place	Not aware	Aware	Fully aware	Grand Total
Chickmagalur	--	--	3	3
Kushal Nagar	--	2	--	2
Mysore	--	2	--	2
Wallayar	1	--	--	1
Grand Total	1	4	3	8

E) Characteristics of coffee samples collected during market chain survey

The characteristics of coffee samples collected during the survey at different stages (growers, local agent and at curing works for exporters), are presented in tables 25,26 & 27 for one the entire chain representing each of the three exporters.

Table 25: Characteristics of coffee samples collected from coffee chain of Exporter-A

Coffee Chain	Type of Samples Collected	Quality Parameters Tested				
		Moisture Percent (Oven Dry Method)	Moisture Percent (Moisture Meter)	Water Activity Level (aW)	OT-A Mould Infection (%)	OT-A Level (ppb)
Exporter-A, (Curing works at Hassan)	Robusta- Clean Coffee	10.75	10.60	0.696 (78.7 ^{0}F)	5.0	0.70
Exporter-A, (Curing works at Chikmagalur)	Robusta Cherry-Clean Coffee	10.14	10.00	0.635 (77.3 F)	24	BDL
	Robusta Cherry-Raw Coffee	11.54	11.90	0.421 (78.0 F)	57	0.421
Local Agent-1 (Hassan Zone)	Robusta Cherry-Raw Coffee	13.57	13.80	0.763 (80.8 ^{0}F)	100	1.31
	Arabica Parchment- Raw Coffee	13.72	14.80	0.745 (80.4 ^{0}F)	No Infection	0.293
Planter-1 (Hassan Zone)	Arabica Parchment- Raw Coffee	14.61	16.20	0.75 (81.7 ^{0}F)	No Infection	BDL
Planter-2 (Hassan Zone)	No Sample					
Planter-3 (Hassan Zone)	No Sample					
Local Agent-2, Chikmagalur Zone	No Sample					
Planter-1, Chikmagalur Zone	Robusta Cherry-Raw Coffee	13.54	13.30	0.738 (24.3 ^{0}C)	48	0.196
Planter-2, Chikmagalur Zone	Arabica Parchment- Raw Coffee	12.31	12.70	0.697 (24.3 ^{0}C)	5.0	0.196

	Arabica Cherry-Raw Coffee	14.45	NA*	0.755 (24.4 ^{0}C)	100	0.20
Planter-3, Chikmagalur Zone	No Sample					

Table 26: Characteristics of coffee samples collected from coffee chain of Exporter-B

Coffee Chain	Type of Samples Collected	Quality Parameters Tested				
		Moisture Percent (Oven Dry Method)	Moisture Percent (Moisture Meter)	Water Activity Level (aW)	OT-A Mould Infection (%)	OT-A Level (ppb)
Exporter-B (Curing works at Kerala).	Robusta Cherry Bulk - Clean Coffee	11.53	11.40	0.704 (24.4 ^{0}C)	5	1.98
	Robusta Cherry Bulk - Clean Coffee	10.30	10.0	0.644 (24.2 ^{0}C)	10	0.65
Local Agent-1, Sulthan Bathery	No Sample					
Planter-1, Sulthan Bathery	Robusta Cherry-Raw Coffee	12.90	12.40	0.718 (24.4 ^{0}C)	5	0.608
Planter-2, Sulthan Bathery	No Sample					
Planter-3, Sulthan Bathery	No Sample					
Local Agent-2, Sulthan Bathery.	Robusta Cherry –Clean Coffee	12.05	12.50	0.735 (24.0 ^{0}C)	14	0.408
	Robusta Cherry-Raw Coffee	13.30	13.3	0.744 (24.8 ^{0}C)	No Infection	BDL
Planter-1, Kalpetta	No Sample					
Planter-2, Kalpetta	Robusta Cherry-Raw Coffee	12.0	11.5	0.724 (24.5 ^{0}C)	5	BDL
Planter-3, Kalpetta	No Sample					

Local Agent-3, Kalpetta	No Sample					
Planter-1, Kalpetta	Robusta Cherry-Raw Coffee	13.8	13.1	0.781 ($24.8\ ^0C$)	5	BDL
Planter-2, Kalpetta	No Sample					
Planter-3, Kalpetta	No Sample					

Table 27: Characteristics of coffee samples collected from coffee chain of Exporter-C

Coffee Chain	Type of Samples Collected	Quality Parameters Tested				
		Moisture Percent (Oven Dry Method)	Moisture Percent (Moisture Meter)	Water Activity Level (aW)	OT-A Mould Infection (%)	OT-A Level (ppb)
Exporter-C (Curing works at Mysore)	Arabica Cherry-Clean Coffee	9.90	10.40	0.687 ($80.6\ ^0F$)	14	BDL
	Robusta- Clean Coffee	10.15	10.20	0.692 ($80.4\ ^0F$)	10	0.50
Local Agent-1, Coorg Zone	Robusta Cherry-Raw Coffee	11.61	11.50	0.698 ($79.2\ ^0F$)	33	0.50
Planter-1, Coorg Zone	Robusta Cherry-Raw Coffee	9.79	NA	0.712 ($79.3\ ^0F$)	100	0.45
Planter-2, Coorg Zone	Robusta Cherry-Raw Coffee	12.89	12.90	0.744 ($79.0\ ^0F$)	19	0.15
		11.0	10.90	0.675 ($81.8\ ^0F$)	81	0.819
Planter-3, Coorg Zone	No Sample					
Local Agent-2, Chikmagalur Zone	Arabica Parchment-Clean Coffee	9.50	9.70	0.598 ($79.2\ ^0F$)	5	BDL
	Arabica Parchment-Raw Coffee	9.80	9.80	0.587 ($77.9\ ^0F$)	5	BDL

Planter-1, Chikmagalur Zone	No Sample					
Planter-2, Chikmagalur Zone	No Sample					
Planter-3, Chikmagalur Zone	No Sample					
Local Agent-3, Chikmagalur Zone	Arabica Cherry-Raw Coffee	12.24	12.90	0.704 ($24.3\ ^{0}C$)	67	BDL
Planter-1, Chikmagalur Zone	No Sample					
Planter-2, Chikmagalur Zone	No Sample					
Planter-3, Chikmagalur Zone	No Sample					

The data on oven moisture, water activity and level of OTA in the final product through out the market chain surveyed is presented in table 28.

Table 28: Mositure content, aw and OTA levels in coffee samples collected during market chain survey

Type of coffee	Source	Oven Moisture (%)	Aw	OTA (ppb)
Arabica parchment	Grower	12.7-16.2	0.697-0.75	BDL-0.196
	Local agents	9.7-14.8	0.598-0.745	BDL-0.293
Arabica cherry	Grower	NA	0.755	0.20
	Local Agents	12.9	0.704	BDL
	Exporters	10.4	0.687	BDL
Robusta cherry	Grower	10.9-13.1	0.718-0.781	BDL-0.819
	Local Agent	11.50-13.8	0.698-0.76	0.408-1.31
	Exporter	10-11.9	0.421-0.774	BDL-1.98

The moisture and water activity levels are considered critical factors in predisposing the coffee to OT-A moulds infection. The results of measurements on coffee beans at each stage of market chain revealed that at estate level and local agent level, the average moisture content and water activity levels of all types of coffees are found to be slightly higher than prescribed levels (especially for moisture content). But at exporter level (curing works level) the moisture content as well as water activity levels were usually at prescribed levels for all types of coffee.

The data on level of Ochratoxin A in coffee shows that the coffee at different stages of market chain has very negligible levels of OTA. About one half of the samples were below the detection limit (BDL =0.2ppb). The remaining samples showed less than 1 ppb OTA level.

Conclusions:

Overall there appears to be no significant correlation between moisture, aw level and OTA at the point of sampling at estate level, local agent level and exporter level. But the scientific evidences have clearly established that mere presence of OTA moulds itself is a great risk for OTA contamination at later stages, when favourable conditions exist during storage, shipment etc. From this point of view, the moisture levels recorded both at the farm sale point and local agent collection point are a cause for worry. More over, the methods adopted by these stakeholders in testing of moisture content are not satisfactory. Added to this, lack of a mechanism to provide incentives for good quality coffees and penalty (discounts/ rejections) for poorly processed coffees is responsible for non-adoption of good manufacturing practices by the growers, especially the marginal and small growers. Similar trend can be seen at the next stages of coffee chain such as local agents, middlemen, curing works, exporters etc. As long as such a mechanism is not introduced at various stages of coffee purchase, either under a voluntary scheme or mandatory scheme, there is little chance of eliminating the risk of mould formation and OTA contamination in coffee.

Recommendations for improving quality of coffee at estate level and through out coffee market chain in India

Producing mould free coffee has become imperative to the coffee growers of the country as the export market threshold levels for mould contamination is being lowered. International quality standards for coffee have been raised to reduce the permissible limit for OTA contamination and all the producing countries are left with no alternative but to fall in line with the international standards. This calls for a comprehensive effort that spans all stages of production right from the post harvest stage up till it is exported. However, the earlier stages of the supply chain appear to be more critical while the later stages call for follow-up action of maintenance in nature. The general quality improvement depends on a collective approach between stakeholders in the commodity chain since each has responsibilities at each stage. Within a given type of stakeholders, a coffee batch may consist of a multitude of individual contributions. Some of the specific recommendations that have emerged from the market chain are presented.

1. Educate the farmers on the practices of production of mould free coffee, through training programmes and distribution of literature and make stakeholders in the coffee chain aware of the significance of the WTO agreements on food safety regulation in international trade.
2. Familiarise stakeholders in the coffee chain with the Codex General Principles of Food Hygiene and their significance to any food hygiene programme
3. Preparing package of Good Agricultural Practices (GAP) and Good Manufacturing Practices (GMP) for coffee estates and Guidelines on handling, storage, transport and shipment coffee among the local traders/agents, curing works personnel and exporters.
4. Specialised care for producing mould free coffee will require extra effort and consequently a higher cost. Incentives should be provided for the production of mould free coffee even if the market mechanism does not provide it. This will encourage the growers to adoption of GAP / GMP. The Government may introduce a system of fixing indicative prices for all

types of coffee before commencement of trading season and also indicative premium for coffees above Fair Average Quality coffees.

5. Make efforts to identify low cost but reliable moisture meters for use in field level by growers, local traders. Introduce a scheme of financial incentive for purchase of Moisture meters by all stakeholders. This single step would enable growers and local traders to determine the correct moisture content of coffee before storage, thereby preventing risk of mould formation.

6. Provide financial assistance to construct, modernise or repair drying yards and on-farm store houses for coffee, especially at estate level.

7. The high percentage distribution of marginal and small growers across all regions is the main reason for heterogeneous quality of the final produce, which the exporters are forced to blend to prepare desired lot sizes. In many coffee countries like Brazil, Kenya, Vietnam cooperatives of small growers are functioning effectively to produce of product of uniform quality. Government should actively encourage growers' cooperatives and provide incentives for establishment of community processing, drying, storage facilities for improving the overall quality of coffee from the marginal and small grower sectors.

8. Ensure compliance to quality criteria (moisture, clean smell, clean cup, permissible levels of defects etc) at the point of shipment or sale in domestic market which would ensure management of risks associated with mould contamination. This will gradually result in rewarding quality and penalising mould contamination in coffee through the market mechanism.

9. Presently the OTA analytical facilities in the country are limited with only Coffee Board's Laboratory being able to provide standard acceptable OTA analysis. Few private laboratories accredited by national and international levels have capability to do similar analysis, but there is a need to harmonise the analysis protocols of these labs with Coffee Board's laboratory.

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