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Implementation of Hazard Analysis Critical Control Point (HACCP) in blending and bottling plant of beverages

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Abstract

Hazard analysis and critical control points (HACCP) is scientific and systematic process that recognizes biological, chemical and physical hazard in food and beverages and measures their control to ensure the safety. The reason behind the study was to observe the HACCP plan laid down in a blending and bottling plant of beverages in Jalpaiguri District, West Bengal, India. The study was based on real conditions in the factory. It was observed that to upgrade the safety and quality of beverages production, HACCP's seven principles and plan were implemented and HACCP chart, verification procedures and record-keeping were initiated by the four members HACCP team constituted by the top management. The study identified an important Critical Control Point (CCP) *i.e.* inspection of bottles or packed product in the production of beverages and the study proposes to implement HACCP system in all types of food production services.

Keywords: Hazard Analysis Critical Control Point, Critical Control Point, Beverages, Implementation, Verification and Record-keeping

1. Introduction

There are various types of drink or liquid that humans can consume for sustenance, energy or hydration. Earlier, water, milk and fruit juices were considered as beverages but now alcohol, various teas, coffees, cocktails, cocoas, ciders and sodas become a part of life. [1] The blending and bottling plant in which the study was conducted produces Whisky, Rum, Gin and Brandy.

The Pillsbury Corporation, the National Aeronautic and Space Administration (NASA), the US Army and the US Air Force Space Laboratory Project Group developed food safety methodologies for the US space programme in the 1960's and termed it Hazard Analysis and Critical Control Point (HACCP). [2]

Hazard Analysis and Critical Control Point (HACCP) is not a traditional quality control inspection system but a preventative food safety system. It may not be considered "zero risk" as there are chances of hazard getting into the food product even after careful implementation. It tries to decrease the chances of a potential hazard to an acceptable level. [3]

Hazard Analysis and Critical Control Point (HACCP) is rising as an industry-driven concept and the firms are taking a realistic role in assuring the food processing procedure that leads to a safe food product. There is diversity in the food industry and its products. The different food product requires different production processes that may lead to different hazards. Single HACCP plan may not cover all types of productions. So, for each specific process or product a unique HACCP plan is required to ensure safety. [4]

The implementation of Hazard Analysis and Critical Control Point (HACCP) involves a large amount of capital and extra costs in infrastructural development, recruitment new employees, increased paperwork, consultant fees, training, etc. [5]

2. Need of the study

The study will help in understanding the safe framework of food and beverages production and evidences that prove that they are produced safely. It will further clear the concept of prevention and control of potential food safety hazards. It will also help in understanding the ways science and technology are used in ensuring the production of safe food. As the aim of HACCP system is to detect problems before they occur and certainly before they reach the customer, the critical control points (CCP) and critical limits chosen are to be observed carefully.

3. Review of Literature

During study, an extensive literature review was conducted and some related reviews are as follows:

Sara Mortimore and Carol Wallace (1998) in their book namely `*An introduction to HACCP'* [6] stated that Hazard Analysis and Critical Control Point system is often misunderstood and poorly applied in real situations. The concept of HACCP in the food industry is debated carefully at international level. The concept has developed itself in past ten years and some countries and their government accepts its implementation as a remedy for all food safety issues. The use of HACCP approach offers a practical and major contribution in forward stepping, but only if the people responsible for its implementation has the proper knowledge and expertise. The HACCP technique needs people to operate it.

Kit Fai Pun and Patricia Bhairo-Beekhoo (2008) in their study namely `*Factors affecting HACCP practices in the food sectors: a review of literature 1994-2007*' [7] stated that most of the countries worldwide are focusing on food safety sincerely. The Hazard Analysis Critical Control Points (HACCP) is an acceptable food safety management system. The study tried to find out success factors of HACCP practices with reference to the domains of food production, processing and delivery. In this study the researchers conducted a thorough literature review on 102 journal

articles in relation to food safety and management identified between 1994 and 2007. The results show that most critical factors for HACCP practices are food regulations, role of the industry, government policies and interventions, training on food safety and hygiene, and food contamination and/or poisoning. More research in future will help in investigating the holistic paradigm that includes the success factors and aligns HACCP measures to attain safety performance goals.

Eunice Taylor (2001) in the study namely *`HACCP in small companies: benefit or burden?'* [8] discussed regarding the importance of small companies across the food chain and identifies the sluggish absorption of HACCP in these companies as an area of concern for the production of safe food. Availability of appropriate training in HACCP methodology, access to technical expertise and the general resource problems of time and money sets the prospect for an analysis of the barriers to HACCP implementation. The study further discussed the burden that this place on the small business, particularly in terms of documentation, validation and verification. The study concludes with a summary of the burdens and benefits that this sector faces as it moves towards compliance with food safety legislation.

Laurian J Unnevehr and Helen H Jensen (1999) in their article *`The economic implications of using HACCP as a food safety regulatory standard'* [9] discussed the nature and role of Hazard Analysis Critical Control Point (HACCP) as a food safety control system and its role as an element of public food safety regulation. The concept of efficiency in food safety regulation is discussed and related to the nature of food safety controls. When appropriately applied, HACCP is a more economically efficient approach to food safety regulation than command and control (CAC) interventions. The economic implications of HACCP were discussed with reference to estimates of the costs and benefits, in particular for the food industry. The use of HACCP as an international trade standard and the facilitation of trade in processed food products are also considered.

S. Notermans, M. H. Zwietering and G. C. Mead (1994) in their study *`The HACCP concept: identification of potentially hazardous micro-organisms'* [10] stated that the hazard analysis critical control point (HACCP) concept is becoming an increasingly important aspect of Good Manufacturing Practices in safe food production. The study also stated that HACCP is a systematic means of controlling microbiological hazard that may arise in a food processing or handling operation and aims to identify problems before they occur. At first to establish the hazardous organisms associated with a particular food product and the organisms that are retained needs to be ascertained whether or not they have caused food borne disease involving identical or related food products. The doubtful cases of organism should not be deleted from the list of potentially hazardous agents. The evaluations of the hazards are made during the identification of critical control points (CCPs) and the setting of control criteria at each CCP.

Yunus Khatri and Ray Collins (2007) in their study *`Impact and status of HACCP in the Australian meat industry'* [11] stated that in Australia, HACCP has been implemented but there is less information in relation to the motivators, constraints, costs and benefits of Hazard Analysis and Critical Control Point (HACCP) as a food safety programme, as well as novel verification

methods in the meat industry. The result of study shows that there is a widespread and significant benefit of food safety systems incorporating HACCP within the meat industry in Australia. The study also observed that there is less rejection in output and customer complaints, improved product hygiene, improved morale and an increase in overseas markets. This is due to the renovation for small businesses and training of firms that have not complied with the HACCP requirements.

Renzo Akkerman, Poorya Farahani and Martin Grunow (2010) in their study namely *`Quality, safety and sustainability in food distribution: a review of quantitative operations management approaches and challenges'* [12] stated that the management of food distribution networks is receiving more and more attention, both in practice and in the scientific literature. The study reviewed quantitative operations management approaches to food distribution management, and related this to challenges faced by the industry. The study was mainly focused on three aspects *viz.* food quality, food safety, and sustainability. The study also conducted literature review on three decision levels and they were strategic network design, tactical network planning, and operational transportation planning and surveyed the research contributions, discussed the state of the art, and identified challenges for future research.

4. Objectives

The objective of the study is to find out if the food safety is compromised by the blending and bottling plant of beverages. The plant needs to meet their clients' requirements. This is also to observe whether the plant comply with official regulations and find out if the system encourages better competition on world markets and reduces barriers to national and international trade.

5. Research Questions

Some of the research questions useful to understand the concept of hazard analysis critical control point (HACCP) are as follows:

a. What is there in HACCP plan?
b. Why are critical control points important?
c. What is the primary concern for HACCP team members conducting a hazard analysis?
d. How HACCP helps in improving national and international trade?

6. Scope

The scope of the study was to understand the operational steps associated with HACCP system *i.e.* from receiving of raw materials, locating critical control points (CCP), processing, packaging and dispatch of the beverages to the end user and once the scope was determined the researcher carried out Hazard Analysis according to the set scope.

7. Limitations

It was observed during the study that HACCP system faces certain limitation in terms of its implementation like most of the costs involved with HACCP could not be earned back in the

short-term. The unwillingness of small firms to participate in the research had repercussions on the outcome. It requires technical, human and material resources that are not always available. It requires sincere effort and involvement of all elements of the organisation. It demands time availability, change in attitude, detailed technical data and constant updating. It further requires conserving information for a simple way of understanding and intense actions of all participants of the food chain.

8. Research methodology and data

The study was qualitative and exploratory in nature as it delivered deep and careful analysis of the situation.[13] The basic purpose of this study was to frame HACCP model of for possible implementation in an actual situation. The study also recorded the events, employee interaction and their behavior inside the operational areas. It gives the interacted details of phenomena that are difficult to convey with quantitative methods.

9. Resources and Techniques

9.1 Area of study

The study was conducted in a blending and bottling plant of beverages, situated in Jalpaiguri District, West Bengal, India of an international liquor manufacturing company. The plant supplies the local markets in West Bengal. There are about 150 employees working in one shift to produce four brands of beverages. The plant has three production lines and has a capacity to produce around 5,000 cartons of beverages per day. The study was conducted for four weeks and observation of all the necessary steps like monitoring of quality control, operators, employees and final product was done and the design of a brief HACCP plan, based on the setting and processing was framed, so that, the quality of final product can be improved. The various stages of the process, raw materials used, storage and dispatch of finished products, and procedures were monitored and data was collected. Some data were also collected from various laboratory analyses records, management and workforce.

9.2 Approach for study

A brief HACCP plan based on the setting and processes was designed during study that is helpful to improve the quality of output. On the basis of guidelines for application of HACCP Principles, [14] the forms to keep the record of various activities designed and some of the forms were list of product ingredients and incoming materials, prerequisite program (PRP), other prerequisite program (OPRP), description of product, flow diagram of process, hazard identification, critical control points (CCP) determination and HACCP control chart.

10. Results

10.1 Pre-requisite Programs

The study tried to accumulate all the prevailing prerequisite programs (PRP) under the HACCP plan, so that, they can be streamlined to have an appropriate control on defective output. This minimizes the chances of health hazards in the products automatically. The programs like Good Manufacturing Practice (GMP) and Sanitation Standard Operating Procedure (SSOP), that controls the operational conditions and promote environmental conditions favorable for the production of safe food were used.

10.2 Design and layout

The study observed that the cleaning materials used in the plant were appropriate and the plant was cleaned and sanitized on regular basis to preclude contamination. The production area and all the rooms of the premises are readily cleaned and sanitized daily. The cleaning methods are listed in the Sanitation Checklist and checked daily for satisfactory status by designated management and processing personnel. The provision for ventilation and light is adequate. Hand washing stations are at appropriate locations with required sanitizing materials. Toilet rooms are separated from the plant building so the chances of contamination are less. A quality control laboratory is there that carries out inspection test of the raw materials and the tests related to production monitoring and process control, packaging checks and testing, hygiene and GMP audits, microbiological tests, tests to identify pesticides, heavy metals and other contaminants, shelf life and stability and chemical tests.

10.3 Hygiene

The employees and workers thoroughly wash their hands with sanitizer prior to working in production, after each break and after using toilet facilities. Hand washing stations are maintained in good working order with sanitizer and clean paper towels in both the toilet and processing areas. Signs are posted on the toilet and processing areas reminding employees of hand- washing requirements. They remove jewellery prior to product handling. Clean clothing and waterproof boots are worn. They use head-gear, mask and gloves in the production area. Eating, drinking, spitting and smoking are not allowed in the processing area or any other area where processing equipment or materials are handled. The employees and workers with illness or injuries that may reasonably be a possible source of contamination to the product are not allowed to enter the processing area. Any illness and injury is reported to management and the information is recorded by the designated personnel.

10.4 Water Supply

It was observed that the supply of water is tested every six months to comply with IS: 10500/ FSSAI standards for potable water. The test results are kept documented by the management. Good quality potable water is supplied at the desired temperature for use in processing operations and cleaning. The quality of water is tested daily in the quality control laboratory and results are recorded accordingly.

10.5 Equipment

The HACCP team members ensure that the equipment walls; floors and product contact surfaces of the processing area are cleaned with clean water every day to remove dirt. A foaming detergent agent is used in conjunction with the wash down procedure. All floors, walls, sinks, drains and tables are rinsed with approved sanitizer. The floors and equipment are thoroughly rinsed with clean water in order to rinse off all chemicals to prevent chemical contamination of the product. All the equipments are checked regularly to ensure a smooth running system, operating properly and free of cracks, rust and dents. All other areas of the facility are regularly cleaned and kept free of litter and excess clutter by designated personnel and records are maintained.

10.6 Storage and Transportation

All the sealed packages are stored in the manufacturer's original carton. The packaging storage area ensures the same standards as any high-risk food processing area. There is appropriate temperature and humidity for the raw materials and the final product in the storage room. Proper transportation facilities are provided to transport the finished goods.

10.7 Sanitation

It was observed that the plant always tries to maintain a proper sanitation program to meet the goal. Sometimes, cleaning of equipment and tools is done but not as per set sanitation program, so the equipment can be a source of contamination.

10.8 Pest Control

It is observed that a modern pest management program is practiced in the plant every month to prevent and control pests like rodent, insects and birds. The plant keeps weed cut, pick-up litter on facility grounds and keep area clean and free of harborage areas for pests. The daily survey of facility is done and disposes the unused and discarded equipment and materials that may become harborage areas for pests. The standing pools of water on facility grounds are eliminated through drainage or manually on a daily basis as allowed by weather. The above activities are recorded accordingly.

Table1 (a). Product description - Whisky

Name of the product	Whisky
Composition and description	A neutral spirit conforming to IS 6613 or rectified spirit grade-I conforming to IS 323 or a mixture of both.
Intended use	As per consumer preference- dilution with soda, water, juice. Not specified on product.
Packaging	Glass bottle, PET bottle, Tetra pak *etc.*
Intended shelf life	1 year.
Where it will be sold	Indian Market
Labeling instructions	a) Name and type of the product. b) Ethyl alcohol contents in percentage and by volume. c) Month and year of packing. d) Name and address of the manufacturer. e) Net volume in `ml' and any other marking as per FSSAI or standards weights and measure act rules. f) Statutory warning as per State Excise.
Method of distribution	Controlled as per applicable excise regulation, legislation of importing countries if exported.

Table1(b). Product description - Rum

Name of the product	Rum
Composition and description	An alcoholic beverages made either from neutral spirit conforming to IS 6613 or rectified spirit conforming to Grade-1 of IS 323 or rum spirit which is an alcoholic distillate obtained from fermented sugarcane molasses, sugar beet molasses, sugarcane products and sugar beet products or any carbohydrate source or a mixture of any combination of above mentioned preparation.
Intended use	As per consumer preference - dilution with soda, water, juice. Not specified on product.
Packaging	Glass bottle, PET bottle, Tetra pak *etc.*
Intended shelf life	1 year.
Market	Indian Market
Labeling instructions	a) Name and type of the product. b) Ethyl alcohol contents in percentage and by volume. c) Month and year of packing. d) Name and address of the manufacturer. e) Net volume in ml and any other marking as per FSSAI or standards weights and measure act rules. f) Statutory warning as per State Excise.
Method of distribution	Controlled as per applicable excise regulation, legislation of importing countries if exported.

Table1(c). Product description - Gin

Name of the product	Gin
Composition and description	An alcoholic beverage made out of simply flavoring neutral spirits with essences and other natural flavorings without redistillation.
Intended use	As per consumer preference - dilution with soda, water, juice. Not specified on product.
Packaging	Glass bottle, PET bottle, Tetra pak *etc.*
Intended shelf life	1 year.
Market	Indian Market
Labeling instructions	a) Name and type of the product. b) Ethyl alcohol contents in percentage and by volume. c) Month and year of packing. d) Name and address of the manufacturer. e) Net volume in ml and any other marking as per FSSAI or standards weights and measure act rules. f) Statutory warning as per State Excise.
Method of distribution	Controlled as per applicable excise regulation, legislation of importing countries if exported.

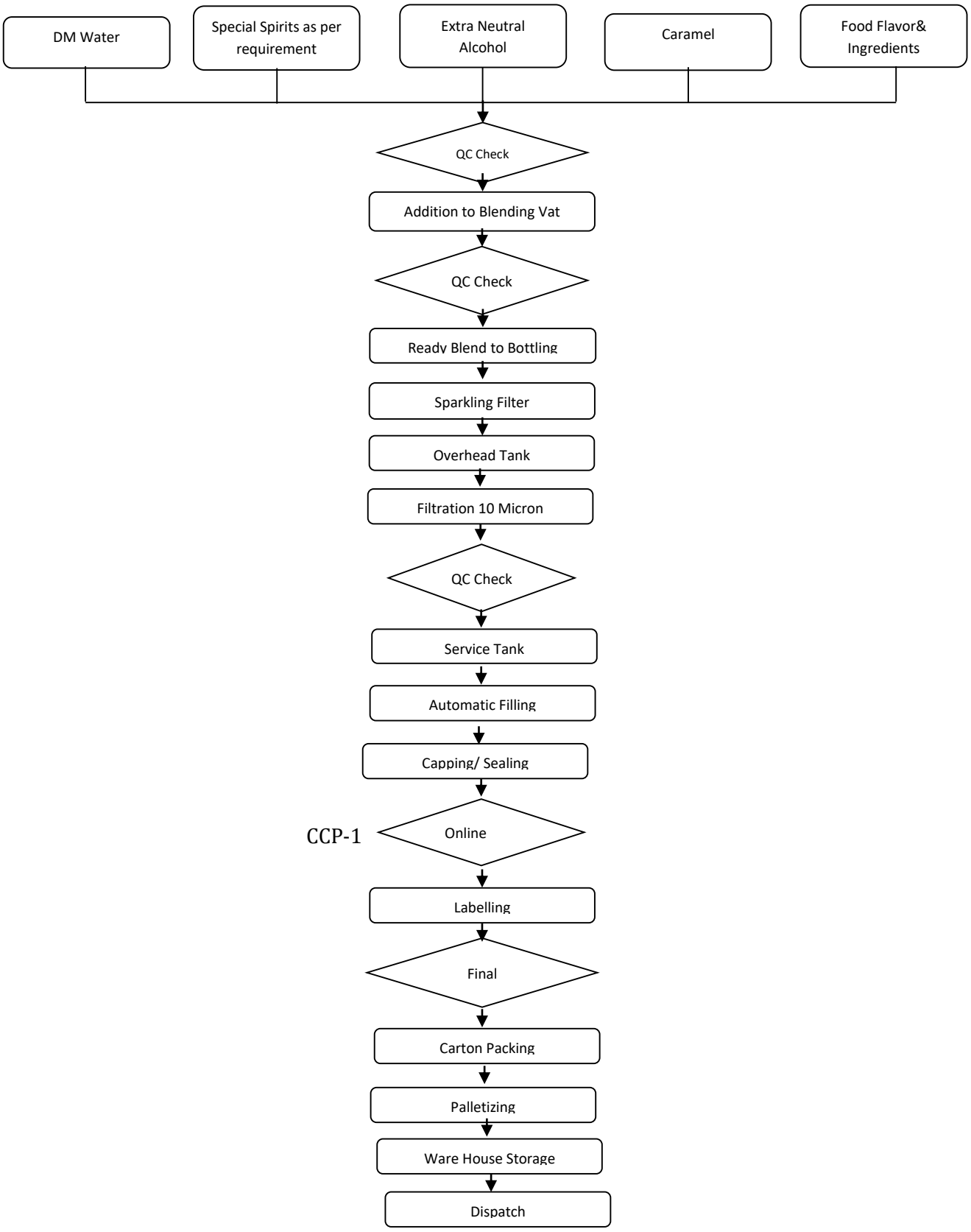
Table1(d). Product description - Brandy

Name of the product	Brandy
Composition and description	A neutral spirit conforming to IS 6613 or rectified spirit grade-I conforming to IS 323 or a mixture of both.
Intended use	As per consumer preference - dilution with soda, water, juice. Not specified on product.
Packaging	Glass bottle, PET bottle, Tetra pak *etc.*
Intended shelf life	1 year.
Market	Indian Market
Labeling instructions	a) Name and type of the product. b) Ethyl alcohol contents in percentage and by volume. c) Month and year of packing. d) Name and address of the manufacturer. e) Net volume in ml and any other marking as per FSSAI or standards weights and measure act rules. f) Statutory warning as per State Excise.
Method of distribution	Controlled as per applicable excise regulation, legislation of importing countries if exported.

It was observed that the plant consist HACCP team that includes Manager- Operations, Quality In-charge, HR /OHS Manager and Manager- Production. The team was led by Manager- Operations. The process flow diagram as revealed in **Figure-1**, illustrates the actual operational activities. It was verified by observing each step one-by-one.

All the four products produced in the plant are discussed in **Table – 1 (a, b, c and d)**. It shares proper information of products and alert the end users of potential hazards.

Figure 1: Flow diagram of blending and bottling plant of beverages



In **Table – 2** all types of physical, chemical and microbiological hazards present in the raw material and the decision matrix based on the answers given to the question from the decision tree are illustrated.

Table 2: Critical Control Point (CCP) decision tree

PROCESS STEP	**HAZARD**	**Q1. Is there a significant hazard at this step? (Y/N)**	**Q2. Do control measures exist for the hazard (Y/N)**	**Q3. Is the step designed to eliminate or reduce the hazard to an acceptable level? (Y/N)**	**Q4. Could contamination occur at or increase to unacceptable? (Y/N)**	**Q5. Will a subsequent step/action eliminate or reduce the hazard? (Y/N)**	**CCP**	
							(Y/N)	**If Y, No. of CCP**
Raw Water Source/ receiving & storage	Chemical contamination like Pesticide Residue, Heavy Metals. Pathogenic organisms like coliform & E.Coli.	Y	Y	N	N		N	
Bottle washing water	Physical contamination with dust particles, sand & carbon particles. Chemical contamination like high free chlorine.	Y	Y	N	N	Y	N	
Demineralized Water Plant & DM Water	Physical contamination with dust/sand/resin particles. Chemical contaminatio	Y	Y	N	N	Y	N	

	n like high free chlorine.							
Ingredients & PRIMARY packaging material	Physical (dirt, stone particles, lumps, insects) Chemical (toxins, mycotoxins, pesticides from raw materials) Microbiological (high microbiological load of raw materials and/or presence of pathogenic bacteria).	Y	Y	N	N	Y	N	
Pre-washed Market bottles	Physical (dirt, stone particles, insects) Chemical (Acid residues, glass leached due to high alkalinity).	Y	Y	N	N	Y	N	
Empty bottle storage - issue for production	Physical & Chemical (Glass leached due to high alkalinity).	Y	Y	Y	Y	Y	N	
Empty Bottle Rinsing before bottling	Physical - Dust & Glass particles/ neck chipping.	Y	Y	N	N	Y	N	
Blending Process	Physical - Dust & Glass particles,	Y	Y	N	Y	Y	N	

	lumps of ingredients. Chemical - Oil/grease leak from agitator.							
Blend Filtration	Physical - Dust & Glass particles, lumps of ingredients.	Y	Y	N	Y	Y	N	
Filling	Physical - Dust & Glass particles/ neck chipping.	Y	Y	N	Y	Y	N	
Sealing & Capping	Physical - Dust & Glass particles/ neck chipping.	Y	Y	N	Y	Y	N	
Inspection of bottles/ packed product	**Physical - Dust & Glass particles/ neck chipping, insects.**	**Y**	**Y**	**Y**	**Y**	**N**	**Y**	**CC P-1**
On-line recovery of blend from rejected bottles	Physical - Dust & Glass particles/ neck chipping, insects. Chemical - pigments, oil.	Y	Y	N	Y	Y	N	
Labeling	Physical - Chipping/ Breakage if mis-handled	Y	Y	N	N		N	
Packing & Warehousing	Physical - Chipping/ Breakage if mis-handled	Y	Y	N	N		N	
Personal Hygiene & Sanitation	Physical - Metal fragments, jewellery,	Y	Y	N	Y	Y	N	

	stone. Chemical - Allergen, residue							

In **Table - 3** potential control points of the hazards along with prevention methods are shown. The HACCP control chart was developed to include components of several HACCP principles *viz.* critical limits, monitoring and corrective action.

Table 3: Hazard Analysis and Critical Control Point (HACCP) plan

OPERATIONAL STEP	**HAZARD**	**CONTROL MEASURE**		**CRITICAL LIMITS**	**MONITORING METHOD**				**CORRECTIVE ACTION**	**RECORDS**
		PREVENTATIVE MEASURE	**CONTROL POINT**		**WHAT (Parameter)**	**HOW (Procedure)**	**WHEN (Frequency)**	**WHO (Responsible)**		
Raw Water Source/ receiving & storage	Chemical - pesticide residue, heavy metals, coliform etc.	Pre-Approved water source. It is periodically tested. The storage tanks are provided with proper covers & cleaning schedule.	Raw water source & water storage tank	Drinking water standard (IS:10500/ FSSAI)	Water potability test report from external approved laboratory	Drinking water standard (IS:10500/ FSSAI)	Half Yearly	Unit QC & Manager-Operations	Changing of source.	Half yearly test report from approved laboratory. The storage tank records.
Bottle washing water	Physical - dust particles, sand & carbon particles.	Washing water - regular checking, filtration through 10 micron cartridge filter.	On-line Checks.	Free from visible particles and any off-odor	Appearance, Sensory, turbidity and pH	As per procedures referenced in SOP	Daily at start-up	Unit QC	Reject the water in process, cleaning of all tanks/lines and checking filtration.	In -house test reports and half-yearly external laboratory test report.
Demineralized Water Plant & DM Water	Physical - dust/sand/resin and chemical contamination.	Following preventive maintenance Schedules. On-line monitoring of conductivity and regular cleaning of storage tanks.	DM water storage Tank	Clear, colorless, Free from any off-odor.	pH , Conductivity & organoleptic and taste quality. Half-Yearly approved test report as	As per procedures referenced in SOP	Every Storage tank before transfer to blending.	Unit QC	Not meeting specifications, DM water should be drained. Check DM plant health/resin conditions	In -house test reports and half-yearly external laboratory test report. Tank cleaning records.

					per FSSAI					
Ingredients (spirits, caramel, flavors etc.) and primary packaging material (bottle, cap)	Physical - dirt, insects Chemical – toxins, Microbiological - bacteria	Procurement from approved suppliers only. Compliance to FSSAI standards for ingredients and BIS specifications for primary packaging materials.	Incoming Inspection & visual inspection/ verification prior to usage	As per FSSAI and internal specifications	Supplier guarantee certificate. Any damaged consignment to be kept on-hold.	As per procedures referenced in QA Manual	Before transfer to stores & before using for production.	Unit QC	Reject materials if not accompanied by supplier guarantee & also if not complying to company's specified specifications.	Supplier Guarantee certificate. In-house test reports
Pre-washed Market Returned Glass bottles (RGB)	Physical (dirt, insects) Chemical (Acid and caustic residue)	Approved Vendors. Incoming quality inspection for every batch.	Checking of incoming bottles	As per company's specifications	As per company's specifications.	As per procedures referenced in SOP.	Every receiving LOT	Unit QC	Reject non-conforming consignments.	RGB (Market Bottle inspection QC reports
Empty bottle storage - issue for production	Physical & Chemical - Glass leached due to high alkalinity	Alkalinity checking of all bottle.	Checking of empty bottles on hourly basis prior to use.	Alkalinity not to be more than 8.5 pH.	Alkalinity not to be more than 8.5 pH.	As per procedures referenced in SOP	Each consignment after receipt	Unit QC	Alkalinity condition- pH > 8.5 should be acid washed as per advised procedure.	Bottle inspection QC reports.
Empty Bottle Rinsing before bottling	Physical - Dust & Glass particles/ neck chipping.	Preventive Maintenance. No glass to metal contact. Checking foreign objects and rinsing water pressure.	On-line checks	Intact rinsed bottles free from any dust and neck-chip.	Visual inspection of washed bottles. Remove the dirty bottles.	As per procedures referenced in SOP	As per frequency specified	Unit QC	Hold the line/ stop the production till corrections made.	On-line rejection data.
Blending Process	Physical – Dust,	Preventive maintenance schedules.	Blending start-up &	Blend free of any	Blend sample to meet	Blend - QC	As per frequency	Unit QC	Hold the non-complying	Blending register/ sensory

	Chemical - Oil/grease	Filtration process checks foreign matters, if any.	Final Blend sample	foreign matter and no off-odor.	company specifications.	protocol	specified		blend batch and dispose after consultation with master blender	analysis sheet.
Blend Filtration	Physical - Dust & Glass particles, lumps of ingredients.	Control of blend filtration step - calibrated pressure gauges on filter and use of final guard filter 10 micron before bottling.	Filtration	Blend free of any foreign matter or sediments.	Visual check of filter - After each cleaning.	As per SOP	As per frequency specified	Unit QC & Manager-Operations	Change of the filter and stop the batch and start new filtration.	Blending filter maintenance record
Filling	Physical - foreign matter & Glass particles/ neck chipping.	Preventive Maintenance schedule. Cleaning of transfer line, service tank, filter, filling line, *etc.* after every changeover of liquor. No glass to metal contact.	Bottle Filling Station	No glass breakage, neck chipping. Filled bottles free from any foreign matter.	Check for strength, quantity and clarity of liquor on each line prior to start of filling or on every changeover.	As per SOP	As per frequency specified	Unit QC & Manager-Production	Hold the line/ stop the production till corrections to be made	On-line start-up report
Sealing & Capping	Physical - Dust & Glass particles/ neck chipping.	Optimum sealing /capping pressure and function. Approved closures. Inspection of caps before application Further on-line and random checking	Sealing Station	Caps free from dust. No glass breakage. Sealed bottles free from dust particles	Check for specified sealing parameters prior to start of the line or at every change overs.	As per procedures referenced in SOP	As per frequency specified	Unit QC & Manger-Production	Hold the line/ stop the production till corrections made	On-line start-up report
Inspection of bottles/ packed product **CCP-1**	Physical - Dust & Glass particles/ neck chippi	Trained inspectors, Regular Eye-sight checkup & rotation of inspectors. Conveyer to have stopper	Filled bottle Inspection Station	Bottles free from visible glass particles, dust, insects.	On-line Inspection of every filled and sealed bottle	After inverting the bottles.	Continuous during bottling operation	Unit QC & Manager - Production	Remove the rejected bottles at inspection stations. Reprocess after QC clearance.	On-line rejection record. Verification of CCP by periodic

	ng, insects.	to avoid passing uninspected. Inspection stations to have adequate light intensity.			for dust, particles, glass pieces or insects.					challenge testing.
On-line recovery of blend from rejected bottles	Physical - Dust & Glass particles, insects. Chemical - pigments, oil.	Inspection, assessment and pre-filtration of recovery blend. To reduce recovery due to on-line rejection. Bottles having contamination to be rejected.	Rejection Handling Station	QC passed rejection to be added to blending vat after filtration.	Sensory test & as per specified parameters	As per procedures referenced in SOP	As per frequency specified	Unit QC	Reject the non-conforming blend or reprocess after permission from Unit QC.	On-line rejected blend monitoring and verification sheet.
Labeling	Physical - tearing if mishandled	Follow good personnel training practices. No obstructions on conveyers that can result in dropping the packed bottles.	Labeling	Follow specific product packing instructions.	Visual Checks	As per procedures referenced in SOP	As per frequency specified	Unit QC & Manager-Production	Hold the line/ stop the production till corrections made	On-line start-up report
Carton packing/Secondary packing/ Warehousing	Physical - Chipping/ Breakage if mis-handled	Personnel training. No obstructions on conveyers/storage. Random checking of packed boxes. Warehouse inspection. Follow stack height norms during storage and transportation.	Secondary Packing & Warehousing/ Storage	Follow specific product packing instructions.	Cartons & boxes of approved quality. Ensure no damage to bottles. Truck inspection before loading and dispatch.	As per procedures referenced in SOP	As per frequency specified	Unit QC & Manger-Production	Randomly check and reprocess defective stock after segregation.	Packed case inspection report.

Personal Hygiene & Sanitation	Physical - Metal fragments, jewelry, stone. Chemical - Allergen, residue	Personnel hygiene checks. Housekeeping schedules. Smooth flooring and drains to avoid water logging. Good pest control practices.	Personnel hygiene, Housekeeping schedules, Pest control schedules	As per Schedule-IV checklist of FSSA-2006.	Cobwebs cleaning. Pests control activities. Medical examination.	As per procedures referenced in SOP	As per frequency specified	Manager -HR	Ensure implementation and corrective actions on GAPs.	Hygiene records/ reports

The identification and documentation of critical control points (CCP) was done by responding to the queries in the decision trees. The record related to control is maintained by responsible operator or the supervisor. The safe and quality products usually produced due to proper implementation and documentation of HACCP helps in eliminating the critical hazards during production and improvement of the plant in future.

11. Discussion

A critical control point (CCP) namely inspection of bottles/ packed product was identified by the researchers on the basis of process decision tree. The prerequisite programs requirements in the plant were crucial to determine the critical control points. The CCP details are as follows:

Inspection of bottles/ packed product: In the production line, each sealed or capped bottle before labeling and packaging are checked thoroughly at a point with a luminous screen in the background with minimum one thousand lux of light to find out any hazardous material like dust particle, glass pieces, crack on the bottle or any other visible impurity. This point is considered as CCP-1 as per HACCP plan. The worker's involved in this point works six hours a day, their eye and health check-up is conducted by the authority half-yearly basis and the records are kept properly. The finished product is stored at appropriate conditions in clean and dry place away from direct sunlight.

Conclusions

The prioritization and control of potential hazards in food production are due to HACCP. From last decade, there is a steady growth in the food industry and overseas business and as a result customers are demanding safe and healthy food products. The production and distribution of safe food is very important and the companies are implementing food safety management systems to make sure that it gets the utmost priority. A HACCP plan for the beverages blending and bottling plant to improve the safety and quality of products was designed during the study. A step-by-step, seven principles of HACCP system based model was developed during the hazard analysis. It was observed during the study that to improve the output, the numbers of CCPs are reduced so that the production cost may be kept under control. There is a scope for further research on design of HACCP plan in various food processing companies not only in West Bengal but also in other parts of India too.

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