THE IMPLEMENTATION OF FOOD SAFETY MANAGEMENT SYSTEM (HAZARD ANALYSIS CRITICAL CONTROL POINT- HACCP) IN MORAGALLA TEA PROCESSING CENTER

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DECLARATION

I carried out the project work at Moragalla Tea Processing center, which is described in theses and Faculty of Applied Sciences under the supervision of Mr. Kumarasinghe Mr.Gajamange and Mrs. Priyadarshanie. A report of this has not submitted to any other university for another degree.

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Affectionally dedicated to my ever loving parents, Brothers, and Teachers.

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ABSTRACT

Tea industry of a Sri Lanka generates lot of foreign income and all of the produces are exported worldwide and the country is reputed for its high quality tea. However safety of the product is being dramatically decreased since last decades. Therefore health risks may associate with black tea. HACCP is a food safety management system that can prevent or minimize or eliminate risk and bring them down to acceptable levels so that they do not harm the consumers. HACCP is used in much food industry to prove such products are not harmful to the consumer. However if any tea producer is willing to export black tea to European countries this will be permitted or accepted with HACCP certificate. The HACCP certificate for tea is compulsory with effect from 2007 by European Union.

The project was carried out to in order to implement an HACCP system in Moragalla Tea Processing center with proper establishment of supportive networks such as GMP and GHP, supplier control etc. Moragalla Tea Processing Center belongs to the low country tea productions region and manufactures black tea in the orthodox process. The entire manufacturing process was studied and a detailed flow chart was prepared. The existing shortcomings were identified by means of worker survey. As an initial corrective measure the 5 S systems was applied to selected sections of the factory along with a personal hygiene programme. Maintenance and cleaning programme were adapted to the whole factory as a prerequisite for a Good manufacturing Practices (GMP) programme. Sanitary Standard operations practices (SSOP) and Standards Operation practices (SOP) were carried out as the other prerequisite programmes.

CCP's were identified in green leaf, drier temperature, moisture level, and metal detections of dispatch product. Those critical control point (CCP) can be controlled through the corrective actions and verification procedures. However supplier control is difficult task because more than hundred bought leaf suppliers supply green leaf to the factory. But suppliers could be acknowledged and accessed according to the factory standards.

All CCPs can be controlled with adhering to the GMP and GAP and using corrective actions of HACCP principle. After implementation of HACCP it should be maintained otherwise this would breakdown the system. If the HAACP system is properly functioning that will not allow the generation health risks in tea industry, because, HACCP is a universal risk prevention method.

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LIST OF ABBREVATIONS

CTC - Crush, Tear, and curl.

CCP - Critical control point.

CCPS - critical control points.

CFU - Colony forming unit.

CAC- Codex Alimentarius Commission.

EMS-Environmental Management System.

EFK-Electrical Fly Killer.

FSMS-Food Safety Management system.

FMEA-Failure mode and effect analysis.

FSR- Food quality, Food safety and related risk.

GMP-Good manufacturing practices.

GHP- Good hygiene practices.

GAP-Good agricultural Practices.

GLP-Good Laboratory practices.

HACCP-Hazard analysis critical control points.

HAZOP-Hazard operatability.

HPC- Helerophylic Plate Count.

ISO- International Organization for Standardization.

MOS-Microorganism.

MPN-Most Probable Member.

NASA-National Aeronautics and Space Administration.

NACMC-National advisory Committee for microbiological criteria.

PRP-Prerequisites Program.

PPM-Production, processing and marketing.

QA-Quality assurances.

SSOP-Sanitation Standard operating procedure.

SQC-Statistical Quality Control.

SLSL-Sri Lanka Standards institute.

TRI-Tea research institute.

TASL-Tea Association of Sri Lanka.

TR- Thearubigins.

TF- Theaflavins.

TPC – Total plate Count.

TQM- Total quality management.

USA- United Stated of America.

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CHAPTER-1

1. INTRODUCTION

1.1 Tea processing center:

Talawakelle Tea Estates Ltd, sub agent of Haylyes groups, manages Moragalla tea processing center, located in southern region in Sri Lanka. The Tea-Processing Center is located in 16 Km away from Galle town, and easily reached through the rout of Galle-Akuressa. Daily crops amount of the Moragalla tea factory around 12000 Kg, which is vary with brought leaf supplier amount because it is totally depend on the suppliers. Average made tea production of factory is around 48000 Kg / Month. These made black tea are sent to the Colombo auction to wholesale for 4, 5 times per months. It is a famous factory under Talawakelle Tea estates limited.

Tea industry of a Sri Lanka generates lot of foreign income and all of the produce are exported worldwide and the country is reputed for its high quality tea. How ever safety of the product is being dramatically decreased since last decade. Therefore health risks may associate with black tea. HACCP (hazard analysis critical control point) is a food safety management system that can prevent or minimize or eliminate risk and bring them down to acceptable levels so that they do not harm the consumers. HACCP is used many food industry to prove such products are not harmful to the consumer. However if any tea producer is willing to export black tea to European countries this will be permitted or accepted with HACCP certificate. The HACCP certificate for tea is compulsory with effect from 2007 by European Union.

Talawakelle estate limited has good commitment to quality of black tea that having pioneered the food factory concept. They already have ISO, HACCP certified several factories and will increase number of factory those are HACCP certified (Lake House, Newspaper Ceylon Ltd, 2002). Adhering to these international standards will reinforce their long term commitment to wards further enhancing quality, product, safety, factory hygiene, quality of work life of employees and more importantly buyer sanitations (Talawakelle Tea Estates Ltd, Annual report 2005).

However Moragalla tea factory doesn't have any ISO, SLS or HACCP certifications, if it is managed by TTL, but they are ready to get HACCP certification in this year. Currently they don't have supportive network (Prerequisite program), but currently established prerequisite program as on going program. This project is completely preformed to established food safety management system in Moragalla tea-processing center to reach international standards.

1.2. Objectives

- To Implement the GMP (Good Manufacturing practices) and GHP (Good Hygienic practices) in Moragalla tea factory.
- To implement Prerequisite program as supportive process network for HACCP. Implementing.
- Application food safety management system (Hazard Analysis Critical Control Point) to prevent hazards and their likely occurrences throughout the food chain and Increase food security consumer protection.

1.2.1 Specific Objectives:

- To implement five –S in rolling & fermentations (Selected) area.
- To increase People satisfactions on their working environment.
- To create clean and safe work place.

CHAPTER-2

2. LITERATURE REVIEW

2. Nature of tea

The tea plant is a flowering evergreen shrub. It belongs to the Camellia family and the correct botanical name is *Camellia sinensis*. There are two subspecies:

1.*Camelia sinensis* (originally from China)
2. *Camelia assamica* (originally from Assam).

They are also called *Tea sinensis* or *Tea assamica*. Then china type of a tea plant with small semi-erect leaves is thought to have indigenous to frosted environments north of the Himalayas (Hajra, 2001).

Ceylon Tea industry

Ceylon tea industry has done well last year to produce and export record volumes. National productions of black tea 317.1 million kg in 2005.which was 9.1 million Kg more than that made the year before and also pervious 310 million kg was in 2002.The island not only exported its highest ever volume of tea in 2005,for third successive year, but also shipped more value added teas. Total tea exports reached 38.8 million kg last year compared with 300 million Kg in year of 2004 (Talawkella Tea Estates Ltd, 2005).

2.1 Plucking

Plucking is the most important harvesting operations and intricate to pruning and tipping. In tea tender typical portions of the shoots comprise the terminal bud, the internodes and two or three expanding leave immediately below it. Which to gather constitute the crop. The flush is removed at periodic intervals is called plucking. Plucking provides stimulus and ensure regenerations of shoots if a stead supply of assimilates to growing bud is ensured by the retention of adequate photosynthetic machinery of the bush (Hajra, 2001).

It has been worked out in past that harvesting the first two leaves to gather with the unforled bud. Figure (1.3) is the best compromise between the conflicting demand of the high yield and high quality (Willson, 1992) for plucking. It is convenient of the to have a smooth surface at the top of the bush

Figure 2.1: Standard leaf flush, which TRI recommended.

2.2 Plucking standard of Sri Lanka

Green leaf is starting materials for processing therefore it is a vital to pluck good leaf to ensures the productions of good quality tea .Good leaf is usually defined as tender leaf, since tender leaf contains more poly phenols, which undergo oxidations during processing and also result in compounds .Which contribute to the final quality of made tea .It is well established that maturity of leaf (Mohamed, et.al, 2003). In the process of tea leaf ,which comes from divers sources ,variations ,difficulties and problem are bound to occur of these poor leaf standard could be consider as major obstacle in producing good quality tea

Most of the suppliers in Sri Lanka one bud and three leaves are plucked. However plucking Standards which TRI recommended one bud and two leaf (2, and 1/2) but fine plucking is done in order to produced very high quality and highest value tea, that consist bud and one lea(Moder,2003).

2 .2.1 Impotency of plucking and leaf handling

The quality of the manufactured leaf depend upon the delicacy and skill with which plunking is perfumed. Only the bud and first second leaves are usually taken, the larger and coarser leaves being left on the bush. These leaves should be delivered to the factory as soon as possible after plucking and not allowed to remain in the plucker's gunny bags, or basket for any length of time, as heating may take place with resultant lowering in quality of the finished product (Mulky, and Sharma, 1993).

2.2.2 Basic quality requirement

The quality of our cup depends on the quality and condition of the fresh leaf as it reaches the factory (Moder, 2003), only if the right leaves have been plucked, if the extraneous matter has been removed from them, if they were transported quickly and if they were not bruised, can manufacture have the best results

2.3 Major method of black Tea Processing

Tea manufacturing is normally carried out in two ways,

(i) CTC and (ii) orthodox.

CTC refers to the Crush, Tear & Curl process where the withered green leaves are passed in-between two rollers rotating in opposite directions. There is complete maceration of the leaves and the resulting powdery material is referred to as "cut dhool". Enzymatic action is maximum in the CTC type of manufacture.

In orthodox type of manufacturer, the withered leaves are rolled on specially designed an orthodox roller, which twists and crushes the leaves thereby rupturing the cells. Black tea manufacturing technology essentially involves disruption of the cellular integrity of tea shoots, thereby enabling the mixing up of substrates (polyphenol) and the enzymes (polyphenol oxidases). This results in the initiation of a series of biochemical and chemical reactions with the uptake of atmospheric oxygen and formation of oxidized polyphenolic compounds that are characteristic of tea along with volatile flavor compounds that impart characteristic aroma to tea (Moder, 2003).

2. 4 Basic Steps of black tea manufacturing

- Withering
- Rolling
- Roll braking and sifting
- Fermentations
- Drying
- Grading and sorting
- Bulking
- Packing and dispatch

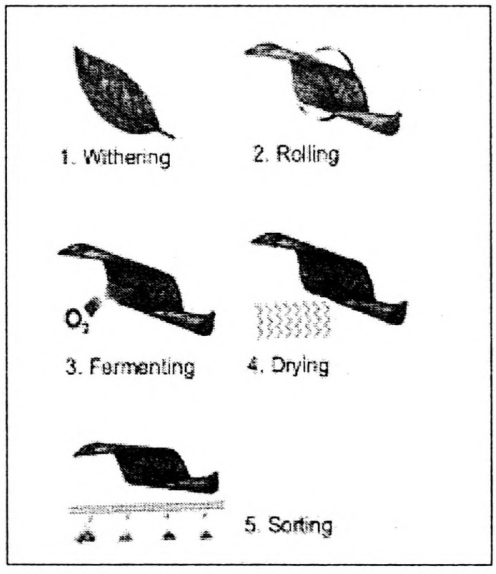


Fig. 2.2 Physical changes of leaf during processing.

2.4.1Withering

Withering is the first and fore most step involved in tea manufacture. The evaporation of moisture in the green leaf is brought about by blowing or moving air over the leaf in the withering trough. Whenever the hygrometric difference is below 3° C, hot air is mixed in

suitable proportion or heat energy is supplied to increase the hygrometric difference with the concomitant rise in the dry bulb temperature of air. But the dry bulb temperature of air after mixing should not exceed 35°C (Jayathunge, 1987).

2.4.2 Bio chemical changes in black tea processing

2.4.2.1 Withering

Withering brings about physical and chemical changes in shoots to produced quality, apart from conditioning the flush for rolling reducing tugor, weight and volume. The process is generally achieved either by thinly spreading the flush on mats or thicker layer in trough for 12 hours depending on the conditions of the leaves. During this period, the moisture concept of the leaf drops to between 60-(Soft wither) and 50% (hard wither). The physical part of withering can be achieved quickly by passing a blast of hot air (35^0C) trough the levels but this may adversely affect quality because of the inhibition of full biochemical changes (Dev choudhury and bajaj, 1980).

- **Breakdown of protein into amino acid:**
  Peptidase present in tea shoots causes an increase in free amino acid levels, particularly hose of aspertics acid, glutamic acid, serine, glutamine, alanine, tyrosine, phenylalanine, Valine etc. Total losses of protein amount to about 1.2%, the break down of protein is significance because its influence on tea quality (Banerjee, 1996).
- **Caffeine:** Withering cause an increasing caffeine content but the quantity of increase is dependent upon temperature and nature of cultivars. This biosynthesis of caffeine involves transfer to methyl group from S-adenosyl methionine to methyl xanthine to from caffeine.
- **Sugar:** Loss of sugar during withering amount about 4% and those getting reduced glucose six phospate, glucose-1- phosphate. A part of sugar is also metabolized in to amino acid
- **Organic acid:** Apart of sugar metabolized in organic acid causing an increase in fumaric acid, citric acid, succsinic acid, and oxalic acid. However, there is a decrease in mallic acid, which possibly happens due to its utilizations for synthesis of amino acid.
- **Poly phenols**: poly phenol oxidase activities generally increase, but the activity is dependent on temperature and moisture of the stored shoots. The increase poly phenol activity also helps in fermenting the leaves, which is the next operative stage in tea processing (Takeo, 1973).

- **Chlorophyll**: Withering causes degradations of chlorophyll to the extent of about 15%. Break down of chlorophyll affects appearance of made tea, a part of the degraded chlorophyll produces chlorophyllied by the action of the chlorophyllase present in the shoots (Banerjee, 1996).
- **Volatile compound:** some amino acid derived aldehydes like phenyl acetaldehyde, methyl butanol and n-hexanol increase during withering. This a part Cis-2-. pentnol, cis-3 hexanal, trance-2-linalool oxide, nerol, geraniol, 2-. phenyl ethanol and phenyl methanol markedly increase, during withering, but carotenoids decrease(Moder,2003).

The mechanical damaged during withering also release lipid degrading enzymes which attack lipoprotein membrane structures and stored lipids to release fatty acids. Thus four major classes, namely phosphatidyl choline, monoglactosyl diglyceride, diglactocyl glyceride and phoshatdyl ethanolamine partially decline during withering. The principal fatty acids (linolenic, linoleic and palmaric acids) released form ,these lipids also decrease during withering (Banerjee, 1996) although not bio chemical phenomenon, permeability of. cell membrane efficient mixing of reactants during fermentations (Sanderson,1964), cell permeability may also influence the formation of aroma components.

2.4.3 Rolling

The rolling is to macerate the leaf so that the enzymes and their substrates get intimately mixed up this is achieved mechanically either by the use of an orthodox roller, rotorvane or by CTC machines. For optimizing this process it is often essential to pre- conditioning the withered leaf by rolling it for about 10-15 minutes without pressures. This treatment also allows maximal availability of polyphenol oxidase during fermentation, as the enzyme is located in the leaf epidermal cell (Wikramasinghe, 1974). This step facilitates mixing up of cell constituents viz., enzymes and substrate, thereby starting fermentation, in orthodox only internal injury is imparted due to rolling. Enzymic oxidation of the catechins (poly phenols) begins at this stage. Rolling is rupturing the cell –wall thereby enabling the production of the enzymes. Following changes may occur during rolling,

- Leaf is twisted and simultaneously broker up, twisting, or, cutting, macerations.
- Produced small leaf particles or dhools.
- Broken up pieces of leaf with juices dripped upon their surfaces.
- Temperature rise due to heat generations.
- Ensure temperature below 95 ^{0}F, to void unstable chemical & enzyme reaction.

Other than these physical changes no prominent biochemical changes occur during rolling. Only increases the availability of polyphenol activity due to the rupture of cell wall.

2.4.4. Roll braking and shifting

These two steps are involved mainly for the orthodox type of manufacture. On discharge from the roller the leaf mass is more or less compressed into lumps. These are broken up in the sifting process by the machine, which usually combines the operation of roll-breaker and sifter. The roll-breaker and green-leaf sifter in the first instance cools the leaf; secondly it aerates the mass, and thirdly by sieving out particles.

2.4.5 Fermentations

Fermentation is process of oxidations that simple substances convert in to complex characteristics substance by endogenous enzyme. Enzymatic oxidation is the main step in the process of fermentation though a number of chemical reactions occur. Polyphenol oxidase plays key role in tea fermentation. During this stage, the polyphenols are acted upon by the enzymes polyphenol oxidase (PPO) and peroxidase (PO) resulting in the production of theaflavins (TF), thearubigins (TR) and highly polymerized substances (HPS), the main liquor constituents of black tea.

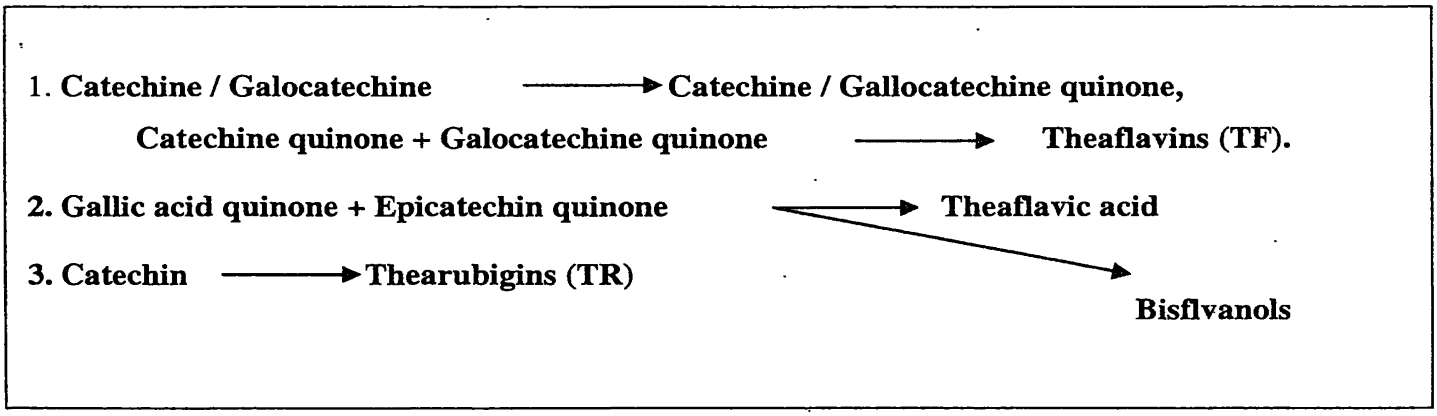


Fig.2.3- Synthesis of TR and TF

Theaflavins (TF's) are orange-red substance, which contribute significantly to the brickness, brightness colour and strength of tea brew (Banerjee, 1993). Thearubigins (TR's) are chemically complex, mixture of flavonoide derivatives. They are red browning in colour and affect to the colour strength and briskness of the tea brew.

2.4.5.1 Chemical structure

During this stage, the leaf changes colour and turns into a dark coppery tone. Typical aroma develops at this stage. Formulation of volatile flavour constitute from two paths by oxidations of flavonols are strong oxidizing. The ideal conditions for fermentation agent they cause for oxidizing of amino acid in to the aldehydes.

As an example

Phenyls acetaldehyde ⟶ Acetaldehyde, Isoacetaldehydes

Other paths of flavor development are direct biosynthesis. Volatile compound are synthesised via major two biosynthesis paths. Acetate biosynthesis pathway leads to the formations of lenolenic acid, which is, converted to Trans –2- hexanal. Leusine pathway minimizes excess formation of acetone. The carotenoids and fatty acids levels decrease due to the conversion of carotenoids volatile compounds.

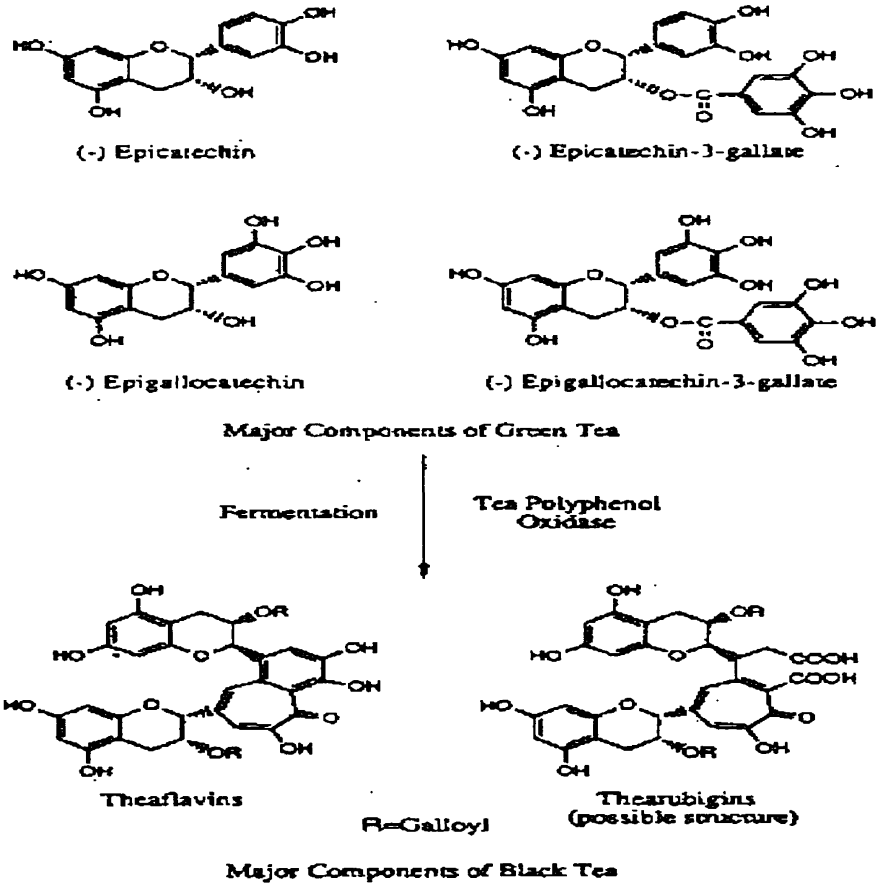


Fig. 2.4 Chemical structure of TR and TF

Table.2.1 Optimum conditions for fermentations

Dhools temperature	<30°C
Dhools	Moisture: ~55%
PH	4.5 to 5.0
Relative humidity	Above 90%

2.4.6 Drying / Firing

It reduces the moisture content and increases the shelf life of black tea. The dhool is dried to final moisture content of 3%. Modern innovations on the drier are the hot-feed drier, where hot air is supplied separately to the feeder to arrest fermentation immediately as the dhool is fed. After firing, the tea is spread out to cool and then temporarily stored to a wait sorting.

2.4.7 Grading and sorting

Grading is carried out on mechanically oscillated sieves, which fitted with meshes of appropriate size. After processing, tealeaves are sorted into two major categories as unbroken and broken. Unbroken teas have relatively large and intact leaves. We refer to these teas as "full-leaf" or "whole-leaf" teas. Broken teas are a step below full-leaf teas. The leaves have become fragmented, torn, or broken into pieces during the manufacturing process.

The common grades of orthodox tea are as follows. Table 2.2 is showed different tea grade in Orthodox tea manufacturing (SGS-TASL, 2003).different grads are short out during the sifting step which are coming under Small, Medium, and Large dholes during roll breaking steps

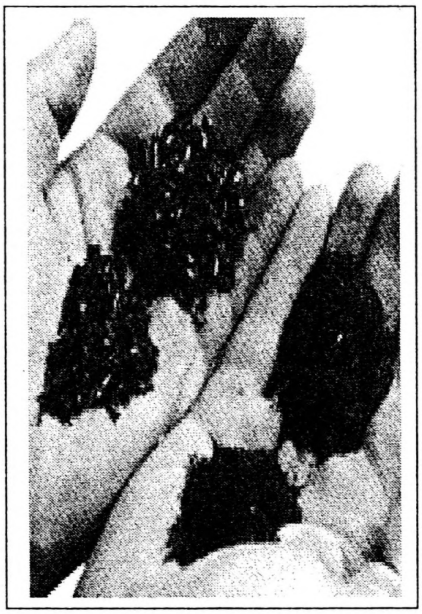


Fig.2.5 Different tea grades

2.4.8 Packing

Teas are packed in airtight containers in order to prevent absorption of moisture, which is one of the main causes for loss of flavour during storage. Packing chests are usually constructed of plywood, lined with aluminum foil and paper, and sealed with the same material. Corrugated cardboard boxes lined with aluminum foil and paper sacks lined with plastic are also employed. Finished grades are stored in airtight bins until a sufficient quantity has been accumulated to dispatch.

Table 2.2 The common black tea grades of orthodox manufacturing (SGS-TASL, 2003).

Tea grade	Descriptions
BOP	Well made neat leaf of medium size without excessive stalk or fiber. there should not be any fine particles which are not true to grade
FBOP	Smaller /shorter than BOP the presence of tips, buts lager than FBOPF1
PEKOE	Shortly, twisted, or semi curly leaf of large size of any elevations
FBOPF	Similar or size to BOP,BOPF and must contains tips
FBOP Ex Sp	Small leaf and must have an attractive shoe of golden or silver tips with little black leaf
OPA	Long bold leaf tea with faire twist
OP	Long wiry, well or partly twisted
DUST	Smaller than BOPF, even, well-made and reasonably clean.
SILVER TIPS	Long tippy leaf, Silver in colour, with hardly any black leaf

2.4.9. Is tea good for your health?

Yes. And it tastes good too. Tea contains a number of compounds including amino acids, minerals, caffeine, and polyphenols. A growing body of research indicates that the tannin in tea are naturally occurring flavonoids (Food and drug administration, 2001), which have strong antioxidant properties. There is mounting evidence that suggests that antioxidant-rich foods can play a role in reducing the risk of certain cancers, heart disease and stroke.

Pharmaceutical properties of black tea

- Strengthens immune system.
- Powerful germicide.
- Combats heart diseases.
- Reduces "bad" cholesterol.
- Is an anti carcinogenic.
- Improves oral health.
- Is an effective digestive
- Stimulates central nervous system such as better concentration, less reaction time etc.
- Is a smooth muscle relaxant.
- Influences aging process and improve longevity.
- Can be used as slimming diet

2.4 The Concept of QSR in the context of Tea Commodity

Food quality, food safety and related risk (QSR) in business management are a vast subject area. To understand and analyze it fully would require a discussion of the complete chain of steps in tea production, through primary agriculture, primary, secondary and tertiary processing, packaging, storage and, finally, consumption. Production, processing and marketing (PPM) play an increasingly important part in our experience of QSR. In many ways the story of tea industry is one of the great progress and success. However, the industry is partly a victim of its own success the consumer has come to expect and demand quality and value to improve constantly and at the same time is increasingly intolerant of the failures in either in safety (or) quality. Therefore, the industry must continue to harness good management of science & technology to continue the journey towards zero defect products, which command still greater value, safety and quality in global trade to minimize risk.

2.5.1 Definition of Risk

Risk is an estimate of the probability and severity of the adverse health effects in populations, which are exposed, to hazards in consumable food. Risk can be categorized in to few groups (Bonell, 1994) based on the hazards characteristics, as follows:

- Category-VI: A special category that applies to non-soiled sterile products designated and intended for consumptions by at risk populations. Example- Infant the age, the infirm or immunocompromised individuals, all six hazards characteristic must be considered.
- Category V: Food product subjected to five of the hazards characteristics.
- Category IV: food product subjected four of the hazards characteristics.
- Category III: food product subjected three of the hazards characteristics.
- Category II: food product subjected two of the hazards characteristics.
- Category I: food product subjected one of the hazards characteristics.
- Category 0: food product doesn't subject to the any hazards characteristics.

The food can be assigned to risk category (Crosland, 1995), in elevating hazards that can ranking according to the characteristics as revised by national advisory committee for microbiological criteria (NACMC) for food subcommittee on HACCP 1998 as follows.

Hazard –A:

Deals with the special at risk populations .It was felt important to flag , non-sterile food products designated and intended for consumption by in the infants, the aged .infirm or immunocompromised individuals.

Hazards –B:

The product contains sensitive ingredient .Those ingredient that historically have been known to harbour pathogens or other hazards such as chemical or adulterants.

Hazards –C:

The process does not contain a controlled processing step that effectively destroys or excludes harmful microorganism.

Hazards- D: The product is subjected to recontaminations after processing before packing.

Hazards –E: The product is subject to potential for abusive handling in distribution or in consumer handling that could render the product harmful when consumed.

Hazards F:

There is no terminal heat process after packing or when cooked in the home.

2.5.2 Issues Related to (QSR) in the Tea Sector

QSR is not limited to agro-microbiological safety. It also includes a discussion of the organoleptic quality, food-borne infection, pesticide-residues and undesirable physical Contaminants. Organoleptic quality has proper proportion of TF/TR polyphenols components as well as does the tea cup-quality taste good. Tea safety risk analysis is an emerging discipline, and the methodological basis for assessing and managing QSR in tea is still in developing phase. It is important to recognize the difference between *"hazard" & "risk"*. Hazard may be a biological, chemical or physical containment or condition of food, which has the potential to cause harm. Understanding the association between a reduction in hazards, associated with tea and the reduction in the risk to consumers of adverse health effect is of particular importance in development of appropriate QSR in tea.

For example, as an HACCP expert while assessing the design of a tea-processing unit it is important to ask if it is possible to manufacture tea safely. Equipment should be designed to minimize any cross contamination risk. Alternatively, we need to assess if equipment has any dead areas, is difficult to clean (or) microbiological build-up area at the time of design.

2.6 What is the HACCP

The HACCP system, which is science based and systematic, identifies specific hazards and measures for their control to ensure the safety of food. HACCP is a tool to assess hazards and establish control systems that focus on prevention rather than relying mainly on end product testing. Any HACCP system is capable of accommodating change, such as advances in equipment design, processing procedures or technological developments. HACCP can be applied throughout the food chain from primary production to final consumption and its

implementation should be guided by scientific evidence of risks to human health. As well as enhancing food safety, implementation of HACCP can provide other significant benefits. In addition, the application of HACCP systems can aid inspections by regulatory authorities and promote international trade by increasing confidence in food safety.

2.6.1 Origin of HACCP

HACCP was developed originally as a microbial safety system in the early days of the US manned space programme, as it was vital to ensure the safety of food for the astronauts. At that time, most food safety and quality system were based on end –product testing, but it was realized that this could only fully assure safe products through testing 100% of the product, a method which obviously could not have worked as the product would have been used up. Instead it become clear that preventive system was required which would give a high level of food safety assurance, and the HACCP system was borne.

The Pillsbury Company working alongside NASA and the USA army laboratories at Natick pioneered the original system. It was based on the engineering system, failure, mode and effect Analysis (FMEA), which looks at what could potentially go warning at each stage in an operation together with possible causes and the likely effect. Effective controls mechanisms are then put in place to ensure that potential failure are prevented from occurring. Like FMEA, HACCP looks for hazards or what could go wrong but in the product safety sense. Controls are then implemented to ensure that a product is safe and cannot cause harm to the consumer (Mortimore And Wallace, 1998).

2.6.2 The Concept of HACCP

HACCP is an abbreviation for Hazard Analysis Critical Control Point. It is the most effective management system of maximizing product safety and cost effective system. It targets system to critical areas of processing and reducing the risk of manufacturing and selling unsafe products. Critical control points (CCP) are the steps in manufacture where control is essential to guarantee that potential hazards do not become manifest as actual Hazards. A CCP is a location, a practice, a procedure or a process, which, if not controlled, could result in an unacceptable safety risk in agro-commodity trade.

2.6.3 Principles of the HACCP System

The HACCP system consists of the following seven principles, which outline how to establish, implement and maintain a HACCP plan for the operation in tea sector.

2.6.3.1 Principle 1:

Conduct a hazard analysis. Prepare a list of steps in the process where significant hazards occur and describe the preventative measures.

Identify the potential hazard(s) associated with food production at all stages, from growth, processing manufacture and distribution, until the point of consumption. Assess the likelihood of occurrence of the hazard(s) and identify preventative measures for their control. A hazard is an unacceptable contamination of a biological, chemical or physical nature and /or survival or multiplication of microorganisms of concern for food safety, and/or unacceptable production or persistence in foods of toxins or other undesirable products of microbiological metabolism. Biological hazards include pathogenic microbes (parasites, bacteria and viruses) and toxigenic plants and animals. Chemical hazards include, among others, pesticides, cleaning compounds, antibiotics, heavy metals, and additives such as sulfites etc.

Physical hazards include objects - such as metal fragments, glass and stones, that may cut the mouth, break teeth, cause choking or perforate the alimentary tract.

Control measures are those actions and activities that can be used to eliminate hazards or reduce their impact or occurrence to acceptable levels. More than one measure may be required to control a specific hazard and more than one hazard may be controlled by a specified measure. No attempt is made at this step to establish CCP.

2.6.3.2 Principle 2:

Determine the Critical Control Points (CCPs) in the process.

Determine the points / procedures /operational steps that can be controlled to eliminate the hazard(s) or minimize its likelihood of occurrence Critical Control Point (CCP).

A step means any stage of food production and / or manufacture including raw materials their receipt and /or production, Harvesting transport, Formulation processing, Storage, etc.

After hazards have been identified, a CCP decision tree may be used to determine whether a step is a CCP for the identified hazard. A model HACCP decision tree for establishing CCP is given in Appendix I. Application of the model decision tree may differ slightly, depending on whether the operation is for production, processing and manufacturing, storage, distribution or other sectors.

All hazards, which may be reasonably expected to occur, or to be introduced at each step, should be considered. If a hazard has been identified for which no control

measure exists, the product or process should be modified so that the hazard is eliminated or reduced to acceptable or minimal levels.

2.6.3.3 Principle 3:

Establish Critical Limit(s) for preventative measures associated with each identified CCP.

Establish critical limit(s) that must be met to ensure the CCP is under control. Critical limits must be specified for each control measure at each CCP. The critical limits describe the difference between unsafe products at the CCPs. They must involve the measurable parameter and may also known as the absolute tolerance or safety limit for the CCP In some cases, more than one critical limit will be specified at a particular CCP.

Criteria often used include temperature, time moisture level, pH, water activity, available chlorine, and sensory parameters such as visual appearance and texture. Critical limits may be derived from a variety of sources such as regulatory standards or guidelines, literature surveys, experimental studies and /or expert advice.

2.6.3.4 Principle 4:

Establish CCP monitoring requirements. Establish procedures from the results of monitoring to adjust the process and maintain control.

Establish a system to monitor control of the CCP by scheduled testing or observations. Monitoring is the periodic measurement or observation at a CCP to determine whether a critical limit or target level has been met. The monitoring procedure must be able to detect loss of control at the CCP. This will involve specifying monitoring actions along with monitoring frequency and responsibility. In additions, procedures will need to be established to adjust the process and maintain control according to monitoring results.

2.6.3.5 *Principle 5:*

Establish corrective actions to be taken when monitoring indicates, a deviation from an established critical limit (That a particular CCP is not under control).

Establish the corrective action to be taken when monitoring indicates that a particular CCP is not under control. Corrective actions are those actions to be taken either when, monitoring results show that a CCP has deviated from its specified critical limit or target level, or, preferably, when monitoring results indicate a trend towards loss of control. In the latter case, action may be taken to adjust the process

and maintain control before the deviation leads to a loss of control and hence to a safety hazard.

Disposition action needs to be taken with food that has been produced during the time period that the CCP was out of control. Both corrective actions and disposition actions should be documented in the HACCP record keeping. Responsibility for documenting these actions must be clearly assigned.

2.6.3.6 Principle 6:

Establish procedures for verification to confirm that the HACCP system is working effectively.

Verification procedure must be developed to maintain the HACCP system and ensure that it continuously work effectively. Monitoring and auditing methods, procedures and tests including random sampling and analysis can be used for this purpose.

2.6.3.7 Principle 7:

Establish documentation concerning all procedures and records appropriate to these principles and their application.

Record must be kept to demonstrate they the HACCP system is operating under control and that appropriate corrective action has been taken evidence for any deviations from the critical limits. This will provide evidence of safe product manufacture.

2.6.4: Benefit of HACCP

There are numerous benefits for the food industry while applying HACCP system as a management tool for food safety control. Some key benefits are as follows.

- The HACCP approach is a systematic approach which can be applied to all aspects of food safety, including biological, chemical and physical hazards, to all stages of the food chain, including raw materials, growth, harvesting, purchase, production, distribution, and storage to final product use.
- HACCP system provides scientifically sound bases for demonstrating that all reasonable protections have been taken to prevent a hazard from reaching the consumer.
- The HACCP approach shifts emphasis from statistically unreliable end product testing which is often retrospective to a prevention-oriented approach for the production of safe food products.

- Application of the HACCP concept is a cost-effective method of assuring food safety and preventing food borne disease and injuries.
- HACCP system focus resources on those parts of the process critical for assuring safe products HACCP system can reduce product losses due to spoilage. HACCP system encourages confidence in the safety of food products and thus promotes confidence in food trade and stability of food businesses.
- HACCP system can facilitate the design and construction of new food processing facilities and equipment by predicting potential hazards and suggesting control measures. Principles HACCP are a system, which identifies specific hazard(s), and preventative measures for their control.

2.6.5 Basic requirement of HACCP

2.6.5.1 Link with prerequisite program

HACCP is a foundation for product safety management and in practice, links with many other management systems, as illustrated in figure 2.4.2.1 many of these systems could be called pre-requirement or prerequisite for HACCP as they are already known in some countries. Prerequisite is the term used to describe system that must be in place in order to support the HACCP system. The name perquisite applies because these are normally system in place before the HACCP plan is developed. Prerequisite are normally systems in their own right, such as supplier quality assurance, good manufacturing practices, good hygiene practices, and good laboratory practices

Prerequisite programmes are defined as the universal procedures used to control the conditions in the food plant environment, which contribute to the overall safety of the products; documented prerequisite programme as the foundation of food safety management (Mortimore and Wallace, 1998). HACCP is not a stand-alone programme but is part of a larger control programme; implementation of HACCP relies on adherence to prerequisite programmes. Prerequisite programme must be developed, implemented and documented. Prerequisite programmes include Good Manufacturing Practices (GMP) and other programmes as given below.

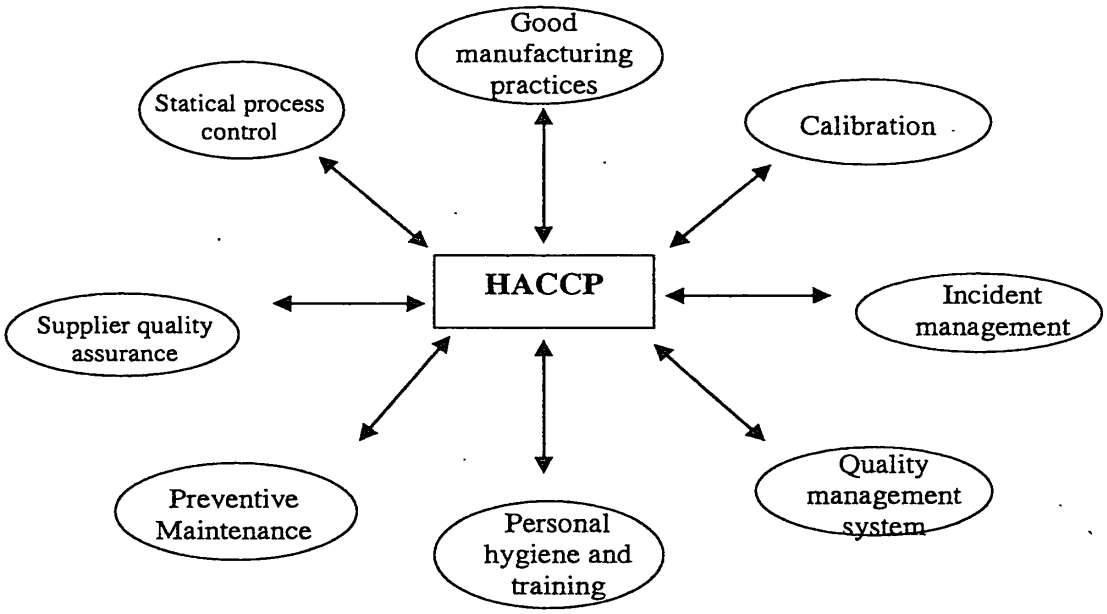


Fig. 2.6 The HACCP support network (Source: Mortimore and Wallace, 1998).

2.6.6 Good manufacturing practices:

2.6.6.1 Introduction

GMP is a guideline scientifically worked out ton prevents hazards. It is based on industrial standards as well as on regulations. Regulations for GMP were first published by the FDA in the Federal Register (FR) in 1967,and later with revisions a code of GMPs was established in 1969.Now the FDA is expanding GMPs to ultimately include all major processed foods are being proposed and published in federal resistor for ultimate public approval and implementations (Minor, 1983)

2.6.6.2 Elements of GMP

The GMP rules contain the general conditions and requirement for the specific sector. GMP in the food industry is based on to closely related and complementary elements: Effective manufacturing activities, controlled process and effective control of food quality .As a part of pre requisite program, the GMP related elements are, safe and hygiene of the building premises, Raw material control, Processing and technology, personal conditions, Process control, Statically process control, Distribution of raw material and finished product. Equipment maintain& cleaning etc

2.6.6.3 Good hygiene practices (GHP)

Good hygienic practices is a system of preventive hygiene hazards and for assuring the consistent fulfillment of the requirements of a clean and unsoiled productions in all meanings, GHP is the consequent implementations of requirement of cleanliness .In case of foodstuff the occurrence of pathogen and spoiling micro organism in additions to the chemical and physical contaminations shall be taken in to considerations.

It is essential to be matters that affect their multiplications and reductions. GHP activities can carry out in your organizations as follows to assurance safety of the product.

- Define personal hygiene assessment & record keeping,
- Cleaning schedule with instruction about usage of cleaning compound and method of cleaning.
- Pest consol method and disinfection.
- Design plant and equipment in hygienic manner.
- Process separations according to the nature.
- Minimize cross contaminations through out the process.
- Raw material, Product, safe handling and storage.

2.7 Concept of Japanese 5-S

This again is a Japanese concept of house keeping the surroundings clean and ensuring proper house keeping and constant review. The 5-S system is a series of activities designed to improve workplace organization and standardization. These five activities, which are begin with the letter S. This basic philosophy is applied in unique ways for many different situations such as: to improve or design workstations, to improve overall plant organizations, to improve plant safety, to create visual aids, to standardize systems across work areas so employees can help each other out easier, and to increase efficiency and quality.

- **SEIRI - (Sorting out):** Sort unnecessary items in the work place and discard or sell them
- **SEITHO- (Systematic arrangement):** Arrange necessary items in good order to So that they can be easily picked for use.
- **SEISO- (Shine):** Clean your work place thoroughly so that there is no dust on the floors, machines and equipments, etc.
- **SEIKETHSU- (Serene atmosphere):** Maintain high standards of housekeeping of house or at work place at all items
- **SHITSUKE-(Stick to self discipline).** Train people to follow good house keeping disciplines automatically

2.7.1 Benefit of 5-S application

- Operations can be performed safe and comfortably, reducing, the changes
- Operations can be performed without error, proceeding in a well regulated and fewer defective items therefore increasing the overall quality of food product.
- Machinery and equipments can be carefully maintained, reducing the number of breakdowns
- Operations can be performed eliminating waste therefore increasing the efficiency and productivity.
- Boost employee morale as well as work environment and Reduce storage costs.

2.8 Total quality management (TQM)

TQM can be defined as integrated organizational approach in delighting customer (Both internal and external) by meeting their expectations on a continuous basis through every one involved with the organizations, working on continuous improvement in all products, services and process along with problem solving methodology (Aggarwal, 1995). There are common points in the operating of TQM (Kalia, 2001). They are as follows:

- That improving quality by removing the cause of problems in the system inevitably leads to improved productivity.
- That the person doing the job is most knowledge about that job.
- That people want to be doing the jobs is most knowledgeable about that job.
- That every person wants to feel like valued contributors.
- That more can be accomplished working together to improves the system than having individual contributions working around at the system.
- That a structured problem solving process using graphical technique produces better solutions than in an unstructured process.
- That graphical problem solving process using techniques let you know where you are, where the variations lie, the relative importance of problem to be solved and whether the changes made have had the desired impact.
- That the adversarial relationship between layout and management is counterproductive and outmoded.

2.8.1 Quality assurance (QA)

QA involve all the planned and systematic actions which are required to give customer adequate confidence that a product or service will satisfy given stated requirements through life cycle.

Meaning of quality

Basic definition of the quality is' fitness of use' or degree of excellence. However ISO 9000 gave the following definition of the quality, which is now widely accepted ***quality, is a totality of features and characteristics of the product or services that bear upon its ability to satisfy stated or implied needs.***

2.8.2 Statical quality control (SQC)

SQC plays an importance role for the maintenance of proper product quality and interpretations of reports, which is a crucial function in the successful operations of the quality assurance program.

The SQC employed statistical principles and methods, which have been developed, to assess the magnitude of chance cause variations and to detect assignable cause variations. Such as variations in the products should not go without corrections, which depend on the laws of probability. Probability simply defined is the number of items an event occurs as to the total number of possible. Thus, SQC is really sampling of the product, determine the quality variations of the sample and relating the finding to the entire lot under consideration.

2.8.3 Quality management certification

Regulatory and authorized body that gives as third party certifications offers the quality management certificate. SLSI is the authority of national quality standards formulation and certifications body in Sri Lanka. ISO and Codex Allimentariuos Commission can consider as International Standard formulations body, which accept the all over the world.

2.8.4 ISO 9001: 2000 quality management system

Quality management system (QMS) can be defined as system to established quality policy and quality and quality objectives and achieve those objectives. Many companies base their QMS on ISO 9001, certifiable standards. ISO 9001 is a standard, which can be applied across a broad spectrum of activities in many organizations.

A quality management system can provide the framework for continual improvement to increase the probability of achieving customer satisfactions and the satisfaction of other interested parties. It provides confidence to the organizations and customer that is able to provide products that consistently fulfills requirements. To achieve this main goal the

standard stipulates some important requirement. The ISO 9000:2000 standard uses a process approach. The figure is a given below conceptual illustration of one model of such process.

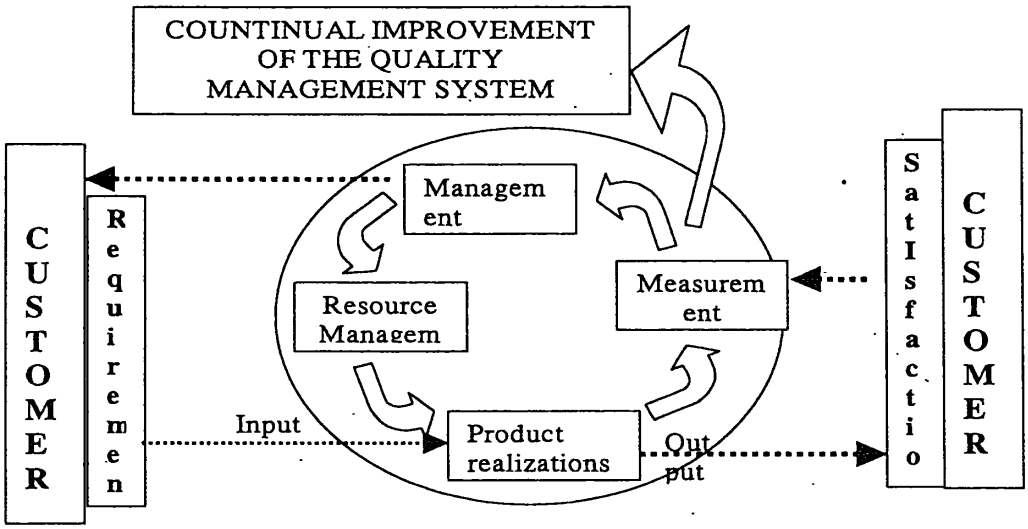


Fig.2.7 Model of the process approach (*source: ISO 9001:2000*)

2.8.5 Environmental management system (EMS) - ISO 14001:1996

Environmental management system (EMS) is that aspect of the total management structure of the organizations which address the immediate as well as long term impact of its products, services, process on the environment .In the specifies requirement for an environment. The international organizations standardizations (ISO) has published ISO 14000 series of standards with view to provide organizations world over with the structure for managing environmental impacts of the of their activities (Khitoliya, 2004) The environmental management system (EMS) is intended to provide to assistance to companies to achieve environmental and economical goals. An important basis for an EMS is the ISO standard 14001'Environmental management system', Specifications with guidance for use (ISO 14001:1996).

2.8.5.1 Food safety management system (ISO 22000:2005)

Food safety is related to the presence of food borne hazards in food at the point of the consumption. As the introductions of food safety hazards can occur at any stage of the food chain, that adequate control through out the food chain is essential. This food safety is ensured through effort of all the parties, participating in the food safety management system that combinations the following generally recognized key element to ensure food safety along the food chain up to the point of final consumption.

The implementation of food safety management system (FSMS) is a systematic approach to prevent unsafe food. It consists of the food safety element, such as methods and tools (HACCP, GMP or GHP) and management system elements such as ISO 9001.Both together build overall food safety management system

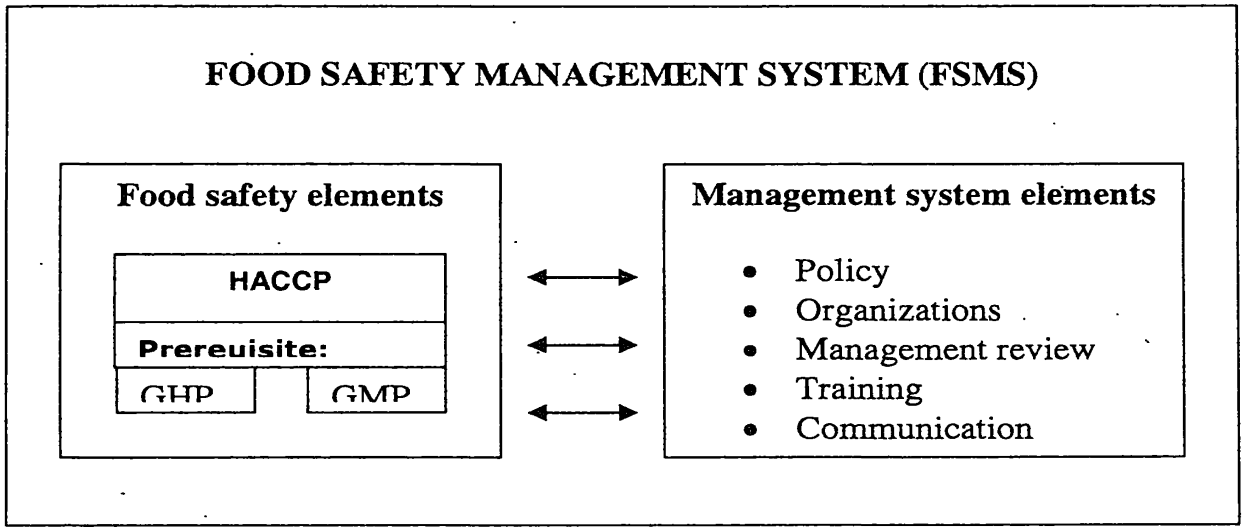


Fig.2.8: Elements of Food safety management system (Source: Det Norske Veritas, 2006).

The aim of this international standard is to harmonize on a global level of the requirements for food safety to the management of the business within the food chain .It is particular intended in applications by organization that seek a more focused, coherent and integrated food safety management system than is normally required by law. It requires an organization to meet any regulatory requirement through its food safety management system (ISO 2200, 2005).

2.8.6 HAZOP for HACCP

Hazard & Operability (HAZOP) analysis is recognized as one of the most powerful computer tools for identifying potentially hazardous scenarios and for developing a course of action to minimize the risks. It may also be used to enhance process efficiency. The HAZOP method (short for **HAZ**ard and **OP**erability) was being firstly introducing by engineers from ICI Chemicals in UK, in midst 70s.

The guidewords are applied to the relevant process parameters, e.g., flow, temperature, pressure, composition-in order /to identify the causes and consequences of deviations in these parameters from their intended values. Although the HAZOP method is still the new to many tea companies, it is rapidly becoming the preferred hazard analysis technique. It has been proven that HAZOP, if carried out by experienced personnel, results in the most comprehensive evaluation of a plant's safety and operability.

Computational aids are available to enhance the quality of both the HAZOP study and it's reporting. Widely used is the package HAZOP-PC, developed by Prima Tech Inc., USA.

2.8.7 Food Contamination sources

2.8.7.1 Microbes

Food product provides ideal nutrient sources for microorganism and generally has a pH value in the range needed to contribute to proliferations. They are contaminated with soil, air, and waterborne microorganism during harvesting, processing, distribution and preparation. Food products may transmit certain microorganism, causing food borne illness that can be classified as either infections or intoxications. Food borne infections can result in two ways:

1. The infecting micro organism is ingested and the multiplies as is true for *Salmonellan sp, Escharichia coli*
2. Toxin are released as the microorganisms multiply, sporulate or lyse such as *Clostridium perfringens* and some *E-coli*

2.8.7.2 Equipments

A contamination of equipment occurs during production, as well as when the equipment is ideal, even with hygiene design features. Equipment can collect Microorganism and other debris from air materials during production. Improved hygienic design and more effective cleaning can reduce product contaminations from equipment can be reduced by improved hygienic design and more effective cleaning.

2.8.7.3 Employees

Of all the viable means of exposing micro organism to food, employee who do not follow sanitary practices contaminate food that they come in contact with trough work and other parts of the environment .The hands, hair nose, and mouth harbour microorganism that can be transferred to food during processing, packing preparations and service by touching, breathing, coughing or sneezing. Because the human body is warm, microorganism proliferate rapidly it the absence of hygiene practices.

2.8.7.4 Air and water

Water serves as cleaning medium during the sanitations operations and an ingredient added in the formulation various processed food. It can also serve as a source of contaminations. If excessive contamination exists another water sources should be obtained or chemicals or other methods should treat water source.

Contamination can result from airborne microorganism in food and preparations areas. This contamination can result from unclean air surrounding the food plant or from contamination are through improper sanitary practices (Marriott, 1998). The most effective method of reducing air contamination through the sanitary practices, filtering of air entering food processing area and protection from air by appropriate packaging technique and materials.

2.8.7.4 Insect and rodents

Flies and cockroaches are associated with living quarters, eating establishments and food processing facilities, as well as with toilets, garbage and other filth. These pests transfer filth-contaminated areas to food through their waste products mouth, feet, and other body parts, and during regurgitation of filth on to clean food during consumptions. To stop the contaminations from these pest eradications is necessary, and food processing, preparations and serving areas should be protected against their entry.

Rodents transmit filth and diseases through their feet, fur and intestinal tract. Like flies and cockroaches they transferred filth from garbage dumps and sewers to food or food processing areas.

2.8.9 Sanitation

It is applications of sciences to provide whole some food handled to prevent concentrations with micro organism that cause food borne illness and to minimize the proliferations of food spoilage microorganism. Effective sanitations refer to the mechanism that helps accomplish the goals (Forsyth and Hayes, 1998).

Sanitations are equated with more than cleanliness. It is responsible for the improvement of the aesthetic quality tea of factory, commercial operations and public facilities. Sanitation is an applied science because of its of its importance to the protection of human health and its affiliations with those segment o of the environment that relate to health. Sanitations sciences must thoroughly unrest stand the living organism that are most likely health to affect human health.

2.8.9.1 Sanitation Standard Operating Procedures (SSOPs).

SSOPs are procedures used by food processing firms to help accomplish the overall goal of maintaining GMPs in the production of food. Typically, SSOPs describe a particular set of objectives associated with sanitary handling of food and the cleanliness of the plant environment and the activities conducted to meet them.

When SSOPs are well-designed and fully and effectively implemented, they are valuable in controlling hazards. Identification of critical control points may be influenced by the effectiveness of a GMP program, including industry SSOPs.
For example, SSOPs can help control bacterial hazards by specifying procedures to:

1) Avoid product cross contamination by proper product flow and limiting employee tasks and movement;
2) Locate hand washing and sanitizing stations near the processing area to facilitate proper hand washing;
3) Ensure appropriate equipment maintenance and cleaning and sanitizing procedures.

SSOPs can likewise be used to help control chemical contamination from sanitizer and other chemicals found in food processing operations.

In some situations, SSOPs may reduce the number of critical control points in HACCP plans. Relegating control of a hazard to SSOPs rather than the HACCP plan does not minimize its importance or indicate lower priority. In fact, hazards are typically controlled effectively by a combination of SSOPs and HACCP critical control points when SSOPs are in place, (Codex Alimentarios Commission, 1997). HACCP can be more effective because it can concentrate on the hazards associated with the food or processing and not on the processing plant environment. If sanitation controls are included as part of a HACCP plan, they must lend themselves to all aspects of a critical control point (CCP) such as establishing critical limits, monitoring, corrective actions, verification and record-keeping procedures.

2.9.2 Food borne diseases

Food borne diseases are harmful illness mainly affecting the gastro intestinal tract and transmitted through the consumptions of contaminated food or drink

2.9.2.1 Food borne illness

A food borne illness is a general term applied to all of illness caused by an organism, substances or material of any kind, which is present in the food and gains entrance in to the body when such food is consumed.

2.9.3 Food poisoning

Food poisoning or food intoxications is an illness caused by toxin present in contaminated food. The toxin may be a poisonous chemical toxin, which is accidentally, or interventional

added, a naturally occurring poison like *solanine* in green potatoes or toxic metabolite extract by bacteria, (Roday, 1996).

Gastro-enteritis describes symptoms affecting the bowel, such as nausea, vomiting, diarrhoea and stomach pain. Food poisoning is the type of gastro-enteritis caused by eating or drinking something contaminated with microorganisms or germs, or by toxic substances produced by these germs (Hiks, 2006). These illnesses are often accompanied by fever, muscle aches, shivering and feeling exhausted.

These microorganisms enter the body in one of two ways:

1. In the food. The food isn't cooked thoroughly, so the microorganisms are not killed off. This is often the case with barbecued food, for example.
2. On the food. For example, the person preparing the food doesn't wash their hands before handling the food.

2.9.4 Factors affecting microbial growth

Microorganisms, like other living organisms, are dependent on their environment to provide for their basic needs. Adverse conditions can alter their growth rate or kill them. Growth of microorganisms can be manipulated by controlling.

- Nutrients available.
- Oxygen.
- Water.
- Temperature.
- Acidity and pH.
- Light.
- Chemicals.

2.9.5 Type of Bacteria

Bacteria are single-celled microorganisms found in nearly all natural environments. Outward appearances of the cell such as, size, shape, and arrangement are referred to as *morphology*. Morphological types are grouped into the general categories of spherical (the cocci), cylindrical (the rods) and spiral. The cocci may be further grouped by their tendencies to cluster. Diplococci attach in pairs, streptococci in chains, staphylococci bunch like grapes, and sarcinae produce a cuboidal arrangement.

Bacteria often divide in to four major groups, with respect to their growth temperature classifications. The four classes are Mesophiles, facultative Thermophiles, obligate Thermophiles, and psycrophiles (Minor, 1983).

2.9.5.1 Mesophilic

Misophilic microbes are commonly encountered in food service work since grow well in the temperature ranges of 15^0c-40 ^{0}C. They have their maximum growth 30-32^0C.Most pathogenic bacteria are mesophiles. They have their best growth at body temperature.

2.9.5.2 Facultative Thermophiles

Some microorganisms have their best growth at temperature higher than those suited from mesophilic growth, some in the hot water of spring. Thermophiles grow best at 37^0C-60^0C but can exist at temperature 82^0C. They can adopt the changing environment.
Ex: *Clostridim, Salmonella, Staphylococus.*

2.9.5.3 Obligate Thermophiles.

The optimum temperature for growth for obligated thermopiles 55 ^{0}C.They are not able to change as the be environment changes they can some times exist in food that are pasteurized and later may become spoilage agents in such a food (Minor, 1983). Other wise they don't cause to many problem s in food services firms.

2.9.5.4. Psycrhophiles

These are the cold loving bacteria that grow beast at temperature10 ^{0}C-19 ^{0}C .How ever they are capable growth of at 0^0C or less. Some grow well at refrigerator temperature. Psycrophiles are important because they are instrumental in breaking down organic material in soil and they sometime problems in food service work, are *Achromobactor, Micobacterium, Pseudomonas* and *Streptococci* (Bathia, and Ichhapujani, 1995).

2.9.6 Yeast and mold

Yeast and mold are *fungi,* which do not contain chlorophylls. Yeast is antinuclear organism about five to 10 time's lager than bacteria. Morphologically they may be ellipsoidal, spherical and some cases cylindrical. Most yeast reproduces asexually by a process called budding

2.9.6.1 Fungi /mould

Moulds are the major fungal organisms that can be seen by the naked eye. We have all seen them growing of food such as bread or citrus fruit, as black green or orange growth depending on the spices of moulds. They have intertwining branching mat (Mycelium). The filament that

makes up this mycelial mat growth on the surface of the nutrient It can refer as vegetative mycelium. They range in size from single-celled organisms to large mushrooms. Although some are multi celled, they are not differentiated into roots, stems and leaves. The true fungi produce masses of filamentous *hyphae, which* form the *mycelium.* Depending on the organism, they may reproduce by fission, by means of *spores* borne on fruiting structures depending on the organism

2.9.6.2 Salmonella sp

Salmonella is gram negative anaerobic, none, spore, forming rod shaped bacteria. Most are mortile (Mortimore and wallence, 1998). Sources of salmonella are human being, poultry and animals, either directly or indirectly contaminate of the food, cats, dogs, swine cattela, and rodents. Proliferate Salmonella are readily destroyed at 82^0C, Recontaminations should not be permitted to occur from work surfaces or utensils used for raw product preparations. (Minor, 1983).

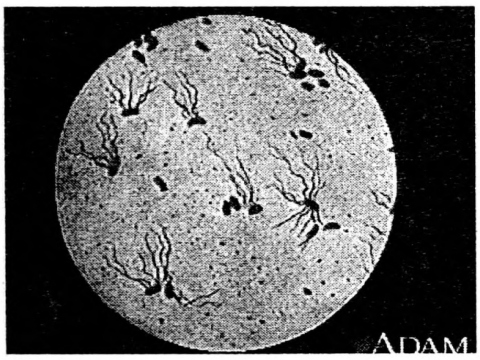


Fig.2.9 *Salmonella thaypi*

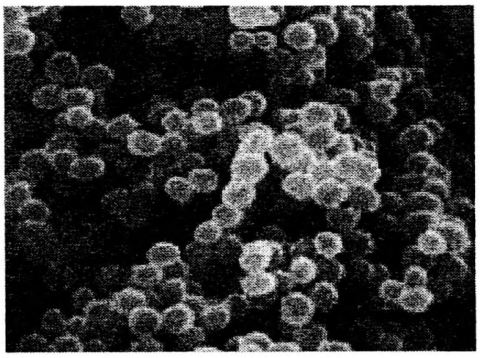


Fig.2.10 *Staphylococus aureous*

2.9.6.3 *Staphylococcus aureous*

Staphylococcus aureus is one of the principle causative agents in food borne illness. They are on the hand and skin proliferates when the skin is breakdown, cut, boils, and burnes. The bacteria are heat sensitive and can be controlled or destroyed by heat but heat stable toxins develop which persist long after the cells have been destroyed, Gram-negative catalase positive anaerobic metabolism. They forms a wide variety of aggressive exotoxin and enterotoxin cause vormiting response by stimulating the sympathetic nerve system normally 2/4 hrs after ingestion food containing the enterotoxin system. Include nausea, diarrhea, etc.

2.9.7 Indicator organism

The routine examinations of foods for a wide range of pathogenic bacteria are impractible in most laboratories either because they are in adequately equipped or because sample size would be impractical to handle. Thus it has become it has become a normal practices to examine food for bacteria whose presence indicates the possibilities of food poisoning or other pathogenic bacteria being presence. These bacteria are thus termed.' indicator' organism and they are often regarded as being of great significance when assigning the micro biological safety and quality of foods

2.9.7.1 Coliform

The principle coliform bacteria are *Escherichia coli(E-Coli)* ,and E*nterobactor aerogenes.* The E-coli is normally found in the gastrointestinal track of man and other animals, and rarely found elsewhere *Enterobactor aeregenes* is normally associated with vegetations and is only occasionally found in the intestine. In water testing, *E-Coli* are a classical indicator for the possible presence of enteropathogens (Jay, 1992).

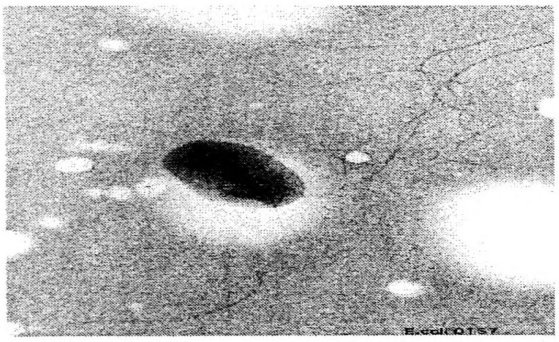


Fig.2.11 *Escherichia coli* in electron microscope

2.9.7.2 Detection methods of coliforms

The detection of E-coli is performed in three stages. The first stage is the presumptive test, and second stage is conformation, the thired is enumerations which involve the counting. Maconcky and Red violet bile agar are used as selective media for coliform testing (Jay, 1992). Enumerations technique includes direct planning of dilutions of homogenized food sample or similar media employing pour or spread plate method. Incubation if it is kept for 24 hrs, at 37 ^{0}C, coliform appearing as red colonies (Jay, 1992).

2.9.7.3 Culture media

Medias of isolations for microorganism are three types, general purpose, selective and deferential medias for isolations and growth of microorganism it is needed to select suitable media according to the nature of microorganisms, (Larry, 1978).

2.9.7.4 Media for fastidious organisms

These are enriched broths and agar which may be used alone or with the additional of supplements. They include blood agar base, formulation containing brain heart and veal extract and saybean. Some are marked as Casman (B.D.G),Columbia,(B.D.G.L.O),Eugon (B.D),Agars,etc (Collins,and Lyne, 2002)

CHAPTER-3

3. METHODOLOGY

3.1 Factory preparation for accept the HACCP system

3.1.1 Preliminary survey was carried out to identification the current status of the factory and problems. Oral interview and cause and effect diagrams were used to determine the problems. A special checklist was used to identify all factory requirement, currently exists resources, current good manufacturing practices etc.

Training program and awareness program were carried out with specially design food safety, Hazard, Food contaminated sources, etc.

3.1.2 Training program and awareness program were carried out according to the schedule and selective topics and Effectiveness of the training program and individual performance were measured by assessment with questionnaires

3.1.3 Control system was established in fermentation area. Effective cleaning and maintaining system was established to perform 5-S and GMPs.

3.1.4 Process control procedure was established especially for raw materials acceptance, Withering operation fermentation, and drier operations, clearly assessed by several log sheets.

3.1.5 GMP manual was developed as prerequisite program that cut down CCP in to Control point.

3.2 HACCP implementing procedure

Preliminary steps of implementing HACCP plan

3.2.1 **HACCP policy:**

HACCP policy was defined according to the international standards (Codex alimentarius commission) and conforming to the policy of Talawakelle Estates Limited.

3.2.2 **Scope:**

Scope was defined to show the HACCP activities and the range of the covered area by the effective HACCP in tea processing .It can help to identify the range of HACCP plan.

3.2.3 **Management responsibility:**

Management responsibility and management commitment were considered to full fill the basic requirements. Management hierarchy was used to assign the responsibilities for individual persons.

3.2.4 **Resources Management:**

Effective resources management system was established with reviewing input and output to performe the HACCP plan.

3.2.5 **Assembling HACCP team:**

HACCP team was assembled with multidisciplinary persons considering all factory staff member. It was small group have not more than 10 member.

3.2.6 **Product description:**

Product descriptions were defined according to the legal requirement and to identify the specific character with regard to such product that would be important to end-users.

3.2.7 **Intended uses:**

An intended use was described for uses of special, specific groups of people and described effect to the consumer that could be after consuming.

3.2.8 **Process Flow Chart:**

Process flow diagram was prepared from raw material receiving point to dispatch unit with covering with every steps of the black tea processing. Onsite verification was carried out by HACCP team.

3.3 **Secondary steps of HACCP implementation**

3.3.1 **Hazard analysis:**

Hazards analysis was carried out for raw material and every process steps that was included in the flow diagram. Every step was the process was considered and determined significance hazards and likely occurrences of hazards. Causes of the hazards were highlighted for every hazard that could be lead to determine the CCPs.

3.3.2 **Determine CCP:**

Principle Two- Determine the CCP (Critical control point).CCPs were established using decision tree (Appendix –I), for every steps and raw materials.

3.3.3 **Establish Critical limits:**

Critical limits were established for every CCPs to controlled the violation of critical limits. Statistical control chart was used to determine control limits of drier.

3.3.4 **Monitoring CCPs:**

Effective monitoring procedures were established for every CCP by using 4H & 1W system and responsibility also assigned for individual persons.

3.3.5 **Corrective actions:**

Corrective actions were established for each CCP's with effective monitoring procedure that was defined and indicated that particular CCP is not under control at CCPs.

3.3.6 **Verification:**

Verification procedure was established to maintain the HACCP plan, and also to maintain the CCP without deviations of critical limits.

3.3.7 **Document Control:**

Thee documentations and record keeping was established in accordance with 7^{th} principle. GMP, cleaning and maintenance plan, Sanitations, HACCP maintain plan, were kept as permanent record with particular file. Every checklist and log sheets were attached to the corresponding file.

3.4 Microbiological assessment:

Some microbiological tests were done as a particial requirement of microbial safety. Following analysis were carried out for made tea samples, and drinking water samples. Special swab testing was done to determine the pathogenic organisms, in fermentations and rolling areas.

3.4.1 Yeast and mold Test (SLS standards).

Yeast extract dextrose agar, chloraphenicol and distilled water, were taken, and culture media was prepared and sterilised at 122 ^{0}C 15 minutes by autoclave.10 g of dried tea samples was measured and dissolve in 100 ml of water and 3 suspended dilutions serious was prepared. Sample was incubating media and Kept 32 ^{0}C incubator after three day's result were objective and enumerate the result (procedure of this experiment SLS 516, part –2 (1991) microbiological test method part-2- enumeration of yeast and mould 1 st Revision

3.4.2 HPC swab Tests (SLS standards).

HPC – test was carried out to enumerate the pathogenic organism in given floor 2 cm^2 areas randomly selected with using block Swab floor propel by cotton bud that area selected area of in side the block. The cotton bud kept special treated solution and media was prepared EDA yeast extract dextrose agar (5.39g and Glucose (0.3 g) Dissolved in 25o ml of distilled water. Cultural media was sterilized in autoclave 20 min 121 ^{0}C. Samples were incubated in 35 ^{0}C for one day's and result was observed.

Happer counter was used to count CFU that given sample.

SLS. 616 part 1. (1991), procedure was applied to count pathogenic organism.

3.4.3 Coliform Test. - MPN Technique (SLS standards).

Maconky broth agar was used as media in presumptive test and brellient green bile agar was used as media in enumeration test. Broth agar was used conformation tests.

Sterilized single strength & double strength machkonky broth media were used in presumptive test Neutril red indicator was used as indicators (red colour-pH.7). 3 dilutions serous was prepare with 3 replicators. After incubation of sample were kept in 36 ^{0}C. After three day all samples were showed positive result, as colour change alone with gas formations. That sample was further analysed by using brilliant green agar medium and result were observed as gas formation.

3.4.4 E-coli Test (SLS standards).

Positive samples were used GIMVIC. GIMVIC test was done to conform the E/coli.

SLS. 616 part III, (1991, standards procedure was followed this assessment

CHAPTER-4

4. RESULTS & DISCUSSION

4.1.1 Factory preparation for HACCP

Preliminarily survey found out following problems which existing in Moragalla tea processing center.

- Lack of Potable water.
- Lack of work force.
- Lack of hygienic building design.
- Bad quality green leaf receiving.
- Low selling rate (NSA) of mad tea.

Major problem can analysis using cause and effect diagram and that could be found out the possible causes which directly affect the particular problem. Cause and effect diagram are given below for vital few problems.

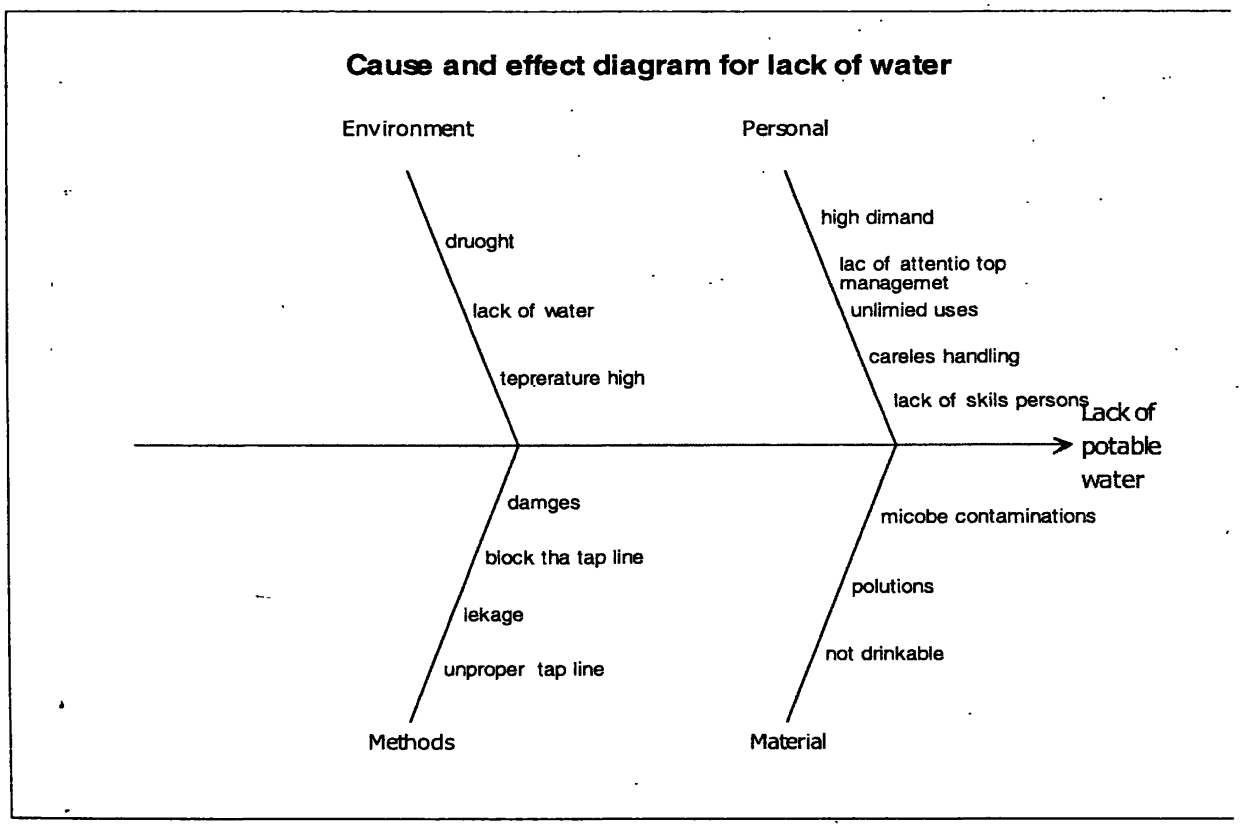


Figure.4.1 Cause and effect diagram

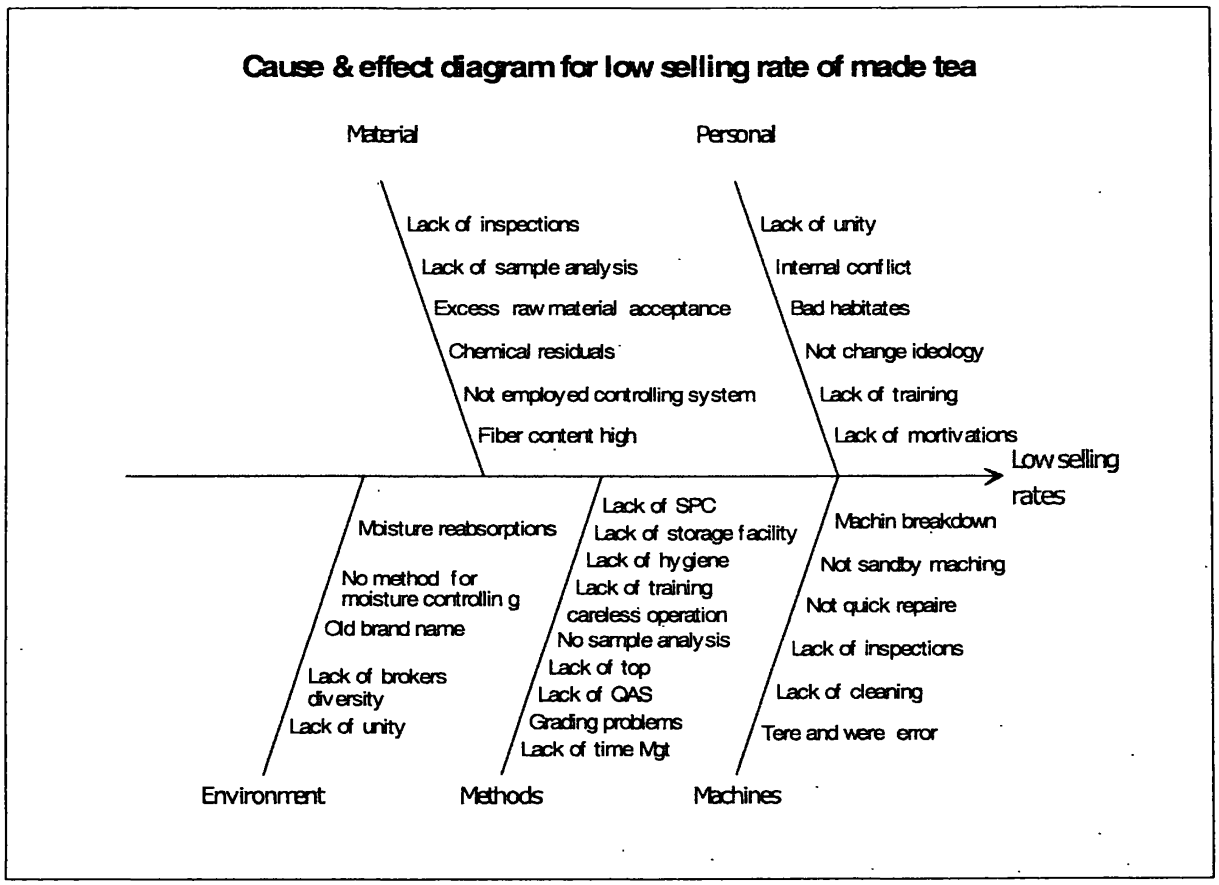


Figure.4.2 Cause and effect diagram

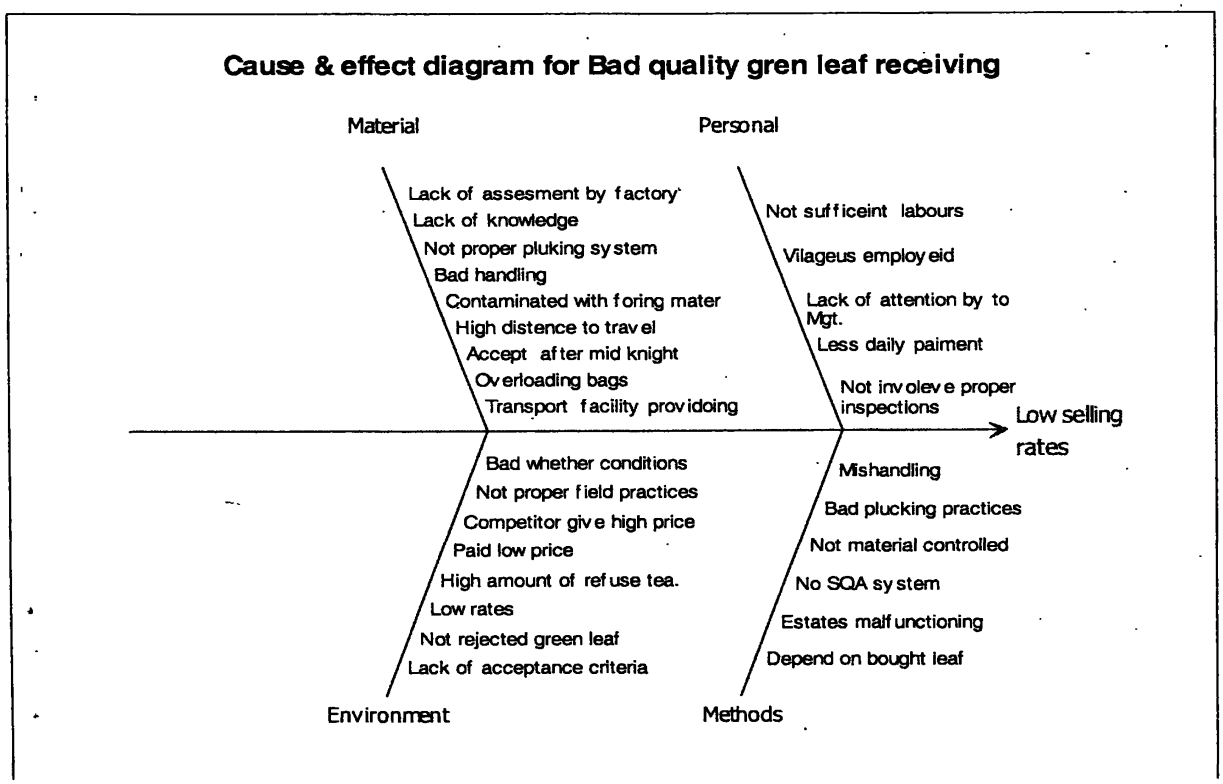


Figure.4.3 Cause and effect diagram

Moragalla Tea Estates				DOC.REF			
TITLE	Training schedule			ID	haccp	audit	Adr-1
DATE OF ISSUE	2006.06.20	ISSUE NO	01	PAGE		*1 of 1*	
DATE OF REVISION	-	REVISION NO	00				

4.1.2 Training schedule

Title	Target group	Date	Duration	Response
1.5-S concept & importance		1st June 06	16.30 to17.15 pm	
2.Basic quality concept.		4th June 06	16.45 to17.30 Pm	
3.Physiochemical changes in tea processing.		6th June 06	16.15 to17.00 pm	
4.Safe food handling & processing		7th June 06	16.15 to17.00 pm	
5.Good manufacturing practices.		13th June 06	16.15 to17.00 pm	
6.General hygiene practices		15th June 06	16.15 to17.00 pm	
7.Food contaminations sources.		16th June 06	16.30 to17.15 pm	
8.Food borne illness & Microbes.		17th June 06	16.30 to17.15 pm	
9.Hazards & How to prevent it.		19th June 06	16.30 to17.15 pm	
10.Basic concept of HACCP.		21st June 06	16.15 to17.00 pm	
11. Maintaining HACCP.		22nd June 06	16.15 to17.00 pm	
12.Sampling & Process control		23rd June 06	16.15 to17.00 pm	

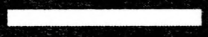
Prepared by:	N.B Boyagoda	Signature:	
Reviewed by:		Signature:	
Approved by:		Signature	

Top Managers
Middle Staff
Employees

4.1.3 Application of 5-S Sign and symbol for fermentation area and rolling room

Following symbol and standard colour code was applied to implementing 5S, in rolling and fermentation areas.

Table.4.2 Five S colour codes

TYPE	COLOR	WIDTH (cms)	NOTES
Dividing lines (floor)	Yellow	10	Solid lines 
Exits / Entrances (floor)	Yellow	10	Broken lines 
Door openings (floor)	Yellow	10	Broken lines 
Traffic flow lines (floor)	Yellow		Arrows 
Tiger pattern Moving Items	Black & Yellow		Stripes 
Work in progress	White	5	Solid lines 
Work tables	White	5	Corner 
Hazard area	White	5	Stripes 
Electricity	Red		
Water	Blue		

STANDARD COLOR CODES AND SAFETY SIGNS

Weight set and weighing machines	**Sign letters of WT**		**WT**
Department names	**Blue board with White letter**		**DEPARTMENTS**
Cleaning Equipment locating	**Blue back ground in CL mark**		**CL**
Cleaning Equipments	**Blue circle**		
Emergency / Exits	**Green board with Human symbols**		
Caution boards	**Yellow letter with half black & yellow Background**		**CAUTION**
First Aid point	**Red cross in white back ground**		
Safety First	**Green board with white cross**		
Danger boards	**Red Zigzag mark in yellow back ground**		
NB:- **Basic rule "Never walk on yellow lines or step over them!"** **"Dividing lines are lifelines!"**			

Other than applying the above colour code, all documentations are effectively store with at glance labeling system. Seiri days are performed according to the 1st and 2nd, 3rd principles. Frequent awareness program are also carried out to improve self discipline.

Maintaining schedule				DOC.REF			
TITLE	Maintain procedure			ID	haccp	pr	mein-01
DATE OF ISSUE	2006.05.18	ISSUE NO	01	PAGE		2 *of* 10	
DATE OF REVISION	-	RIVISION NO	00				

Table 4.2 Maintenances schedule

ɔn / rtment	Machines / Equipments	Maintain procedure	Frequency	Responsibility	Checked by
ning	Leaf hoist	• Check gear box oil leak • Check gears box oil level and replenish as necessary. • Lubricate chain as necessary. • Check all structural nuts and bolts for tightness and security. • Check all chains and sprockets for wear and adjust tensions as necessary. • Check all safety guard for corrective fitting. • Lubricate driver motor	*Daily* *Weekly* *Monthly* *Monthly* *Ones two weeks* *Monthly* *Annually*	Mr. piyasena Mr. Ajantha. Mr Ajantha Mr Piyasena Both Both	Loft supervisor
ering	Trough	• Check trough side panels, all others area for air leaks and repair. • Check trough bed for sagging and repair. • Check wire mesh for tear, holes, and repair. • Check fans for undue vibration and rectify • Check leading edge of fan blades for tightness. • Check hot air supply arrangement, ducts, valves, etc, for serviceability • Check fan motor / condition, and lubricate fn motor	*Weekly* *Ones per two weeks* *Ones per two weeks* *Ones per two weeks* *Ones per two weeks*	Mr Ajantha Both Do Do Do	Loft supervisor
	Trolleys	• Check the conditions of the trolleys, holes, damages and repair.	*Weekly*	Mr Ajantha	Loft supervisor
	Thermo meters	• Check the water level of wet bulb thermometer base before starting work & replenish as necessary.	*daily*	Withering incharge	

Maintaining schedule				DOC.REF			
TITLE	Maintain procedure			ID	haccp	pr	mein-01
DATE OF ISSUE	2006.05.18	ISSUE NO	01	PAGE		2 *of* 10	
DATE OF REVISION	-	RIVISION NO	00				

ɔn / rtmen	Machines / Equipments	Maintain procedure	Frequency	Responsibility	Checked by
	Net & window	• Check wire mesh for tear, holes, and repair.			
	Lighting bulb	• Checked tube bulb performance, wire mesh, switch functioning, repair.	*Two time per day*	Mr Ajantha / Mr Piyasena	
	Roller	• Check gear box oil leak of motor • Check gears box oil level and replenish as necessary. • Check conditions of all bearings and lubricate • Check door locking mechanism • Check jacket bolts for tightness • Check oil leaks of speed reduction gear box • Check all safety guard for corrective fitting. • Check V-belt alignment and fitting for wear and checked roller corn, bed, jacket, etc. • Lubricate motor bearings	*Weekly* *Do* *Ones per two weeks* *Do* *Weekly* *Weekly* *Ones two weeks* *Ones six months* *Do*	Mr Ajantha Do Mr Piyasena Do Mr Ajantha Mr Piyasena Both Do Do	Rolling supervisor
	Roll breaker.	• Drain outwear box and speed reduction unit and refill with correct lubricants	*Do*	Do	

Prepared :	HACCP officer	Signature:		Date:
Reviewed:	Assistant factory officer	Signature:		Date:
Approved:	Factory Manager	Signature:		Date:

Table 4.4 Cleaning schedule

Equipment / Locations	Frequency	Method	Cleaning disinfecting			Responsible	Non commence / Correct action
			Tools	Chemicals concentration	Time durations		
Trough	Daily (after withering)	Properly clean trough bed and mash. Clean fan belt	Broom& Blower	-	-	Loft supervisor	Reclining as per the schedule
Trolleys	Daily (before & after working)	Properly cleaned trolley bed, rinse with water or permitted sanitizer(in rolling room)	Brush Water hose	Teepole. 50 ppm	Five minute	Rolling in charge	Reclining as per the schedule.
Rolling room floor	Daily (after working)	Rinse with water or permitted sanitizer	Brush & Mobs Water hose	Teepole 250 ppm. (change with effectiveness of dis inspections)	10 minute. (change with effectiveness of dis inspections)	Rolling in charge	Reclining as per the schedule.
Electric fly killer	Daily	Remove trapped fly and cleaned	Brush	_	No finite time	In charge of particular department	Reclining as per the schedule

Prepared :	HACCP officer	Signature:		Date:
Reviewed:	Assistant factory officer	Signature:		Date:
Approved:	Factory Manager	Signature:		Date:

Moragalla Tea Factory				DOC.REF			
TITLE	Leaf counting check list			ID	OP	GMP	Le-2
DATE OF ISSUE	2006.06.06	ISSUE NO	01	PAGE		*1 of* 1	
DATE OF REVISION	2006.06.24	RIVISION NO	01.1	DOCUMENT		Factory procedure	

Table 4.5 Leaf quality assessment sheet

Date	Supplier Name	Leaf quality			Amount	Checked by
		Best	Below best	Poor		
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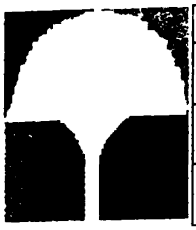
Prepared by:	HACCP officers	Signature:	
Reviewed by	Factory by assistant	Signature:	
Approved by	Factory manager	Signature	

Table 4.6 Withering trough operations

Trough number	Fan On Time	1st tuning Time		Loosing Time		Fan Off time	Withering leaf %				Labour involved (EPF-No)	Checked by
							Good withering	Under withering	Over withering	Leaf counting time		
Number- 01	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Number-02	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Number-03	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Number-04	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Number-05	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Number-06	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Number-07	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Number-08	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

Prepared by:		Signature:	
Reviewed by:		Signature:	
Approved by:		Signature	



Moragalla Tea Estates				DOC.REF			
TITLE	Fermentation- inspections			ID	OP	Dr	D-Chec-2
DATE OF ISSUE	2006.06.23	ISSUE No	01	PAGE		*1 of 1*	
DATE OF REVISION	-	RIVISION No	00				

Table 4.7 Operation record of fermentation

Date	Batch-No	Start time	Complete time	Avg. RH of. Room	Avg, Tem of Bins	Checked by	Remarks

Prepared by:		Signature:	
Reviewed by:		Signature:	
Approved by:		Signature	

Moragalla Tea Estates				DOC.REF			
TITLE	Drier operation checklist			ID	OP	Dr	D-Chec-2
DATE OF ISSUE	2006.06.23	ISSUE No	01	PAGE		*1 of 1*	
DATE OF REVISION	-	RIVISION No	00				

Table 4.8 Drier maintain

YEAR / Date	Equipment / Machine Name	Inspections & checking													Checked by
		Motor & starter.	Gearbox oil level /	Lubrications	All nuts & bolt	All safeguard	accuracy of spreader	V-belt diverse	Recording instrument accuracy	Driver chains and sprockets	Smoke test	Tube clean	Due date	Responsible	
	Drier-1														
	Drier-2														
	Drier-1														
	Drier-2														
	Drier-1														
	Drier-2														
	Drier-1														
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	Drier-1														
	Drier-1														
	Drier-1														

Prepared by:		Signature:	
Reviewed by:		Signature:	
Approved by:		Signature	

4.1.5 GMP Manual.

Purpose: Maintaining HACCP plan and control the CP effective manner and factory performance and ensure the process and operation area at practices acceptable levels.

Scope: To provide basic environmental and operating condition that encourages productions of safe and wholesome made black tea.

Responsibility: All factory staff and employees.

1. Building exterior - waste

- Waste management system shall be established in effective protocol.
- Adequate storage shall be provided to store according to the severity.
- Different waste fraction shall be collected effectively and dispose aesthetically
- Waste storage shall be cleaned and well maintained.
- Proper drainage system shall be established and well maintained.
- Water logging condition shall be prevented and not permit pest harborages.

Document references	Name of the document	page
ID/haccp/prc./cle.1	Cleaning schedule	5

2. Building exterior.

- Design shall be durable, cleanable impervious to water (moisture).
- Building shall not be harbourage for any pest, such as bird.
- Design shall not permit polluted water and polluted air.
- Effective pest control system shall be established.
- External premises inspection shall be document and regularly performed by authorized persons.
- Corrective action shall be taken when required.
- Document and corrective action shall regularly be audited by authorized persons.

- Vehicle shall not be allowed near the processing area and it shall not cause for smoke contamination of the product.
- Outer surround shall be free from any bushes up to 10 M and shall not permit the growth of grass near the building walls. It shall free from grass 1M to on word buildings.
- Effective cleaning system shall be established and well maintained.

3. Building interior and design

- Building material shall not pose threats to product or human.
- Design shall be durable, cleanable impervious to water.
- Floor shall be cleanable, durable and especially well drain in rolling area.
- Window shall be covered with net it should not permit to the entry pests.
- Glass shall not be exposed to sensitive area.
- Glass shall be laminated and Tube bulb cover with safe effective manner.
- Door self closing and impervious to moisture or else air curtain /air crypt shall be used for the door.
- Sensitive processing area shall be separated with air curtain.
- Drier and colour separate area shall be covered with air curtain.
- Light shall be enough to address visual hazards and permit effective productions.
- Live animal entrance shall be prevented and control hygienically.

4. Air quality control building interior

- Good ventilation shall be provided with adequate safety for the workers.
- Air filter shall be used to control or prevent entry of contaminated air or dust.
- Temperature exhaust fan shall be installed especially in drier operation, sifting areas.
- Temperature of the inside factory shall not exceeded 37^0C.
- Fan condition and performance shall be inspected and keep records shall be kept by authorized persons.

5. Waste handling in building interior

- Drains system shall be well established and not permit water login conditions.
- Adequate waste storage bin shall be provided and disposed in effective manner.

- Wastes storage bin and its consist shall not cause for hazards, risk, contaminate, process or product.
- Waste container shall be cleaned and well maintained.
- Record shall be documented, by authorized persons.
- Adequate sanitary facility shall be provided to waste handling.

6. Sanitary facilities of building interior

- Adequate hand washing facility shall be provided.
- Procedure of washing shall be displayed near the station with poster or instructions.
- Adequate washing soap, sanitizer, and drying facilities should be providing in hand washing stations.
- Adequate wash room facility shall be provided.
- Hot, cold potable water shall provide.
- Foot bath shall be installed before entering the processing area.
- Record shall be kept by authorized person.
- Processing area shall not be directly open to the toilet.

Linking document

Document references	Name of the document	page
ID/haccp/GMP/	Sanitary operation practices	4

7. Water in building interior

- Water shall conform to local regulatory guide line for portable water SLS 614.
- Portable and non potable water shall be kept separately and clearly displayed.
- All taps shall be cleanable and prevent leakages.
- Water storage area shall be designed in hygienic manner.
- Records shall perform with responsible persons.

8. Machine and equipment design and installations

- Machine and equipment, pitting, shall permit to proper installation and hygiene manner.
- Design and installation shall permit effective clean and maintenance.
- Equipment shall not create environmental hazards.
- Equipment shall not permit dead end, and well drained.
- Equipments shall, cleaning sand maintaining in regularly performed inspected and document control.
- All performance of design effectively document control, by responsible person.
- Food contact surface shall be free from cracks, and holes.
- All chemical used in cleaning equipment and machine shall be food grade and permitted by regulatory authority.

9. Maintain and calibration equipment

- Maintaining program shall meet manufacture maintaining requirement.
- Maintain shall be specific for different equipments with standard schedule.
- Equipment shall not create environmental hazards.
- When the equipment maintaining or repairing, foreign impurity shall not contaminate the product. Such as oil, grease, metal filling, etc
- Equipment calibration shall be done by trained people.
- Equipment calibration shall be performed with protocol with permitted regulatory body (SLSI or TASL).
- Proper documentation and record keeping procedure shall be performed with authorized persons.

Linking document

Document references	Name of the document	page
ID/hacp/pr./main-1 Id/ hacp/pr/cali	Maintaining schedule Calibrating schedule	4 7

10. Cleaning and sanitation program

- SSOP shall be defined for each cleaning task.
- SSOP shall include scope, persons, and responsibility and method or strength.
- Cleaning compound shall be stored in separate area and good hygiene conditions.
- Cleaning equipment shall be inspected before reassemble.
- Cleaning programs shall hold performed with master schedule.
- Record keeping of cleaning shall be hold responsible y authorized persons.
- Cleaning of equipments and machine shall be preformed, (CIP and wet cleaning) according to the nature.
- Measure effectiveness of cleaning and disinspection swab test.
- Dry zone shall use air blower, broom cleaning.

Linking document:

Document references	Name of the document	page
ID/haccp /sop,ssop	Sanitary standards practices	3
Id/haccp/gmp/cli-1	Daily cleaning schedule	1

11. Training & workers awareness

- Training program shall include hygiene practices, safe handling, food safety, SSOP, regularly evaluation, and training update, by adequate schedule.
- Every employee shall acknowledge each task of the process and instructions set of each task.
- All training requirement and measurement of the training effectiveness shall be documented and keep in with document.
- Effectiveness of training program shall evaluate individual performance by examination and records shall be documented.

Linking document:

Document references	Name of the document	page
ID/haccp/Gmp /train.1	Training schedule	1

12. Health requirements and personal hygiene

- Adequate hand washing facilities shall be provided for wash their hand handling with food and non food material.
- Hand of worker shall be washed as many times as necessary as when become dirty.
- Protective and sanitary cloths shall be provided and mandatory in sensitive area.
- Hair cover /cap shall be provided and impose to wearing it.
- Unsuitable habitat of peoples shall be controlled by effective protocol.
- The personal hygiene shall be regularly checked before entering the work place by authorized person.
- Health condition of the workers shall be assessed by doctor and shall document control for individual persons.
- All personal hygiene records shall be kept separate file in an effective file system.

Linking document:

Document references	Name of the document	page
ID/haccp/sop/ph	Personal hygiene assessment	7
ID/haccp/sop/ssop	SSOP	3

13. Safety and incident management

- Incident management protocol shall be well established to cover every step of the process.
- Adequate fire extinguisher shall be located at each department and display the purpose of the each fire extinguishers unit.
- Every person in the factory shall acknowledge preventive action and controlling method of fire.
- Adequate emergency exit shall be provided to prevent the hazard to the people.
- Warning alarm shall be established and every person shall acknowledge it.
- Instruction and Guide line shall be defined effective incident management.
- First aid boxes shall be installed at each department with adequate medicine and equipments.

- Every workers of the factory shall be aware about incident management and preventive action of physical hazards.

Linking document:

Document references	Name of the document	page
ID/GMP/sop/Im	Incident management protocol	

14. **Pest control**

- Bushes outside factory shall not permit grow within 10M.
- Water logging drains shall be cleaned and disinfested suitable using chemicals which are permitted by regulatory authority.
- Waste management and handling shall not attract pest, flies, etc.
- Every window of the factory shall be covered with net and it shall not permit entrance.
- Fan shall be installed near the main entrance which slightly higher than environment to prevent pest inference.
- Adequate Insecticuters shall be established for each department especially sensitive area.
- Adequate bird control and rodent control system shall be established to prevent their attack.
- Record and infection shall perform by authorized person and keep record in separate files.

Linking document:

Document references	Name of the document	page
ID/GMP/Sop/pc	Pest control procedure	1

Prepared	HACCP officer	Signature:		Date:
Reviewed	Assistant factory officer	Signature:		Date:
Approved	Factory Manager	Signature:		Date:

Moragalla Tea Factory				DOC.REF			
TITLE	SSOP/SOP			ID	haccp	SOP/ SSOp	1
DATE OF ISSUE	2006.06.27	ISSUE NO	01	PAGE		*1 of* 3	
DATE OF REVISION	-	RIVISION NO	00				

Scope: Ensure whole process through the factory operation practices and control the CP acceptable levels to maintained hygienic condition.

Responsibility: All factory staff and employees.

1. Leaf receiving point.

- Green leaf receiving area which is well demarcated and shall be elevated separately from the working area to prevent contaminations.
- On arrival green leaf shall be handled by personal wearing protective cloths.
- Green leaf shall be inspected for pest, foreign mater, diseases, etc.
- None conforming leaf shall rejected and consider the leaf acceptance criteria.
- Nonconforming leaf can be considered as damaged boiled leaf, and coarse leaf.
- Make leaf count accepted and keep record.
- Accepted leaf shall be transported weighing point.
- Weighing scale shall be calibrated with standard scale that regulatory body issued.
- Frequency of calibration shall be performed at least six month with trained persons.
- Weighed leaf shall be sent as soon as possible to the withering trough.

2. Loft operations

- Trough shall be cleaned before spreading green leaf.
- Tags shall be used to determine the leaf suppliers.
- Rate of spreading shall 2.5Kg/Sq.Ft and uniformly.
- Temperature shall be maintained in loft around 95 ^{0}F.
- Leaf loosening shall be done after immediate with spreading.
- Leaf turning shall be performed as necessary times by visual observations.
- Hot air shall be used only when it essential.
- Hygrometer difference shall be maintained about 6 ^{0}F.
- When the hygrometer difference less than 4 ^{0}F, it shall be increased 6^{0}F.
- Hygrometer reading shall take each hour and inspect each 30 minute.
- If to moisture level high which are kept separately with free condition?.

4.2 HACCP implementing procedure

4.2.1: Company profile

Head office:

Name of the company : Talawakelle Tea Estates ltd.
Contacts person : COE.
Number of employees : 12286.
Addresses : No- 25, Foster lane. Colombo-10, Sri Lanka.
Tel.No : + 94 112 68784.
Fax.No : + 94 112 674592.
Email : h.jayasundera@tpl.hayleys.lk

Estates office:

Name of estates : Moragalla Estates.
Contact persons : Mr.Primal vithanege.
Number of employees : 85
Address : Paragoda , Imaduwa, Galle.
Tel.No : +94 91 2286023.
Email : moragalla@sltnet.lk
Sift Operations : 2 Sift Per day.

Moragalla tea processing at a glance

Geographic locations : Imaduwa in 16 Km away from Galle.
Average daily crop : 12000 Kg.
Registration number : MF-
Producing goods : Orthodox Black Tea.
Established in : Since 1960

4.2.3 HACCP policy:

Mission: Produced quality teas that delight our customer ad value to the diverse resources of the company through the innovations and technology and Enhances shareholder interest and quality of employees.

Talawakelle Tea Estates number is a one company among tea produces in Sri Lanka. It is all ready taken HACCP, ISO, and SLS standard for few factories. ISO 22000 and HACCP certificate were taken first time in Sri Lanka and reach international standard while prove the product safety. Our company all ways much concern quality assurance and food safety through out processing operations.

Every aspect is taken ensuring the safety and hygienic conditions of product. Several activities are performed to minimize hazards consequences and strict hygienic practices, sanitary standard operation practices, Good manufacturing practices .Those practices are impose for all workers and staff. All facilities provide for employee motivate to effective functioning HACCP plan. Training and acknowledge employee program frequently carried out. Major objective of people training is to increase workers performance and adhere to hygienic operations.

Every CCPs of the HACCP plan are strictly control with following corrective action and verification procedure. all document and record keep effectively .If would be happen occur any hazard that related with raw material and we get in quick action to prevent acceptable levels. Periodical verification programs are carried out by internal auditing. New technology and machine are used as much as possible to effectively maintain the HACCP plan. Other than those practices quality assurance piracies, well resource management help achieve our main goal.

Prepared	HACCP officer	Signature:		Date:
Reviewed	Assistant factory officer	Signature:		Date:
Approved	Factory Manager	Signature:		Date:

4.2.3 Scope:

Create safe & hygiene black tea products from green leaf receiving stage to final dispatch point by maintaining and minimizing all cross contaminations through out the process while protecting whole some ness of black tea.

Prepared :	HACCP officer	Signature:		Date:
Reviewed:	Assistant factory officer	Signature:		Date:
Approved:	Factory Manager	Signature:		Date:

4.2.3 Management responsibility

Table 4.9 Management responsibility

Activity	Factory Manager	Factory assistant	Senior factory officer	Junior factory officers	Technical officers	Computer operator	Micro Biologist
Weighing green leaf & Raw material inspections		√	√	√			
Withering trough operations.		√	√	√	√		
Rolling, Roll braking, Fermentations			√	√	√		√
Drying operations			√	√			
Grading and sifting		√	√	√	√		
Inspection & testing performance	√	√	√	√	√		√
Maintain & cleaning			√	√	√		
Purchasing Raw materials	√	√					√
Supplier& Management control	√	√	√				
Training and development	√	√	√			√	√
Documentations	√	√	√			√	√
Microbial testing						√	√

4.3.3.1 Management Hierarchy

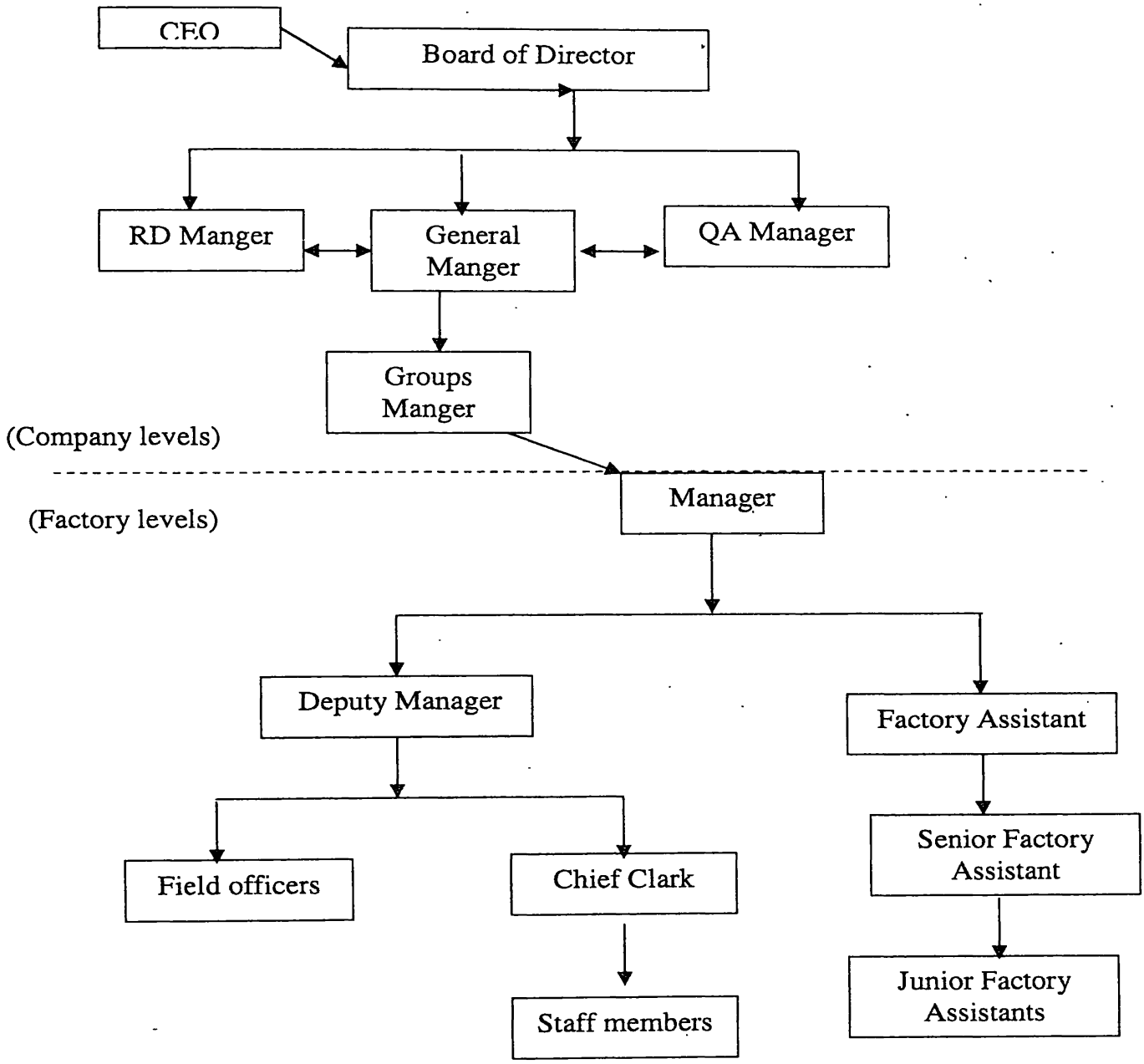


Fig.4.1 management hierarchy

4.2.4 Resources management

Effective resources management is carried out to perform effective HACP plan Recourse management activity refer as major two parts are input review, and output eview.

Input review:

- CCP monitoring document .non conforming violation.
- Consumer compliance record and product recall.
- Corrective action and preventive actions.
- Control al operation checklist and log sheets.
- Product raw material specifications.
- Training and workers awareness
- Providing facility and auditing.

Out put review:

- Increases of overall performances.
- Check the relevant growth and development of, persons, process, product, etc.
- Check the achievement of product safety.
- Continual auditing process & process approaches.

Prepared	HACCP officer	Signature:		Date:
Reviewed	Assistant factory officer	Signature:		Date:
Approved	Factory Manager	Signature:		Date:

4.2.7 HACCP Team member

Table.4.10 Team member

Name of the team members	Position in HACCP team	Designations	Responsibility	Qualifications
Mr Primal Vithange	• Resources person & Team leader	• Factory manger	• Leaderships and motivate team members • Coordinating and control planning marketing and finance functions.	• Over five years of experience in Orthodox tea manufacturing.
Mr .Niihal kumarasinghe.	• Coordinator	• Factory assistant (Head of manufacturing divisions)	• Monitoring HACCP team performance, • Ensure the correct functioning, SOP, through out whole process. • Manufacturing and marketing functions.	• Over thirty years of experiences in orthodox tea manufacturing.
Mr Sampath Bandara	• Sub groups leader	• Deputy manager	• Development criteria and specification to meet HACCP. • Supplier quality assessment, and acknowledge field officer, through propaganda program. • Estate field management and Good agricultural practice (GAP) assessment.	• Over 35 years of experience in estates management and human resources management

Name of the team members	Position in HACCP team	Designations	Responsibility	Qualifications
Mr Sunil kumara	• Team member	• Senior factory assistant	• Direct and guiding for people and HACCP plan functioning and quality assurance and quality planning. • Produced finished product according to the GMP requirement	• Over 15 years of experiences in Orthodox tea manufacturing and quality controlling.
Mr .Kapila sujeewa	• Team member	• Senior factory officer.	• Monitoring HACCP personal hygiene performance. • Ensure the correct functioning, SSOP, through out whole process. • Training needs of workers identifications.	• Over 10 years of experiences in orthodox tea manufacturing. Process controlling. • Labor handling and controlling
Mr. Ajith Sanjeewa	• Team member	• Junior factory officer	• Data control and control chart establishing and monitoring. • Monitoring sanitary facilities and emergency case handling	• Over 5 years of experience in tea manufacturing.
Mr. Yapa	• Team member	• Junior factory officers	• Properly functioning of maintaining and cleaning schedule and record keeping	• Over five year of experience in orthodox tea manufacturing.

Name of the team members	Position in HACCP team	Designations	Responsibility	Qualifications
Mss.Chathurika	• Team member & statically process, data controller	• Data entry operator	• Data analysis. Checklist, control charts, and other documentation material formulator and provider.	• Over two years of experiences in data analyzing and software operations.
Mr .Piyasena	• Team member & Machine equipment installing incharge	• Technical officer.	• Monitoring & maintaining machine performances • Ensure the system supplying functioning ,factory operations • Machine and equipment establishing	• Over 30 years of experiences in black tea factory maintaining
Mr.Nilan Boyagoda	• Microbiologist and HACCP chair person	• Project coordinator	• Data control and control chart establishing and monitoring. • Monitoring sanitary facilities • Development and revising HACCP plan. • Micro Biological testing. • Process standardizations	• Over 1 years of experience in tea manufacturing. • BSc. (Special) Food science & Technology (SUSL)

Prepared :	HACCP officer	Signature:	
Reviewed:	Assistant factory officer	Signature:	
Approved:	Factory Manager	Signature:	

4.3.8 Product descriptions

Table 4.3 product information's

Features / Characters	Descriptions
Product Name	Orthodox black tea
Compositions	Caffeine, Thearubigins, Theaflavins, Carbohydrates, Amino acids ,organic aids
Physical structure	Black leaf particle in different grade ,sizes vary with range of 2.3×10^{-2} to 23.8×10^{-2}
Preservation method	Drying –Moisture level <3% at the dispatch point < 6%
Raw materials	Green Tea leaf
Packaging materials	Inner layer aluminum foils, outer layer ply cart paper sac
Storage conditions	Best storage 35-38 ^{0}C.if open should close tightly to prevent moisture re absorption.
Self life	2 yrs
Specific labeling requirement	Logo, Reg. No of factory. Invoice Grade, Bag No., Net weight, Trade Name, manufacture Date,
Customer	Those are sent with particular /corresponding sample
Preparation method	2 grams of sample of tea put in to the 150ml, of boiled water and allow 3minute.
Sensitive group	No sensitive group. and no effect for the consumer

4.2.8 Intended uses:

Product is specially used for drinking purpose as beverage. It can be prepared with hot boil water. No added artificial colouring materials .no specific sensitive groups. But should not give infant for les than 1year.and it should not be taken before and after 45 Minute of main meals. No harmful effect after consuming.

Prepared	HACCP officer	Signature:		Date:
Reviewed	Assistant factory officer	Signature:		Date:
Approved	Factory Manager	Signature:		Date:

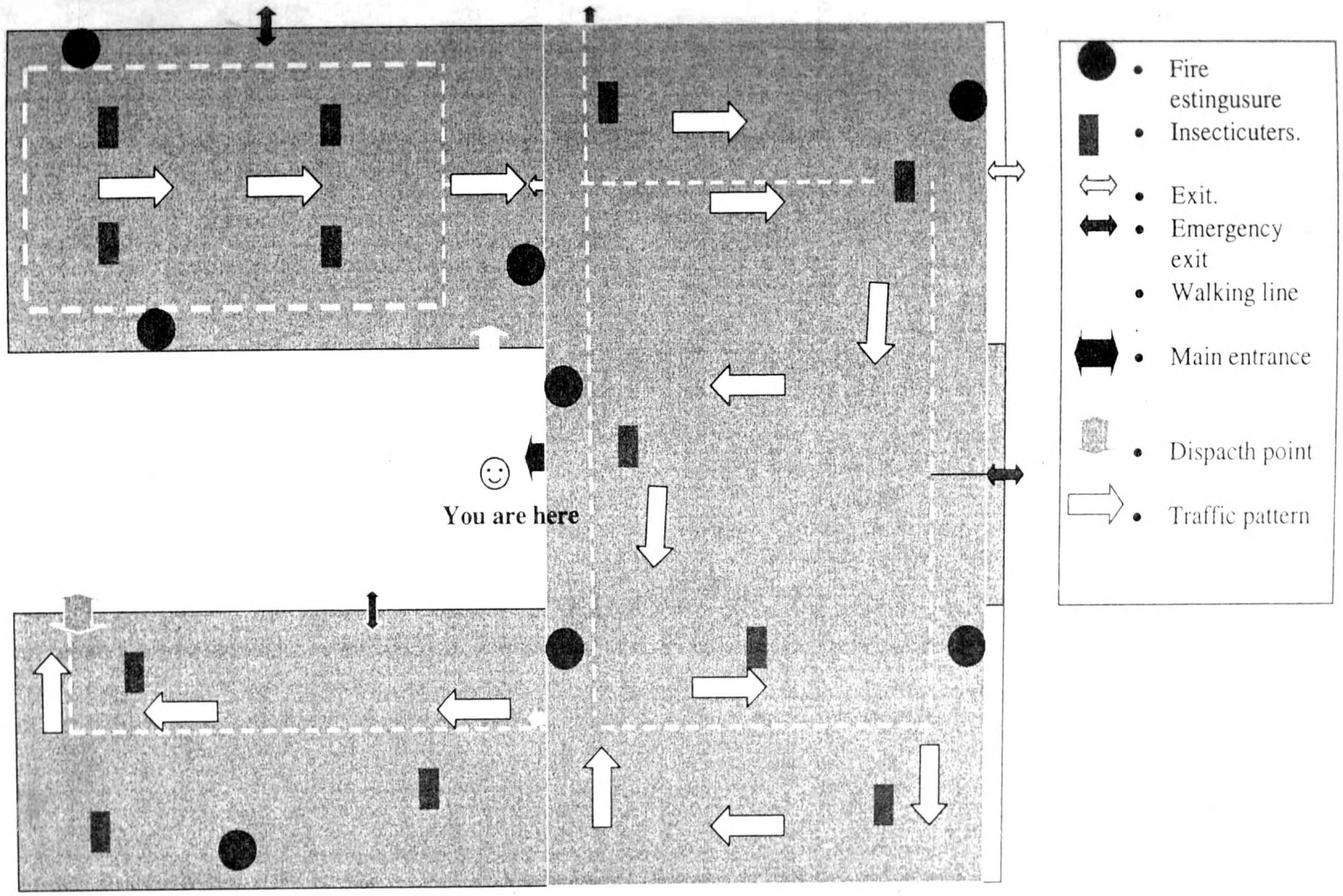
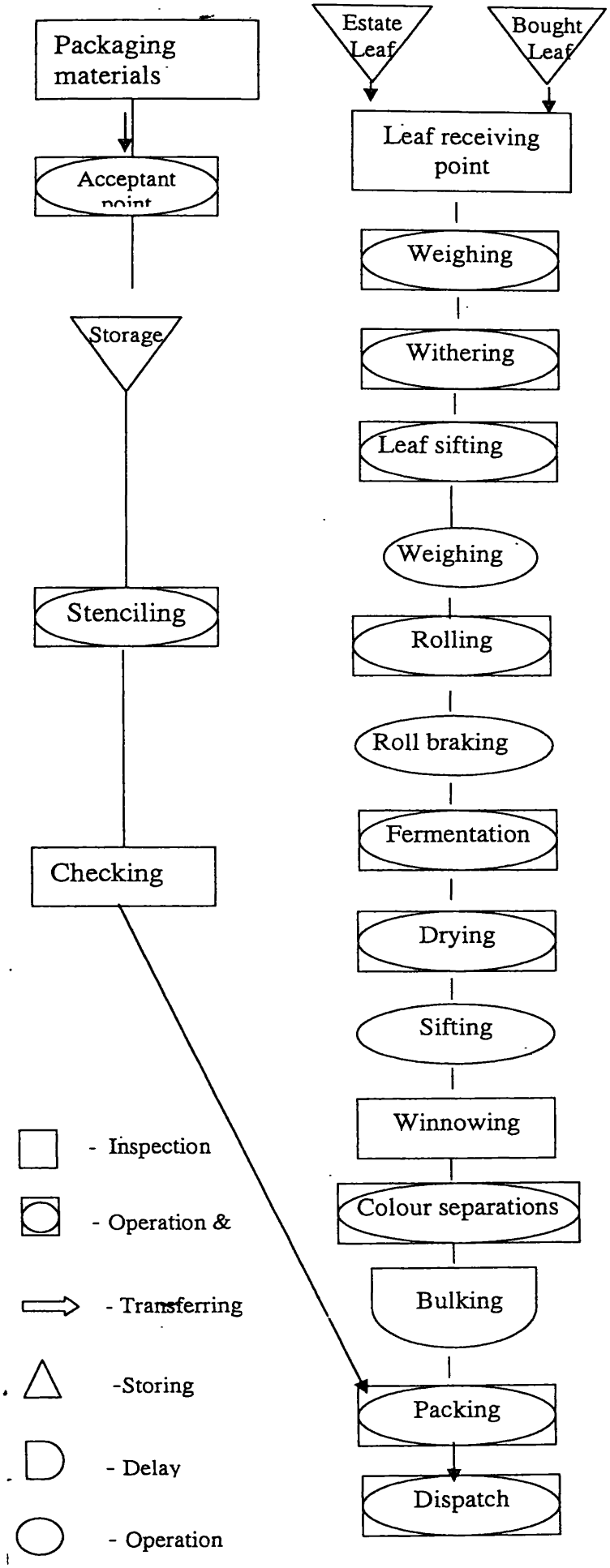


Fig .4.2 Factory lay out

4.2.9 Process flow chart



Control parameters& descriptions
• **CCP-1**,(*Green leaf*)control raw material intake sheet, (SQA) • Leaf counting and inspections. • Weighing calibrated weighing scale, Not accept over loaded bags.(25,Kg>Reject) • Hygrometers, air flow inspection, wither leaf counting. Wither leaf counting, inspections. • Withered leaf handling & inspections. • Batch wise Weighing & recording • Time duration 15 minute ,with pressure or without pressure according to rolling programme, inspection • Dhools separations-according to sizes. • Oxidation, Good Ventilation. RH maintaining-85%,Temperature-35^{0}C ,Recode keeping • **CCP-2**, (Microbes) Moisture testing & weighing -drier out put-(<3%) Temperature control-120 ^{0}C, Record keeping. • Separate particle in t o different sizes. • Remove Impurities. • Sort-out even color of product. • Mixing particular batch and evenly distributing tea product & Storing different grades. • **CCP-3,** *(Metal filling)*and **CCP -4**, *(Microbes)* Inspection packing material , moisture testing-(<6%), sampling analysis, Record keeping • Dispatch log sheet operations, and inspection different batches and invoices.

Fig.4.3 Process flow chart

4.3 Secondary steps of HACCP implementations

Table.4.12 Hazard analysis-R1

Raw material	Hazard type	Causes for hazards	Severity	Likely hood	Preventive actions	Q1	Q2	Q3	CP / CCP	Reason for decision making
Ply craft paper sac.	**Physical** Sand. dust, Metal filling	• Due to poor handling. • Manufacture defect.	L H	H H	• Good handling practices. • Labor acknowledgement • Good handling practices. • SQA.	N Y	- Y	- N	CP CP	• This hazard eliminates in withering operation and withered leaf shifting. • Reputed supplier ands SQA prevent this hazard.
	Chemical Paints & fabrication materials.	• In use not permitted for foods pack fabrications.	H	L	• Supplier quality assurances (SQA) certificate. • Acceptant criteria.	Y	Y	N	CP	• Can Prevent this hazards through supplier. acknowledgement. • SQA can prevent this hazard.
	Biological Insects.	• Due to poor storage. • Packing material Harborage for pest.	L	H	• Sanitary operation practices. • GMP.			N	CP	• In drying step all microorganism killed.

Table.4.13 Hazard analysis-R2

Raw material	Hazard type	Causes for hazards	Severity	Likely hood	Preventive actions	Q1	Q2	Q3	CP / CCP	Reason for decision making
Green leaf	**Physical** Sand. Dust, soil, other impurities.	• Due to poor handling.	L	H	• Good handling practices. • Good handling practices. • Labor acknowledgement	Y	Y	N	CP	• This hazard eliminate in withering. operation and withered leaf shifting.
	Chemical Herbicide and fungicide residual.	• Improper plucking round. • Bad agricultural practices. • Bad transporting methods.	H	H	• GAP, GHP. • Supplier quality assurances (SQA) certificate. • Supplier acknowledgement.	Y	Y	Y	CCP	• Can Prevent this hazards through supplier acknowledgement. • SQA can prevent this hazard.
	Biological Bacteria, fungi and Insects	• Due to poor handling • Contaminate from field	H	L	• Sanitary operation practices. • GAP&GHP	Y	Y	N	CP	• In drying step all microorganism killed

Table.4.14 Hazard analysis-3p

Process steps	Hazard type	Causes for hazards	Severity	Likely hood	Preventive actions	Q1	Q2	Q3	Q4	Q5	CP / CCP	Reason for decision making
Receiving point	**Physical** Sand, grit, piece of coir, poly sac bag, Plastic peace.	• Improper handling. • Lack of awareness. • Careless handling.	L	H	• Adhering GAP. • Labour training. • Supplier certification &Evaluation • Adhering acceptance criteria.	Y	Y	N	N	-	CP	• In withering operation. • Wither leaf sifting steps eliminate this hazard. • GMP prevents this hazard.
	Chemical Oil, Grease, Fertilizer	• Improper handling • Improper condition of vehicle	H	L	• Adhering GMP, • Supplier quality assurance. • Acknowledge workers.	Y	Y	Y	Y	Y	CP	• Impose GMP. • Training of workers can eliminate this hazard.
Receiving point	**Biological** *Coliform.* *Salmonella* bacteria And some fungi	• Lack of hygiene practices of workers • Poor Personal hygiene.	H	L	• Adhering GMP. • Personal hygiene assessment. • Follow SOP.	Y	Y	N	N	-	CP	• GMP prevents this hazard. • Sanitary operations eliminate this hazard.
	Insects	• Pest live with green leaf.	L	H	• Suppler acknowledgement. • Pest control.	Y	N	-	-	-	CP	• SQA eliminate this hazard. • Prevented by effective pest control.

Table 4.15 Hazard analysis-4p

Process steps	Hazard type	Causes for hazards	Severity	Likely hood	Preventive actions	Q1	Q2	Q3	Q4	Q5	CP / CCP	Reason for decision making
Withering	**Chemical** Hg	• Breakages of hydrometer.	H	L	• Alchol thermometer. • Hygrometers cover with net.	Y	N	-	-	-	CP	• Adhering SOP prevent hazards.
	Biological Bacteria	• Lack of hygiene practices of workers.	H	L	• SSOP. • Personal hygiene.	Y	Y	N	Y	Y	CP	• Personal hygiene assessment can prevent this hazards
	Insect	• Pest entering.	L	H	• Insecticuters uses.	Y	Y	N	N	-	CP	• Pest can control by netting & IC uses.
Withering	**Physical** Iron filling, Coir particles,	• Tear and wear of trolleys.	H	L	• Metal detector use.	Y	N	-	-	-	CP	• This hazard eliminate in winnowing steps.
	dust, cobwebs	• Due to mis handling.	L	L	• Effective cleaning and maintaining.	N	-	-	-	-	Cp	• Cleaning and visual observation can remove coir fiber, cobwebs.

Table 4.16 Hazard analysis-5p

Process steps	Hazard type	Causes for hazards	Severity	Likely hood	Preventive actions	Q1	Q2	Q3	Q4	Q5	CP / CCP	Reason for decision making
Wither leaf sifting	**Biological** Bacteria Inset	• Lack of hygiene practices of workers. • Pest entering.	H L	L H	• SSOP. • Personal hygiene. • Insecticuters uses.	Y Y	Y Y	N N	Y N	Y -	CP CP	• Personal hygiene assessment can prevent this hazard. • Pest can control by netting & IC uses.
Rolling	**Physical** Iron filling, Coir particles, Dust, cobwebs, Coconut sticks	• Tear and wear of trolleys. • Due to mis handling. • Poor handling.	H L L	L L L	• Metal detector use. • Train people & GMP. • Follow SOP.	Y N N	N - -	- - -	- - -	- - -	CP CP CP	• This hazard eliminate in winnowing step. • GMP and visual observation can remove coir fiber • Can remove by manually in roll braking step.
	Chemical oil, grease	• Leakage of gear box.	H	L	• Adhere to maintaining schedule.	Y	N	-	-	-	CP	• Proper maintaining can prevent.

Table 4.17 Hazard analysis-6p

Process steps	Hazard type	Causes for hazards	Severity	Likely hood	Preventive actions	Q1	Q2	Q3	Q4	Q5	CP / CCP	Reason for decision making
Rolling	**Biological** Microbial contaminations. Insect.	• Bad Personnel hygiene and sanitary practices. • Pest entering.	H L	L H	• SSOP. • Personal hygiene. • People acknowledge. • Insecticuters uses.	Y Y	Y Y	N N	Y N	Y -	CP CP	• Personal hygiene assessment can prevent these hazards. • Training eliminates bad habit. • Pest can control by netting & IC uses.
Roll braking	**Physical** Coir particles, dust, cobwebs Iron filling, Coir.	• Tear and wear of trolleys. • Due to mis handling • Tear and wear of roll.	H L	L L	• Metal detector use. • Train people & effective cleaning.	Y N Y	N - N	- - N	- - Y	- - Y	CP CP CP	• This hazards eliminate in winnowing steps • GMP and visual observation can remove coir fiber. • Hazard prevent by cleaning. • This hazard eliminate in winnowing steps.
	Chemical Paint particle ,oil	• poor maintaining	H	L	• Eliminate drier operations. • Effective maintaining.	Y	N	N	Y	Y	CP	• Prevent by GMP and labor training.

Process steps	Hazard type	Causes for hazards	Severity	Likely hood	Preventive actions	Q1	Q2	Q3	Q4	Q5	CP / CCP	Reason for decision making
Roll breaking	**Biological** Bacteria Insect	• Peacal mater, some MO's can contaminate. with handling • Pest entering.	H L	L H	• SSOP • Personal hygiene. • Insecticuters uses • Netting cover with window and all entrance.	Y Y	Y Y	N N	Y -	Y -	CP CP	• Personal hygiene assessment can prevent this hazard. • Drying step destroyed MO's. • Pest can control by netting & IC uses.
Fermentation	**Physical** Iron filling, Plastics particles, Dust, sand Glass particles.	• Metal particles coming from trough. • Due to mishandling. • Improper handling. • Breakage of thermometer.	H L L	L L L	• Metal detector use. • Train people & GMP. • Follow SOP. • Cover with mesh.	Y N N	N - -	- - -	- - -	- - -	CP CP CP	• This hazard eliminate in winnowing step. • GMP and visual observation can remove plastics. • If break tools, Mesh is net permit contaminate.

Table 4.19 Hazard analysis-8p

Process steps	Hazard type	Causes for hazards	Severity	Likely hood	Preventive actions	Q1	Q2	Q3	Q4	Q5	CP / CCP	Reason for decision making
Fermentations	Chemical Hg	• Breakages of thermo meter. • Careless handling	H	L	• Alcohol thermometer use. • Sanitary operation practices. • GMP • Proper maintaining hygrometer.	N	-	-	-	-	**CP**	• Alcohol thermometer it prevent this hazards.

Table 4.20 Hazard analysis-9p

Process steps	Hazard type	Causes for hazards	Severity	Likely hood	Preventive actions	Q1	Q2	Q3	Q4	Q5	CP / CCP	Reason for decision making
Fermentation	**Biological** Pathogenic bacteria Such as coliform	• Peacal mater, some MO's can contaminate with handling	H	L	• SSOP. • Personal hygiene.	Y	Y	N	Y	Y	CP	• Personal hygiene assessment can prevent this hazard. • Pest can control by netting & IC uses. • Drying step destroyed MO's.
Drying	**Physical** Iron filling, **Biological** Pathogenic micro organism	• Tear and wear error • Not drier maintain temperature • Poor hygienic practices • Moisture level of dire out more cause for MOs growth	H H	L H	• Metal detector use. • Train people. • Maintaining drier temperature 120 ^{0}C and • Control drier out put moister level < 3%. • Take drier input out temperature reading is taking every 30 min and maintain temperature around 120^{0}C.	Y Y	N [2a] Y	- -	- -	- -	CP CCP	• This hazard eliminate in winnowing steps. • Strictly adhering GMP and Sop can prevent this hazard. • Moister level control prevents this hazard.

Table 4.21 Hazard analysis-10p

Process steps	Hazard type	Causes for hazards	Severity	Likely hood	Preventive actions	Q1	Q2	Q3	Q4	Q5	CP / CCP	Reason for decision making
Sifting	**Physical** Sand, Dust Nuts& bolts, metal filling,	• Tear & wear machine • Poor maintaining.	H	L	• Metal detector use. • GMP.	Y	N	N	N	-	CP	• Winnowing step remove this hazards by metal detector.
	Chemical Oil and grease	• Due to poor maintaining &repairing.	H	L	• Adhering maintaining schedule and effective cleaning.	Y	Y	N	N	-	CP	• Effective cleaning and maintaining procedure. Eliminate this hazard.
	Biological Bird insect droppings, insects & their ,body parts, Rodents, mammalian	• Pest entrance to the sifting areas. • Visitors and other domestic Animal entrance.	L	L	• Effective pest controlling. • Visitors and domestic animal entering control.	Y	Y	N	N	-	CP	• In winnowing step prevent this hazard. • Adhering GMP eliminate this hazards. • Pest controls eliminate this hazard.

Table 4.22 Hazard analysis-11p

Process steps	Hazard type	Causes for hazards	Severity	Likely hood	Preventive actions	Q1	Q2	Q3	Q4	Q5	CP / CCP	Reason for decision making
Colour separating	**Physical** Sand, dust.	• Mishandling of product.	L	L	• Training people and adhere to GMP.	Y	Y	N	N	-	CP	• GMP and impose proper handling practice eliminate this hazards.
	Iron filling.	• Tear& wear of machine.	H	L	• Effective maintain machine & service by external expertise.	Y	Y	N	N	Y	CP	• In packaging steps eliminate this hazard.
	Biological Pathogenic bacteria, Insects and flies.	• Due to poor personal hygiene practices. Nosia, coughing, cut and boils.	H	L	• Effective personal hygiene assessment and offering sanitary facility. • Gloves, Hairnets, Mass ,compulsory to use for every workers • EFK use.	Y	Y	N	N	-	CP	• SSOP eliminate this hazard. • Personal hygiene auditing can eliminate this hazard.

Table 4.23 Hazard analysis-12p

Process steps	Hazard type	Causes for hazards	Severity	Likely hood	Preventive actions	Q1	Q2	Q3	Q4	Q5	CP / CCP	Reason for decision making
Bulking	**Physical** Sand, Dust	• Mishandling	L	L	• GMP and workers training.	N	-	-	-	-	CP	• GMP & workers training prevent.
	Nuts& bolts, metal filling,	• Tear & wear machine. • Poor maintaining.	H	L	• Effective maintain & cleaning	Y	Y	N	N	-	CP	• Effective maintaining prevents this hazard.
	Insect body parts	• Insect entrance processing area.	L	H	• Netting window & EFK installations I	Y	Y	N	N	-	CP	• Effective pest controls prevent.
	Biological Bird insect droppings, insects.	• Pest entrance to the sifting areas.	L	H	• Netting window & EFK installations	Y	Y	N	N	-	CP	• Effective pest controls prevent.
	Bacteria.	• Due to lack of sanitary practices.	H	L	• Personnel hygiene assessment. • Hair net, gloves, mass uses compulsory for all workers. • Hand washing facility before work.	Y	Y	N	N	-	CP	• SSOP prevent this hazards • Personnel hygiene assessments eliminate this hazard.

Table 4.24 Hazard analysis-13p

Process steps	Hazard type	Causes for hazards	Severity	Likely hood	Preventive actions	Q1	Q2	Q3	Q4	Q5	CP / CCP	Reason for decision making
Packing & dispatch	**Physical** Iron filling	• Wear & tear of machine.	H	L	• Metal detector use • Training people to finished product handling.	Y	Y	N	Y	Y	**CCP (3)**	• After this point product send to the auctions. Therefore this step becomes CCP& it is: Sensitive step.
	Sand and dust.	• Mishandling finished product.	L	L	• Provide adequate container to store the finished product till to packing.	N	-	-	-	-	CP	• GMP eliminates this hazard.
	Biological Pathogenic Microorganism, Coli forms.	• Poor personnel hygiene practices. • Moisture reabsorbing. • High moisture level of finished product cause increase microbial activity.	H	H	• GMP and SOP, SSOP. • Moisture measures each batch and every invoice before packing.	Y	Y	N	Y	Y	**CCP (4)**	• There is no preventive measure after this stage therefore its become CCP. • Strike guidelines follow with this operation.

-Table.4.3.1: Hazard analysis-14p

Process steps	Hazard type	Causes for hazards	Severity	Likely hood	Preventive actions	Q1	Q2	Q3	Q4	Q5	CP / CCP	Reason for decision making
Packing & dispatch	**Physical** Iron filling	• Wear & tear of machine.	H	L	• Metal detector use • Training people to finished product handling.	Y	Y	N	Y	Y	CCP (3)	• After this point product send to the auctions. Therefore this step becomes CCP& it is. Sensitive step.
	Sand and dust.	• Mishandling finished product.	L	L	• Provide adequate container to store the finished product till to packing.	N	-	-	-	-	CP	• GMP eliminates this hazard.
	Biological Pathogenic Microorganism, Coli forms.	• Poor personnel hygiene practices. • Moisture reabsorbing. • High moisture level of finished product cause increase microbial activity.	H	H	• GMP and SOP, SSOP. • Moisture measures each batch and every invoice before packing.	Y	Y	N	Y	Y	CCP (4)	• There is no preventive measure after this stage therefore its become CCP. • Strike guidelines follow with this operation.

Table 4.25 All principles-3p

P- 1			P-2	P-3	P-4					P-5	P-6			P-7
Hazard analysis			Determine CCP	Established critical limits	Monitoring					Corrective actions	Verification			Records
Steps	Hazards	Control measure	Type	Critical limits	What	Where	When	How	who	Corrective actions	How	Who	When	Documentations
Drying.	Biological Pathogenic microorganism	• Maintain the drier temperature around 120^0C. • Reading drier temperature, and record each 15 min. • High water activity cause for MO's growth	CCP-(2)	• Drier out put moisture level 3% not exceed 4% and not les than 2%. • Moisture 1% level exceed 1liable microbes Growth. (TRI recommended)	Moisture % of made tea	Immediate after cooling near the drier	Every each batch of dried tea	100g-dried tea randomly collected. Out of 10g shall measure and analysis.	• Dried tea sample shall take by drier in charge. • Sample analysis by QAE	• If drier temperature getting low/high, inform ferns operator • If low moisture recorded isolate the batch and hold with yellow tag with batch number. • If temperature low Hold the dire operation or adjust spreading thickens. • Refried isolate batch	Document reviews Recordkeeping	Factory assistant Drier operation in charge	Daily Each batch	ID/SOP/drier/ch-1,2

Table 4.26 All principles-3p

P- 1			P-2	P-3	P-4					P-5	P-6			P-7
Hazard analysis			**Determine CCP**	**Established critical limits**	**Monitoring**					**Corrective actions**	**Verification**			**Records**
Steps	Hazards	Control measure	Type	Critical limits	What	Where	When	How	who	Corrective actions	How	Who	When	Documentations
Drying.	Biological Pathogenic microorganism	• Maintain the drier temperature around 120^{0}C. • Reading drier temperature, and record each 15 min. • High water activity cause for MO's growth	CCP-(2)	• Drier out put moisture level 3% not exceed 4% and not les than 2%. • Moisture 1% level exceed 1liable microbes Growth. (TRI recommended)	Moisture % of made tea	Immediate after cooling near the drier	Every each batch of dried tea	100g-dried tea randomly collected. Out of 10g shall measure and analysis	• Dried tea sample shall take by drier in charge. • Sample analysis by QAE	• If drier temperature getting low/high, inform ferns operator • If low moisture recorded isolate the batch and hold with yellow tag with batch number. • If temperature low Hold the dire operation or adjust spreading thickens. • Refried isolate batch.	Document reviews Recordkeeping	Factory assistant. Drier operation in charge.	Daily Each batch.	ID/SOP/drier/ch-1, 2.

Table 4.27 All principles-3p

P- 1			P-2	P-3	P-4					P-5	P-6			P-7
Hazard analysis			Determine CCP	Established critical limits	Monitoring					Corrective actions	Verification			Records
Steps / Raw material	Hazards	Control measure	Type	Critical limits	What	Where	When	How	Who	Corrective actions	How	Who	When	Documentations
Packing & dispatch.	Physical Iron filling	• Installation metal detector. • Inspect its performance • Regularly remove iron filling. • Record keeping.	CCP-(3)	• Less than 15mg/1kg (TRI and TASL recommendations)	Measure mount of metal filling	At the packaging point.	Per each batch before packing and dispatch.	Weighing by digital electric balance.	Metal collecting and performance amassment by sifting supervisor. Metal amount measured by QAE.	• Batch wise isolate and hold with yellow tag. • If exceed metal 15mg/1kg, reprocess through the metal detector	Document review and record keeping	Factory officers and Sifting supervisor. QAE	Daily, and before dispatch or As necessarily	*ID/GMP/SOP/Md - 1,2.*

P- 1			P-2	P-3	P-4					P-5	P-6			P-7
Hazard analysis			**Determine CCP**	**Established critical limits**	**Established Monitoring**					**Established Corrective actions**	**Established Verification**			**Records**
Steps / Raw material	Hazards	Control measure	Type	Critical limits	What	Where	When	How	who	Corrective actions	How	Who	When	Documentations
Packing & dispatch.	Micro Biological High moisture level permit Colifoms and yeast and mold growth due to high (aw).	• . Adhering strike sanitary operations. • Hair cap, mass, gloves use compulsory for packing operators. • Prevent moisture reabsorbed to dried product.	CCP-(4)	• Moisture level control below 6%.for ready to pack made tea. • Total yeast max-500cfu/g • Total mould:max-100cfu/g • *E.coli*: absent /g • Coliform10 count /g • Salmonella: absent /25g (TASL standard).	Moisture % by moisture meter Microbiological analysis	At the packaging point.	Per each batch before packing and dispatch.	Randomly sample collected and Moisture meter Make Dilution serious of .Sample. and grow specific culture media	Moisture amount measured by QAE. MOs test carried out by reputed laboratory	• If exceed moisture level that standard, Batch wise isolate and hold with yellow tag. • Microbes amount exceed hold the batch with yellow tag • Reprocess (refried) hold batch.	Document review and Record keeping.	Factory officers and Sifting supervisor. QAE	Daily, and before dispatch or As necessarily MO's test performed at least 6 month.	*ID/GMP/SOPmois-det* *ID/GMP/SOP/Modet*

Moragalla Tea Factory				DOC.REF			
TITLE	Validation of HACCP plane			ID	HAP	RE	1
DATE OF ISSUE	2006.07.27	ISSUE NO	01	PAGE		*1 of*	
DATE OF REVISION	-	RIVISION NO	00				

4.3.6. Validation of HACCP plane

Frequently auditing factory lay out, factory inside, operation practices, process etc, by internal audit team (HACCP team).External auditing shall perform at least each six month per year. If violate the standards should revise immediately getting corrective action with given time durations, audit repot and recommendation, nonconforming of standards should record as appendix VI.

Prepared :	HACCP officer	Signature:		Date:
Reviewed:	Assistant factory officer	Signature:		Date:
Approved:	Factory Manager	Signature:		Date:

4.3.6.1 HACCP effective evaluations

Following phenomena are employee to evaluation HACCP system:

- Monthly evaluate weakness strength of plan supportive network.
- Holding quality circle and groups meeting to identify workers training needs and performance.
- Sample analysis during processing line, dispatch point and measure the conformity or violation of standards
- Equipment calibration performed with regularly basis.

Avoid cross contaminations

- Minimize the process traffic patterns and establish continuous process flow.
- Water bath establish in entrance of process line.
- Establish transparent sheet to the roof to penetrate high amount of sunbeam which can destroy MOs and make dry sanitation environment.
- Improve the daring conditions around the fermentation area.
- Floor shall durable and impervious to moisture, water. Tiling flow would be advantage
- Wind flow shall control as much as possible (Fixing up window) because fungal and mould spores can contaminate the process or product.
- Wet zone shall clean with food graded sanitizer.
- Fixation of door (Self close door) and air curtain application can minimize the risks.
- Personal hygiene practices and hand washing facility and regularly check personal health conditions of employee.
- Keep outer area, inert area, of the factory aseathically.

Prepared	HACCP officer	Signature:		Date:
Reviewed	Assistant factory officer	Signature:		Date:
Approved	Factory Manager	Signature:		Date:

4.3.7 Document control

Record shall be established and maintain periodically, update, It shall provide evidence of conforming to requirement with HACCP to effectively maintain. The responsibility of document control shall assign and the people legally assign to handle the record update. Every aspect of shall take document identifications, location purpose responsibility and retention time, methods of disposal shall include in document plan.

Table 4.3.7 documentation plane

Type of record	Location	Responsibility	Retention time	Disposal method
• Moisture test.	ID/ SOP / Sf-Md. ID/SOP/Dr.Mod,2	Junior factory officer and QAE	7 Months	Burning
• Metal detecting.	ID/SOP/Md	Junior factory officer, QAE	7 Months	Burning
• Glass audit	ID/GMP/Gl.eva.-1	Junior factory officer.	7 Months	Burning
• Personnel hygiene	ID/GMP/Ph-asses,1	Junior factory officers & QAE	7 Months	Burning
• Personal training	ID/GMP/Pt-she.1	HACCP expert and QAE	2 Years	Burning
• Calibrations	ID/hacp/GMP/cali/cb1.	QAE & HACCP experts, Factory assistant.	1 Years	Burning
• EFK performance.		QAE & junior factory officers.	6 Months	Burning
• Cleaning	ID/GMP/Pest/EFK			
	ID/hacp / pr-cle,1	Senior factory officers	6 Months	Burning

Prepared	HACCP officer	Signature:		Date:
Reviewed	Assistant factory officer	Signature:		Date:
Approved	Factory Manager	Signature:		Date:

Discussion

Food safety incidents are reported almost everywhere and can arise any point of the food chain. They are danger to the public society and increase consumer distrust in addition to costing a lot of money wasting. The rapid changes of in technology with more complex technologies being introduced every day in lifestyles have produced a more complexes situations to produced safe foods .This is the most effective way to ensure safe food today is the adoption of food safety through food chain to the fullest extent reasonably possible. Food business operator have an obligation t take all reasonable precautions and exercises all the diligence in the avoidance of failure ,whether in the development ,manufacture, distribution, sale of food products to the consumer. Product liability and legal aspects in the supplier - buyer relationships also increase the awareness for food safety within the industry food safety documentation can be important part of evidence in such incidents.

Five major steps are involved, (CCvd-HACCP, 2002). In the implementation of FSMS are Prerequisites, preparations and planning, Application of HACCP principle, implementations, Maintenance of the food safety management system.
The team should be trained in the methodology and terminology of HACCP to ensure the common understanding of vocabulary .It is also recommend for the team to get general knowledge about the team building and working rules, and methods .The team should understand that changes will be introduced to the organizations and that such changes need to be managed.

HACCP team is consist multi disciplinary persons. Effective HACCP plan can maintain all performances and group effort. Group leader should give driving Force, and detections to achieve the main goal. Management responsible of top management is very important to maintain HACCP and PRPs.

A flow diagram should show all major steps of in a production process from beginning to end. In case of complex process the flow diagram may summarize and broken up in modules with more details,(CCvd-HACCP,2002). Since HACCP is a preventive method it is recommenders to consider, the eliminations of the source of hazards it self. Therefore all hazards at each processing steps should listed to garter with conditions leading the hazards.

Monitoring procedure should provide information fro in time for corrective action to be taken to regain control of the process before there is need to segregate or reject product (Mortimore, & Wallace, 1998).When monitoring of process operating to a target between upper limits and Lower limit within the critical limits.the operator may have the authority to take action to bring the process back to the target. If monitoring indicates he process is

outside, the critical limits the operation must be notify the relevant person with authority to make the necessary decision (Crosland, 1996). The operator should no be allowed to change getting the target value or critical limits.

CCP number one was identified in green leaf which was determined with Q3 decision tree (Appendix-I). Chemical residual is the identified hazard with associate with field practices. It is significance cause for health risk after consumptions. That hazard could found in recently that associated with Sri Lankan made tea. Controlled limits of this hazards is GMP.SQA, GAP, etc., (SGS-TASL, 2003), established control that hazards. Supplier evaluation sheet was provided to acknowledge suppliers. Sample analysis should frequently carry out to prevent these hazards. Sample should take from green leaf receiving point and ready to pack made teas and separately analysis by repudiated laboratory that determine the pesticide residual level dried and green leaf. Random sample procedure should follow to increase accuracy of the sample colleting methods, SQA, supplier acknowledgement are the most effective, and less cost measurement to overcome that problems

CCP number two was identified in drying steps. Biological hazards may associate with drier operations that could occur due to poor operations practices, poor personal hygiene, careless attention etc. The CCP was identified using Q5 decision tree (Appendix-I), according that drier steps that specially design for eliminate this hazards; there fore it becomes a CCP. Because in appropriate drying temperature is caused for survive spores and some Thermophiles remain in this steps, or poor personal hygiene (Nosia, coughing, fecal mater contaminated with hand) cause for the product contaminated, (Minor, 1983) that case of arising point hazards because high moisture content proportional to high water activity, it cause for the growths MOs consequence increases. Therefore Control measures is established to maintain the drier temperature around 120 ^{0}C.Following mean chart shows the critical limit of drier and Control limit of the drier functioning.

According to the X-bar chart inlet temperature goes down to LCL liable for arising of hazard, therefore drier inlet temperature should control within that control limits.

CCP number three was identified in dispatch point .Significance hazards associates with metal particle or fillings. According to Q5 decision tree (Appendix-I) this step is become a CCP, because this hazard will not eliminate further any steps after this operation points. Metal detector is use as control measures, that is the only the way of preventive this hazards. If exceed recommended maximum permissible levels that batch should reprocess through the metal detectors.

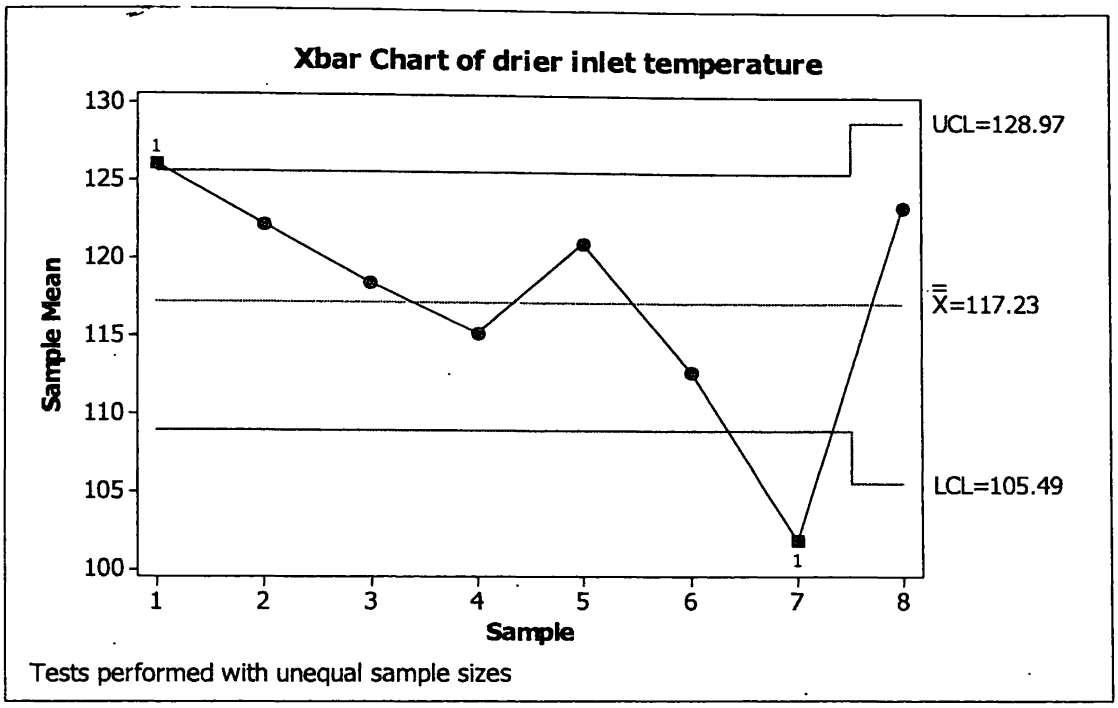


Fig. 4.4 Control chart

CCP number four was identified in packing and dispatch point. It belongs with biological component (microbes),and it determine the by Q5 decision tree because it is may increased unacceptable level that really cased for the health risk and there is no controlling point cut down that hazards acceptable levels. Reasons for the hazards likely occurrences are bad personal hygiene, Bad sanitary operations that hazards can control by controlling moisture level as earlier mentioned. The critical moisture level of dispatch point is < 6% (SGS-TASL, 2003).If sample is recorded more than 6% moisture levels that should be reprocess. Different moisture levels is established for the same product may arise the problem in your mind reasons for that critical limits is dried out sample can moisture absorbed till to packing steps. As result moisture level of the product is gradually increased. How ever, TRI recommend a moisture level of dried tea has 11% permissible in auction but a moisture level is exceeding 11% liable microbes' growth (TRI, Recommendations, 2006). Moisture re absorption and hold in long period in auctions till to sell is the reasons for differences of this critical limits establishing of dried tea in difference stages

Process capability was analyzed to concern the accuracy of product statistically controlled. The statistical verification of process in order to established the confidence of its ability stay within specialized limits is known as process capability. It determines whether the process is capable of achieving control criteria (The critical limits) that have been established. And determine whether the process is capable of being control.

According to the above decision CpK value is les than 1.33 therefore this process should modified up to acceptable levels. Process capability is a process measure the degree to which your process produces out put that meets the customer's specification.

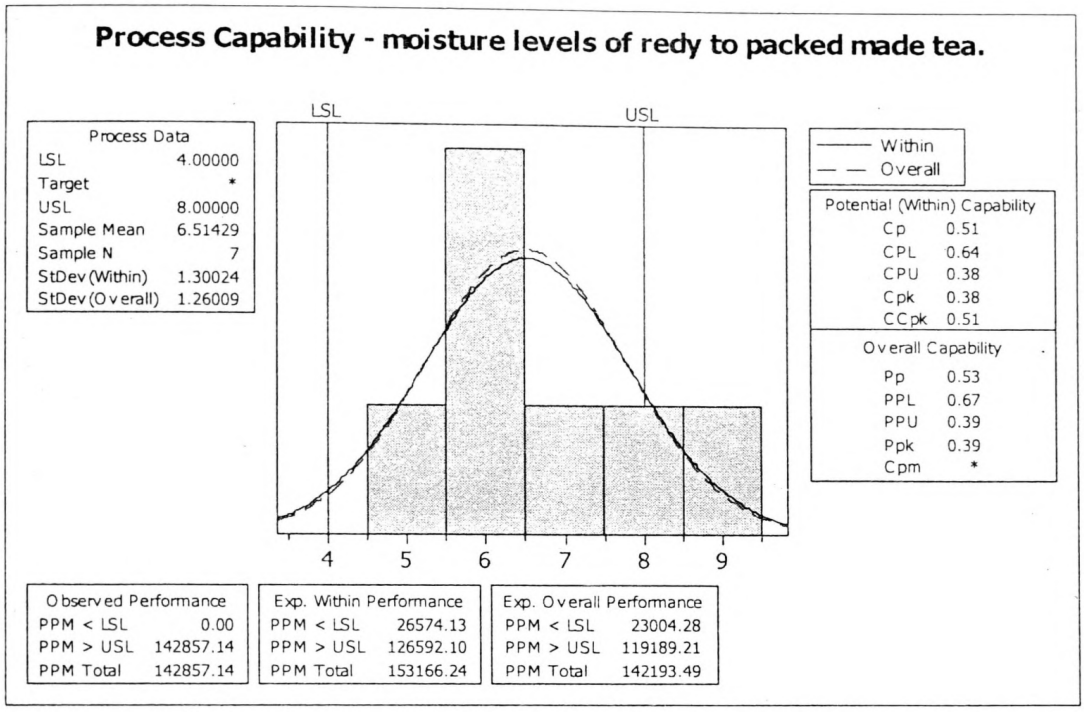


Fig. 4.5 Process capability

- Cpk > 1.33 (A Highly Capable Process).
- Cpk < 1 (The Process is not Capable).

Micro biological assessment were identified most of derided tea sample exceed the maximum permissible levels (SGS-TASL, 2003), it may cause for the arising of health risk. Microbiological analysis was fond the following result

Table.4.29 Micro biological test results

Tested Result				**Maximum permissible level**
Organism	OPA- CFU/g	FBOP-CFU/g	DUST - CFU/g	CFU/g (TASL)
Yeast	Absent	9.00×10^3	2.70×10^2	5000
Mould	38.73×10^3	81.53×10^3	133.3×10^3	1000
E-coli	-	-	-	Absent /g
Salmonella	-	-	-	Absent /25
Coliform	-	-	-	10 count /g

Most of foods born illness are linked with micro organism therefore these micro biological tests were carried out to estimate the microbial safety of the product. However above result show unsafe of product that may harm to the consumers.

Fig.4.6 Yeast and moulds

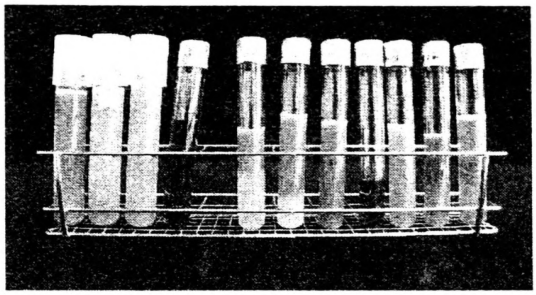


Fig.4.7 Coliform test

Other than above test, drinking water sample was analyzed, results of that analysis as Coliform, E-coli tests were positive. MPN table number of Coliform (333 in three sample analysis) is more than 2400 Cfu/100 ml water it is to high and E-coli also estimate by MPN table is (120 in three sample testing) 6 CFU/100ml of water. Those parameters are too high and which clearly show this water is thighly contaminated with Coliform (SLS-614, 1991).Therefore that water source should treat with permitted sanitizers.

Heterophylic plate count (HPC) test was found out pathogenic organism density of the rolling room floor is 8.08 $\times 10^3$ CFU/cm^2. Therefore effective cleaning sanitation program should thoroughly follow. This micro biological should analysis area frequently perform to measure effectiveness of HACCP plan.

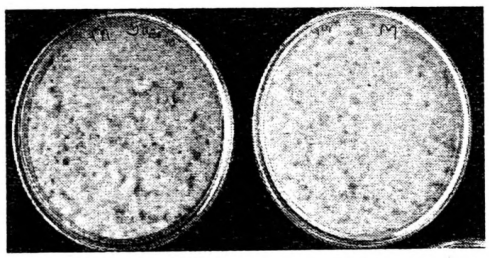


Fig.4.8 Heterophyllic plate count (HPC)

CHAPTER-5

5. CONCUSSION

5.1 Conclusion

Implement food safety management project was successfully completed according to all legal & documentation requirement to achieve the main goal. In basic preparation steps found out following things that are included in results,

Course & effect diagrams sis show 3 major problems found out in Moragalla tea processing center are labors problem, portable water problem & leaf quality etc...

Other than this several minor problem were found out.

Training & awareness program was completed to all workers & a selected staff member. They can handle the HACCP system effectively.

Five s was implemented in rolling are to effective function HACCP with contain & cleaning standards schedule. Process, supplier control are per formed that help to really maintain the HACCP system. Implementation of HACCP and other supportive network increase product safety. Sanitary operation practices, personnel hygiene amassment and other operation practices will create safe works place and people satisfactions. Microbiological safety and health risk also determine and preventive action was recommended. Finally food safety management system is established with free determine CCPs which are effectively control according to the action plan.

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APPENDIX-I

Decision tree for raw materials:

Q_1. Is there a hazard associated with this raw material?

Yes

No → Proceed*

Q_2. Are you or the customer going to process? This hazard out of the product?

Yes

No → Sensitive raw material High level of control required CCP**

Q_3. Is there a cross-contamination risk to the Facility or to other product which will not be controlled?

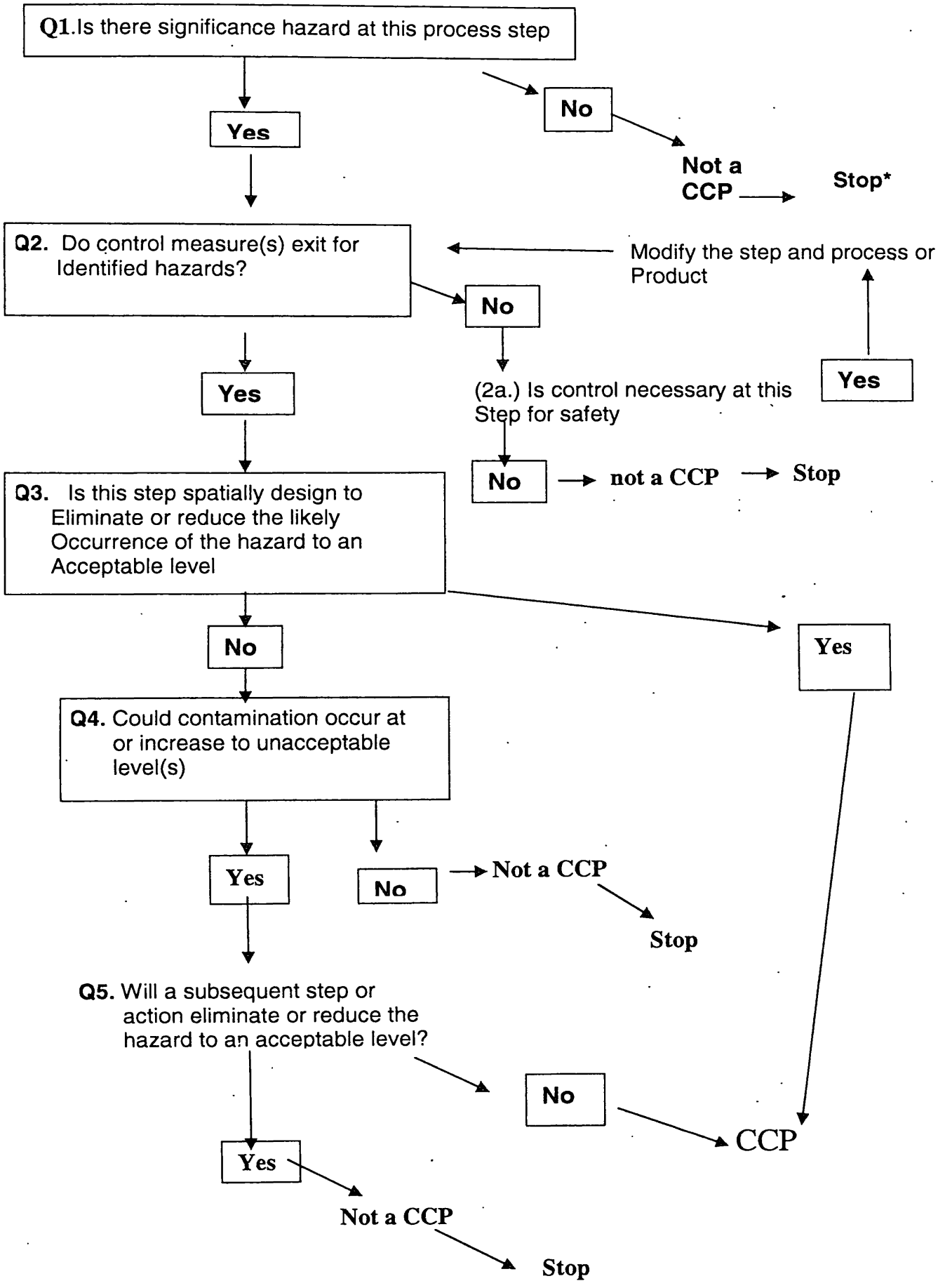
Yes → Sensitive raw material High level of control required CCP**

No → Proceed*

* Proceed to your next raw material

* Following the hazard analysis, you are likely to find that this raw material must be managed as a CCP

Decision tree for process steps



APPENDIX -II

Basic definitions

- **Action Limit:**

  A value fro the product or process parameter under consideration,

  Deduced from the critical limit value, which indicated that an intervention process is required

- **Corrective action :**

  Any action to be taken when the result of monitoring at the CCP indicate that a loss of control.

- **Critical Control Point:**

  A step at which it is essential that a specific control measure is applied to prevent or eliminate a food safety hazard or reduce the risk to an acceptable level.

- **Critical Limits :**

  Criterion which separates acceptability from non acceptability

- **Flow diagram:**

A Systematic representation of the sequence of steps **or** operation use in the preparation processing , manufacturing , storage , transportation , distribution, handling or offering for sale of a particular food item.

- **Food business operator:**

The person or persons responsible for ensuring that the requirements of the food legislation are met within the food business under his their control.

- **Food hygiene:**

All condition and measures necessary to ensure the safety and suitability of food at all stages of the food chain.

- **HACCP (Hazard Analysis and Critical Control Point):**

A system identifies, evaluate and control hazards which are significant for food safety

- **HACCP audit :**

  A systematic and independent examination to determine whether the HACCP system , including the HACCP plane and related results , comply with planned arrangements , are implemented effectively and are suitable for the

achievement of its objectives.Note : Examination of the Hazard Analysis is an essential of the HACCP audit.

- **HACCP plane:**

  A documented prepared in accordance with the principles of HACCP to ensure control of hazards which are significant for food safety in the segment of the food chain under consideration.

- **HACCP team :**

Group of individuals (multi – disciplinary) who develop, implement and maintain a HACCP system.

- **Hazard :**

A biological, chemical, or physical agent in or condition of food with that potential to cause an adverse health effect.

- **Hazard Analysis:**
- The process of collecting and evaluating information on hazard and conditions leading to their presence , to decide which are significant for food safety and should therefore be addressed in the HACCP plane
- **Preventive actions:**

Any action and activity that can be used to prevent or eliminate a food safety hazard or reduced it to an acceptable level

- **Pre Request Program (PRP) :**

Any specified and documented activity or facility implemented in accordance with the codex General Principles of food hygiene, good manufacturing practice and appropriate food legislation, in order to establish basic conditions that are suitable for the production and handling of safe food at all stages of the food chain

- **Preventive action:**

Any measure or activity that will be used to prevent , to eliminate or to reduce the recurrence of causes for existing deviation , defects or any other undesired situation with respect to food safety.

- **Primary production** Those steps in the food chain up to and including harvesting , hunting , fishing , milking and all stages of animal production prior to slaughter.
- **Risk :**

The probability of causing an adverse health effect, caused by the occurrence and the severity of a particular hazard in food when prepared and consumed according to its intended use.

- **Step:** A point procedure, operation or stage in the food chain, including raw materials, from primary production to final consumption.
- **Target value :**

The value of the product or process parameter(s) to be monitored targeted within action – limit values (the range of acceptable variations) and certainly within critical limit values, thus securing a safe product

- **Validation:** Obtaining evidence (in advance) that the specific and general control.
- **Verification :**

The Application of methods, procedure, tests and other measures of the HACCP plane are effective evaluations, in addition to monitoring, to determine compliance with the specification laid down in the HACCP plane and the effectiveness of the HACCP – based safety system

- **MRLs :** Maximum Residue Limits (Made remaining pesticide amount)

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