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CONTAMINATION OF TEA DURING FIELD OPERATIONS

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The quality of made tea is determined by a variety of factors, such as the type of planting material (the cultivar or seedling) used, the extent of adoption of good agricultural practices (GAPs), the leaf standard achieved, the care of post harvest handling, and the standard achieved in factory operations. Poor agricultural practices, and improper factory operations, could result in the contamination of tea, which not only reduces its quality but also poses health hazards in varying degrees to the consumer. The presence of any extraneous matter in the tea is considered contamination, and this has become a barrier in the international tea trade as teas so contaminated do not conform to international standards. In addition to fetching lower prices for tea products, there is also a greater risk of losing international markets to other competitors.

The processes during which tea may be contaminated are the various field operations, leaf transport, processing, bulking, blending, and storage. Hence, these activities need to be carefully planned and executed in order to produce high-quality tea which is largely free of contamination. Of these activities, the field operations are considered the most critical as it allows the greatest potential for the contamination. Therefore, it is imperative that field operations, and leaf transportation, are correctly planned and implemented so that tea leaf is not exposed to any contaminant.

COMMON CONTAMINANTS IN MADE TEA

The followings are considered to be the commonest contaminants in made tea.

1) Sand
2) Iron filings (Fe)
3) Other materials (nylon, plastic, paper etc.)
4) Chemicals, fertilizers and pesticides
5) Heavy metals - lead (Pb), copper (Cu), mercury (Hg), cadmium (Cd) and zinc (Zn)
6) Micro-organisms (bacteria, yeast, moulds, etc.)

These contaminants can be categorized into three groups: physical, chemical and microbial contaminants. Extraneous materials, such as sand, nails, iron filings, coins, pieces of paper, plastics, etc., are considered physical contaminants. The residues of chemical constituents found in made tea (pesticides, fertilizers, heavy metals from paints, etc.) are

known as chemical contaminants, and micro-organisms such as bacteria, yeast and moulds, etc. are categorized as microbial contaminants.

Contaminants present in made tea can be identified by a series of tests undertaken at various stages of processing and marketing. For example, the commonest contaminant, sand, may be detected by the analysis of made tea for total ash content and acid-insoluble ash content. Chemical contaminants, such as lime, may be identified by testing for alkalinity of the ash. The permitted levels for these parameters are specified in the International Standard, ISO 3720.

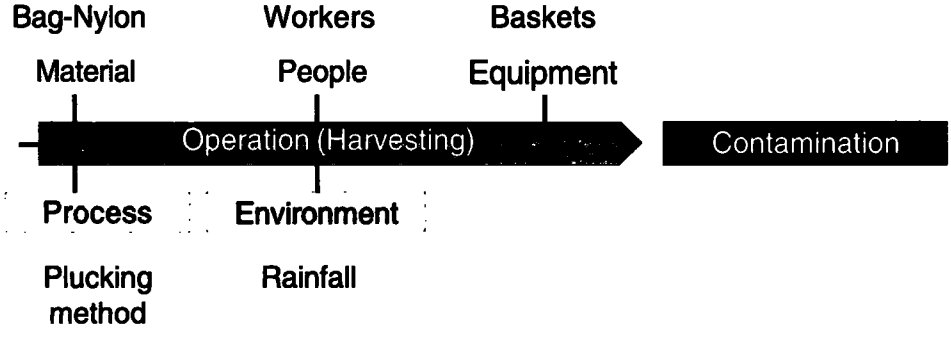
The levels of crude fibre and the extractable water in made tea (which is dependant on GAPs) are also specified in the ISO 3720 standard.

Standards or limits (Maximum Residue Levels or MRLs) for other contaminants, such as heavy metals, pesticides and microorganisms, have been set by the Food and Agricultural Organization (FAO), the European Union (EU) and certain tea importing countries. Therefore it is important that tea growers in Sri Lanka are made aware of these standards, so that they can produce teas that are competitive in the world tea market.

The following are identified as the most important field operations, miscellaneous activities and natural hazards, during which tea can be potentially contaminated.

1. Harvesting
2. Leaf collection
3. Leaf handling
4. Transportation
5. Addition of water to harvested crop
6. Application of fertilizer and foliar nutrients
7. Spraying of pesticides
8. Natural hazards (floods, etc.)

These operations involve people (pluckers, leaf collectors etc), equipments (baskets, leaf bags, vehicles etc), materials (cloth, coir, water etc), processes (plucking, leaf handling etc) and the environment (rainfall, wind etc) as depicted in the chart below.



PRE-REQUISITES FOR MINIMIZING CONTAMINATION

In order to ensure that made tea is free from contamination, it is essential that tea growers give careful consideration to the following aspects at various stages of tea cultivation and transport of leaf.

1) Knowledge, attitude and productivity of people

Field operations and leaf transport require a large number of manual workers. Therefore, the quality of the task is largely influenced by the knowledge, attitude and productivity of the workers. Lack of awareness and a negative attitude towards GAPs can lead to teas being contaminated with extraneous matter. Poor health, and lack of cleanliness of workers, could also contribute to microbial contamination.

Therefore, a positive attitude to prevent contamination must be developed through:

a) extension and awareness programmes;

b) training;

c) skill development; and

d) provision of incentives.

The provision of appropriate sanitary and health facilities will improve the sanitary standards of workers and prevent microbial contamination. Moreover, the daily norms or tasks of different field operations should be made more realistic and achievable, under varying field and environmental conditions, so that the set task can be completed efficiently. Suitable equipment and material should also be provided to workers to improve their productivity, as well as to minimize contamination in the field.

2) Harvesting and leaf collection

Leaf can be contaminated with sand, chemical residues (pesticides and fertilizers), and other extraneous material (polythene and polysacks), during harvesting and leaf collection. Presently, cane baskets are not always used for leaf collection during plucking. However, the use of empty fertilizer bags, allowing poor aeration of the leaf, and cloth sacks are very common in plucking fields. Unclean bags, or bags contaminated with sand and residues of pesticides and fertilizers, the condition of the bags (torn bags or bags in a state of deterioration), and also their storage conditions, contribute to contamination. Hence, it is important to provide suitable baskets with adequate aeration for workers engaged in harvesting and collection of leaf in the field. If bags or sacks are used, they should be of good quality, clean, and free of sand and other debris. It is always safer to avoid using empty bags that contained fertilizers or chemicals for leaf collection.

3) Leaf handling

Leaf is handled in the field during the processes of weighing, spreading and filling leaf into bags, and also during transportation. In addition to physical damage from the handling of leaf during these processes, there is also a possibility of contaminating teas with extraneous materials and with micro-organisms. Sand, and fragments of polysacks and of nylon and coir bags, are the most common contaminants that are introduced during the

handling of leaf. The spreading of leaf on a clean floor, the use of proper, good quality sacks, and careful supervision during the filling of bags, would help to minimize contamination of tea. The possibility of contamination increases when leaf and leaf bags are wet, when leaf is physically damaged, and during rush cropping periods. Hence, more attention needs to be paid to preventing contamination and preserving quality of tea leaves during rainy days and during rush cropping periods, when there is excessive leaf handling. Leaf should never be trampled on because it causes physical damage to the leaf, and can also contaminate leaf with sand and micro-organisms. Leaf bags should also never be kept on bare ground.

4) Transport of leaf

While being transported, leaf can also be contaminated with various extraneous materials, mainly sand and chemicals. Tea leaf should never, therefore, be loaded onto the floor of vehicles unless they are contained in the appropriate bags. Leaf should not also be transported together with materials such as chemicals, fertilizers, and other goods.

Vehicles should be thoroughly cleaned and washed before being used for the transportation of tea leaf. Exhaust fumes contain toxic elements, and the exposure of tea fields and plucked leaf to these emissions should be minimized.

5) Addition of water to harvested crop

Sprinkling water onto harvested tea leaves to minimize wilting, or to increase weight, should never be practised. This may contaminate tea with the silt present in water, or with micro-organisms if polluted water is used.

6) Fertilizer application

The improper use of foliar and ground fertilizers in plucking fields can lead to contamination of harvestable shoots with chemicals. Hence, tea growers should adopt proper fertilizer policies, and use recommended mixtures and rates and frequencies of fertilizers in their plucking fields. Application of ground fertilizers and foliar sprays should be done with the utmost care, leaving an adequate time period until the next harvest in order to prevent contamination of shoots. Ground fertilizers should never be deposited on the foliage or on harvestable shoots.

7) Use of pesticides

The inappropriate use of chemicals for controlling weeds, pests and diseases is one of the reasons for the contamination of tea with pesticides. Although chemicals recommended by the Tea Research Institute (TRI) are safe to use in tea lands, misuse, such as the use of rates and frequencies over and above those recommended by the TRI, incorrect application methods, the use of unsuitable spray equipment, and disregarding the PHI (that is, the pre harvest interval: the resting period required between the spraying of pesticides and an harvest), can lead to pesticide contamination of tea.

When this occurs, the residue levels of these pesticides in made tea could exceed the Maximum Residue Limits (the MRLs) set by various international organizations and tea-importing countries. Therefore, utmost care should be taken when such chemicals are used in tea fields, especially in plucking fields, in order to prevent pesticide contamination.

It is necessary that tea growers should adopt a strategy that would totally prevent any pesticide contamination of the made tea. Towards achieving this, it is imperative that TRI recommendations on the use of appropriate pesticides at appropriate rates and frequencies, be strictly adhered to; that appropriate PHIs be kept after pesticide spraying; and that spray equipment be maintained in good working order with thorough cleaning of such equipment after use. It is advisable to have separate spraying machines for foliar applications of fertilizers and of pesticides, and separate leaf sheds or areas where fertilizers and pesticides can be sorted and mixed.

The appropriate PHIs for some pesticides used in tea lands are given below.

Glyphosate (<0.05)	1 week
Glyphosate (0.5-2%)	2 weeks
Dipterex	2 weeks
Atabron	1 week
Cu Fungicide (for Blister Blight)	4 days
Systemic Fungicide (for Blister Blight)	1 week
Mimic	1 week
Fenthion	4 weeks
Morestan/Omite	2 weeks

8) Natural hazards

Natural hazards such as floods can lead to contamination of tea. When tea bushes in plucking go under water, tea leaves can be contaminated with silt and micro-organisms. In order to prevent contamination, affected tea bushes should be rested, skiffed, and later harvested lightly and selectively, until the bushes have fully recovered from the stress.

Summary

Contamination of tea (the presence of extraneous materials in tea) reduces the quality of made tea and leads to health hazards for consumers. Sand, heavy metals, chemicals, micro-organisms, and other extraneous materials such as plastics and nylon, are the commonest contaminants of tea.

Contamination in the field can occur during harvesting, leaf collection, leaf handling, transport, pesticide usage, other practices such as addition of water to harvested crop, and natural hazards such as floods. Knowledge, skill, productivity and adequate health levels on the part of workers, will all result in minimizing tea contamination.

The presence of contaminants in made tea not only reduces tea prices, but can also lead ultimately to a loss of international markets. Considering the magnitude of foreign-exchange earnings and employment opportunities generated by the tea industry, it is the responsibility of all stakeholders to prevent contamination of tea by paying maximum attention to the improvement of the various processes involved in tea cultivation and manufacture.