Identification of Control Points and Critical Control Points in Application of HACCP Safety Management System to Up Country Orthodox Tea Factories

A.G.B.S. BANDARA[1], S.L. GINIGE[2], K.G.M.C.P.B. GAJANAYAKE[1] and H. JAYASUNDERA[3]

[1]*Department of Plantation Management, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP).*
[2] *Sri Lanka Standard Institute, 17, Victoria Place, Elvitigala Mawatha, Colombo 08.*
[3]*Talawakelle Tea Estates Ltd., No.25, Foster Lane, Colombo 10.*

ABSTACT

In the era of World Trade Organization (WTO) regime application of Hazard Analysis and Critical Control Point (HACCP) food safety management system has become an essential requirement for tea industry, which maximizes product quality and safety and gain competitiveness in the international trade. In tea manufacturing process Critical Control Points (CCP) are the steps in manufacturing where control is essential to guarantee the potential hazards do not become manifest as actual hazards. If this is not controlled it could result in an unacceptable safety risk in tea trade. Identification of Critical Points (CP) and CCP is one among the twelve key tasks in application of HACCP system to the tea sector.

With this context this study was carried out to identify common hazards, control points, and critical control points to facilitate HACCP teams to implement HACCP to their tea factories as food safety management system. The study was done in ten up country orthodox tea processing factories, with seven HACCP certified and three with no certification and managed by Talawakele Tea Estate Ltd. Results found that there are nine biological hazards, twelve chemical hazards, and 18 physical hazards. Two CCPs. were also identified. All other hazards were identified as control points (37).

KEYWORDS: Black Tea Processing, Control points, Critical Control Points, Food Safety Management System, HACCP

INTRODUCTION

Tea *(Camellia sinensis (L) O. kuntze)* is pre-eminent among Sri Lankan plantation crops. Tea industry is one of the most important industries in the country's economy. In year 2004, Sri Lanka had produced 308.1milion kg of tea, out of which 96 percent was exported and the rest channeled to the domestic market (Anon., 2006a).

Sri Lanka being the third biggest black tea producing country, it has a global production share of 19 percent in the international sphere. Today, Sri Lankan tea has dispersed nearly 106 countries. At the same time the tea exports from Sri Lanka subjected to fierce competition from more than 60 tea-producing countries, and Kenya, China, and Indonesia are among the major competitors (Anon., 2006b). An added advantage over competitors can be gained through increased productivity, value addition and quality improvement through food safety techniques.

HACCP is an abbreviation for 'Hazard Analysis Critical Control Point. It is the most effective management system which maximize product safety and cost effective system. (Dhanakumar, 2002). In this system, instead of relying solely on inspection of foodstuffs before delivery, the producer works out exactly where problems might occur and introduces measures to prevent them. According to Ollinger-Snyder and Matthews (1994), HACCP can be applied throughout the food chain from primary production to final consumption and its implementation should be guided by scientific evidence of risk to human health, as well as enhancing food safety.

HACCP is not a new system. The concept was developed in year 1960s by the Pillsbury Company, while working with NASA and the US Army Laboratories to provide safe food for space expeditions. The limitations of end product testing became evident to those who were trying to provide the safest possible food products. In order to ensure that food used for space missions would be safe, almost all the product manufactured would need to be tested, leaving very little for actual use. A new approach was needed which was practical and proactive (Goodrich, *et al, 2005*).

It can minimize the possible hazards by implementing HACCP management system to the tea processing process. Because establishment of critical mechanical or test parameters for control critical points, the validation of these prescribed steps by scientifically verifiable result, and the development of record keeping by which the processing establishment and the authority could regularly monitor how well process control was working all culminated (Anon., 2006c). For tea, this should be done with the help of experts in tea research bodies within international parameters. It will make the product competitive in terms of quality and cost in global market. From beginning of 2006 most of the European countries demand for the HACCP certified tea. This situation demand a new vision for the Sri Lankan tea industry, beyond product testing, beyond HACCP and beyond ISO 22000, the latter had published in September 2005. From beginning of 2006 most of the European countries demand for the HACCP certified tea. This situation demand a new vision for the Sri Lankan tea industry, beyond product testing, beyond HACCP and beyond ISO 22000, the latter had published in September 2005.

Recently implementation of HACCP system to tea factories has rapidly increased. However still there is very little scientific studies carried out to explore the basic requirements in the system. It can cause many weaknesses compared with international standard in the system. So Total Quality Management in tea through application of the principals of quality, safety and risk management are essential for competitiveness equally in case of both the small and large scale growers in the WTO regime. At this juncture, when tea prices are globally depressed, it is particularly important to understand the applications of the principles of HACCP perspective in plantation sector (Dhanakumar, 2002).

Critical Control Points (CCPs) 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 agricultural commodity trade (Dhanakumar, 2002).

Objectives of this study are to identify, common hazards in up country orthodox tea processing factories, CCPs, CPs and to assist HACCP teams to implement HACCP successfully to their tea factories

METHODOLOGY

This section presents the method used to identify common hazards in up country orthodox tea processing factories, CCPs and CPs, which was carried out in three phases *viz.* (1) Preparation of process flow chart (2) Identification of hazards, (3) Identification of control points and critical control points. The necessary data for the study was collected from a survey using a semi structured questionnaires and formal discussions in ten up country tea processing factories under phase (2) which includes three HACCP certified, and seven not certified factories, managed by Talawakele Tea Estate Ltd, from January to June 2006

1. Preparation of Process Flow Chart Diagram

The complete process flow chart diagram was prepared (Figure -1) with all recommended conditions in orthodox tea processing (Annexure II).

2. Identification of Hazards

The each processing step was studied individually in selected up country orthodox tea processing factories, and possible hazards (biological, physical, and chemical) associated with each processing step were identified through a semi structured questionnaire In addition formal discussions were held with factory officers to further confirm possible hazards. Finally the hazard list was prepared (Table – 1, 2 and 3).

3. Identification of Control points and Critical Control Points

The Q3 and Q5 decision tree system was applied to identify hazards .Q3 decision tree system was used to analyze raw material and, Q5 decision tree system was used to analyze all other processing steps (Annexure III). Then results were recorded in a table.

RESULTS AND DISCUSSION

Common Hazards Identified in Up Country Orthodox Tea Processing

In up country factories nine biological hazards, 18 physical hazards, and 12chemical hazards were identified as given in the Table - 1, Table - 2, and Table - 3 respectively. It was found that growth of microbes' sand, dust, stones, iron fillings, oil and grease were most common hazards in upcountry black tea processing procedure.

Identified CPs and CCPs

After applying the Q3 and Q5 decision tree system, two (2) CCPs were identified, (Table - 4) and all other hazards were identified as CPs (38).

Reasons for the decision on identifying CCP is that there is no further step to reduce or eliminate these hazards in the production process.

Table 1 - Identified biological hazards:

Biological hazards	Processing step										
	01	02	03	04	05	06	07	08	09	10	11
01. Growth of microbes	P	P	P	P				P		P	P
02. Moulds	P	P									
03. Insects			P								
04. Tortrix	P										
05. Mites	P										
06. Ant	P										
07. Microbial contaminated water	P			P							
08. Moisture						P					
09. Birds droppings with microbes	P			P							
10. Unclean handling, - Wounds - Dust		P									
11. Unwashed hands with microbes		P									

Note: P mean the present of the Hazards

Table 2 - Identified physical hazards:

Physical hazards	Processing step 01	02	03	04	05	06	07	08	09	10	11
01. Sand/dust /stones	P	P		P		P	P		P		
02. Coins	P	P		P							
03. Nylon Strips	P	P	P								
04. Polythene	P										
05. Twigs /fibers /weeds	P			P							
06. Food particles	P		P								
07. Dead insects	P										
08. Human hair		P	P	P			P		P		
09. Glass particles			P								
10. Insect debris			P								
11. Iron fillings				P		P	P		P		
12. Bristles				P							
13. Brass particles					P						
14. Nuts and bolts				P		P	P				

Note: P mean the present of the Hazards

Table 3 - Identified chemical hazards:

Chemical hazards	Processing Step 01	02	03	04	05	06	07	08	09	10	11
01. Fertilizer residues/foliar nutrients residues/pesticide residues	P										
02. Oil and grease	P			P		P	P				
03. Diesel fumes	P										
04. Smoke	P										
05. Detergent residues				P	P						
06. Paint residues				P							
07. Carbon particles						P					
08. Stencil ink									P		
09. Glue									P		

Note: P mean the present of the Hazards

Processing steps

Step 01: Receiving of green leaves
Step 02: Transport to trough and Spreading
Step 03: Withering
Step 04: Rolling and roll breaking
Step 05: Fermentation
Step 10: Storage
Step 06: Firing (Drying)
Step 07: Grading
Step 08: Binning
Step 09: Bulking and Packing
Step 10: Storage
Step11: Dispatch

Table 4 - Identified critical control points:

Step	Hazard	Q1	Q2	Q3	Q4	Q5	CCP/CP
01. Receiving of raw material	Chemical : Pesticide	Yes	No	-	-	-	CCP*
06.Firing (Drying)	Biological : Moisture	Yes	Yes	Yes	-	-	CCP*

Control Measures for Identified CP and CCPS

Majority of the CPs can be controlled by Good Agricultural Practices (GAP), and Good Manufacturing Practices (GMP). As an example; it can be effectively established that the passage through mesh during the sifting process will eliminate the majority of ferrous and non-ferrous particle from the tea. Any remaining ferrous particles may be removed by placing magnets along the processing path during grading/packing. However, due to the difficulties in establishing scientific verification parameters as to the effectiveness of these measures, they have been regarded as effective preventive measures through GMP accordingly.

Pesticide residues can be controlled only in the field. Because of that it could becomes a CCP. By using TRI recommended agrochemicals, application of such chemicals at TRI recommended rates, following harvesting intervals as per TRI recommendations (follow pre harvest safety period), checking wind conditions in application of pesticides, and use of trained spray operators can control minimum level of residues

By maintaining drier inlet/outlet temperatures also the second CCP can be controlled. It should be 127 ^{0}C +/- 2 of inlet temperatures, and 90 ^{0}C +/- 2 of outlet temperature. The moisture level should be maintained in between 2.5 - 3.0 percent.

CONCLUSIONS

This study revealed that there were thirty nine common hazards in up country orthodox tea factories. Thirty seven of them were CPs, and two were CCPs. It found that growth of microbes, sand, dust; stones, iron fillings, oil and grease were most common hazards in upcountry black tea processing process. In this study the two identified CCPs were related to chemical and biological hazards. One was pesticide residues in green leaves, and the other was moisture level after firing. Proper validation methods were not identified and established for each CCPs specially removal of ferrous (iron) particles through magnets which should be considered as the 3rd CCP according to the decision tree model. It became Good Manufacturing Practice due to lack of accepted validation method for magnet (metal remover).

ACKNOWLDGEMENT

The authors wish to thank the management of Talawakelle Tea Estate Ltd. for their kind permission to carry out the research in their tea factories. Authors would like to extend their grateful to Mr. B.G. Harsha Abewardhana, former Internal HACCP auditor, Talawakelle Tea Estate Ltd. and presently at "Qualitea" Tea Exporting Company as Quality Executive for his assistant and guidance to visit tea factories and make this study a success. Finally authors wish to thank Mr. Anil Kahaduwaarachchi, Standard Officer, Sri Lankan Standard Institute for his guidance throughout the research period.

REFERENCES

Anon. (2006a) "Tea-export countries." *Byte*. Online. Available at http:// www.purecylonetea.com [Retrieved January 15, 2006]

Anon. (2006b). Available at http://edis.ifas.ufl.edu [Retrieved January 15, 2006]

Anon. (2006c) Available at http://standerdsnews.com [Retrieved January 15, 2006]

Anon. (2004). Course Manual "TASL- SGS Product Certification Standard Application to Tea Manufacturing Factories Training Course" Lecture 2, Lecture 5, and Issue: July 2004.

Arampath, P.C, B.D. R. Prasantha and U. Samaraeewa. (2005), *Bud to Brew Quality Assurance in Tea Processing* (pp. 4).

Dhanakumar, V.G. (2002)."TOTAL QULITY MANGEMENT IN TEA through Quality, Safety & Risk Management: An HACCP Perspective." *International Journal of Tea Science* Vol.1, No 2 and 3, 12-27.

Goodrich R. M., *et al* (2005). Goodrich R. M. Schneider K. R and Schmidt R. H. "HACCP: An HACCP Overview". Online. Available at http://edis.ifas.ufl.edu/pdffiles/FS/FS12200.pdf. [Retrieved January 2006]

Ollinger-Snyder P, Matthews M E, (1994). "Food safety issues: press reports heighten consumer awareness of microbiological safety. Dairy, Food and Environmental Sanitation." 1994: 14:580.

ANNEXURE I

Critical Control Point (CCPs): A step at which control can be applied and is essential to prevent or eliminate a food safety hazard or an acceptable level. (Anon,. 2004)

Control Point (CPs): A step in the process at which control may be lost without presenting a significant food safety hazard or, where a FSH will not occur at unacceptable levels. (Anon,. 2004)

Food Hazards: Hazard is a biological, physical or chemical agent in, or condition of, food with the potential to cause an adverse health effect. (Anon,. 2004)

ANNEXURE II

DESCRIPTION AND CONDITIONS

Raw Material
Leaves moisture 70% - 80%
Weigh and record Keeping Source

Withering
Manual even spread on beds with minimum leaf damage. Around 6 -12 hours; Final Moisture 52%-58%, Wet- Dry bulb temp. Difference < 25^{0}C

Rolling
Orthodox rollers, Roller vanes
Single action 35 - 40 rpm; Double action 40-45 rpm. 95 ^{0}F

Roll Breaking
Separate fines from large particles
Desired mesh sizes Preferably No.3 or No. 4 mesh

Fermentation
Spread as 50-75mm thick layers on table, monitor temp. 20-25 ^{0}C , 3 hours; 90-95% RH.

Drying
Use ECP or FBD driers (*i.e.* ECP inlet temperature. 190 - 195^{0}F, (90^{0}C); Exhaust temp. 120-130^{0}F (49^{0}C); Final moisture 3%)

Shifting, Grading, Winnowing
Removal of grit and sand. Separate stalks fiber. Uniform particle shape to meet market dictates.
Grading machinery with defined mesh size; stalk extractor

Bulking Packing Storage
Vibratory packer at 33% RH and moisture 4%, Aluminum lined or stainless steel packs
Ensure homogeneity and pack as needed

ANNEXURE III

Q1. Is there a significant hazard associated with this raw material?

No - **Not a CCP**
Yes - **Q2**

Q2. Are you or the customer going to process the hazard out of the products?

No - Sensitive row material. High level of control required. **CCP**
Yes - Q3

Q3. Is there a cross contamination risk to the facility or to other products that will not be control?

No - **Not a CCP**
Yes - Sensitive row material. High level of control required. **CCP**

Figure 1: The critical control points Q3 decision tree applied to the raw material (Anon., 2004)

SOURCE: Course Manual "TASL- SGS Product Certification Standard Application to Tea Manufacturing Factories Training Course" Lecture 2, Lecture 5, and Issue: July 2004.

Q1. Is there a significant hazard at this process? What is it?

No - **Not a CCP** Modify step, process, or Products
Yes - Q2

Q2. Do preventive measures exist for this identified Hazard?

No - Is control necessary at this step for safety?
- **Yes** - **Not a CCP** Modify step, process, or Products
- **No** - **Not a CCP**

Yes - Q3

Q3. Is the step specifically designed to eliminate or reduce the likely occurrence of the hazard to an acceptable level?

Yes - **CCP**
No - **Q4**

Q4. Could contamination occur at or increase to unacceptable levels?

No - **Not a CCP**
Yes - **Q5**

Q5. Will a subsequent step or action eliminate or reduce the hazards to an acceptable level?

No - **Critical Control Point**
Yes - **Not a CCP**

Figure – 2. The critical control points Q5 decision tree applied to the steps in tea processing (Anon., 2004)

SOURCE: Course Manual "TASL- SGS Product Certification Standard Application to Tea Manufacturing Factories Training Course" Lecture 2, Lecture 5, and Issue: July 2004.