Review article:

HACCP (Hazard analysis & critical control point)

Prashanti and Anania Arjuna

Faculty of Applied Medical Sciences, Lovely Professional University, Jalandhar , Punjab , India
Corresponding author: Ananja Arjuna
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Abstract:

HACCP (Hazard Analysis & Critical Control Point) is the systematic preventative approach to food safety. It addresses physical, chemical and biological hazards as a means of prevention rather than finished product inspection. It is a systematic preventive approach for food safety from biological, chemical and physical hazards in production process. The HACCP system can be used at all stages of a food chain, from food production and preparation processes including packaging, distribution etc.

Introduction:

HACCP has been applied to industries other than food such as cosmetics and pharmaceuticals. HACCP is focused only on health safety issues of a product, but not the quality of product, yet HACCP principles are the basis of most food quality and safety assurance systems and the United States, HACCP compliance is regulated by 21 CRF parts 120 and 123. Similarly, FAQ/WHO published a guideline for all governments to handle the issue in small and less developed food businesses (1)

Benefits of HACCP

In recent year, the food safety planes based on HACCP is internationally known and accepted as a tool for enhancing food safety. The World health organization (WHO) and Codex Alimentarius Commission (CAC) recognized HACCP as one of the plan or system to ensure the food safety.

Although the main aim of HACCP is food protection that means it focuses on identifying and preventing hazards from contaminating food, which leads to many benefits like increasing in consumer volume and their confidence, maintaining and increasing in marketing access, improving control of production process which leads to reduction in cost through reduction of production losses and rework, increasing in focus and ownership of food safety, business liability protection, improving product

quality and its consistency, permitting more efficient and effective government oversight or simplification in inspections primarily because of the recordkeeping and documentation, alignment with other management system(ISO 22000), places responsibility for ensuring food safety appropriately on the food manufacturer or distributor. It reduced the barrier to international trade. It helps food companies to compete more effectively in the world.

The traditional food management plans are reactive to food hazard. However the HACCP applies a preventive approach to minimize food hazards. In recent year, the food safety planes based on HACCP is internationally known and accepted as a tool for enhancing food safety. In food industry they measure main product and package quality attributes by focusing on ingredients and materials and regulating manufacturing, bottling and distributions of product to ensure those products meet company requirements and consumer

expectations in the market place. The Company expands beverage portfolio and supplier system to match up with the increasing demands of growing and developing markets all around the world. This leads to the increase in customers and their expectations. This global nature requires that the Company has the highest standards and system to ensure consistent quality – from raw material to the finishing product, from empty bottles to the full packaged product.

To ensure such reliability, the system is governed by, a new management system, which supports company's strategic growth plan by creating an integrated quality management program which holds all the operations. It integrates business and quality objectives by aligning them with consistent metrics to monitor performance; incorporates Hazard Analysis and Critical Control Point (HACCP) into our system standards, managing risk regarding all issues.

Principles of HACCP

To attain food safety, each and every stage in production from purchasing, receiving, transportation, storage, preparation, handling, cooking to serving should be carried out and monitored with extreme conscientiousness. HACCP is a scientific and systematic approach to identify, assess and control of hazards in the production process. Food safety control is integrated into a particular design rather than relied on end product testing.

The seven principles are:-

1. Analysis hazards
2. Determine critical control points
3. Establish limits for critical control points
4. Establish monitoring procedures for critical control points
5. Establish corrective actions
6. Establish verification procedures
7. Establish a record system

1. Analysis hazards

Before understanding the principle of HACCP, we must understand about hazard. "Any biological or chemical agent foreign matter or substance not intentionally added to food which may compromise food safety or suitability." Hazard can be biological like bacteria, chemical like preservatives and physical means impurities like glass pieces. All these hazards should be undertaken according to HACCP principles.(CAC/RCP 33-1985) These hazards can cause a food to be unsafe for human consumption. Here we analysis the type of hazard and its occurrence (raw material and processing steps) and to assess potential to render food unsafe for consumption. Here we must prepare a process flow diagram of the steps in the process and list out all possible hazards. (2)

2. Determine the Critical Control Point

A Critical Control Point is a procedure in food manufacture process at which control can be applied to that particular hazards lead to the safety of the food. It is not detect hazard, but goes for prevention from that hazard. A logical decision . Making process is applied to determine whether (or) not the process is a critical control point. It indicates few factors such as

-whether that control in a particular step is necessary

-whether that control at this step eliminates (or) reduces the occurrence of the hazard to an acceptance level.

-whether the contamination occurs by the hazard could occur in excess of acceptable level.

3. Establish limits for critical control points

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The limits of critical control point are criteria which separates acceptability from unacceptability. It is a value (max/min) of the hazard which can be biological, chemical or physical must be controlled at a critical control point to prevent, eliminate (or) reduce to an acceptable level the occurrence of the identified food safety hazard. The examples of limits of critical control points are time, temperature, humidity, water activity and pH value. In some cases, more than one critical limit is needed to control a particular hazard.

4. Establish monitoring procedure for CCP

It is a planned sequence of observation (or) measurements to assess whether a critical control point is under control and to produce an accurate record for future use in verification. Monitoring help the plant by warning if there is a change towards loss of control. So that we can take action to bring the process back into control before the limit is exceeded.

5. Establish corrective actions

The action we take after the results we obtain from monitoring at the critical control point indicate that the limit is exceeded is called corrective actions i.e., a loss of control. It is an advanced plan for safety by the management. If the critical control point fails to remove that hazard, then this plan helps to manage and eliminates the hazard. When the limit crosses the critical control point, the plant needs to take corrective action immediately. The persons handling (or) dealing with monitoring the critical control point, should be trained to prefer the appropriate corrective actions.

6. Establish verification procedures

Verification is a procedure which indicates, tests, methods, additions to monitoring and other evaluations to determine compliance with the HACCP plan

7. Establish a record system

Preparing and maintaining a HACCP records is very important part of the HACCP system. Maintaining a record is helpful for tracing the history of an ingredient in process operations, or a finished product, when problem arise in future. It is helpful for identifying and narrowing a product recall operation that could result in a deviation is not corrected.

To create and maintain a record keeping procedure, all points must be noted up to date. Employees must ensure that they understand their roles and responsibilities

HACCP IN PRACTICE

Hazard analysis is depends upon the type of industry and the place where it is situated. Then it becomes easy to analyse the hazards.

While carrying the HACCP process we need to follow several stages like

Stage 1: Define terms of references
Stage 2: Select a HACCP team
Stage 3: Describe the project
Stage 4: Identify intend use
Stage 5: Create a flow diagram
Stage 6: Verify the flow diagram
Stage 7: Identify & analyse hazards & their control measures
Stage 8: Determine the CCP
Stage 9: Establish critical limits
Stage 10: Establish monitoring procedures
Stage 11: Establish corrective actions
Stage 12: Verify the HACCP study
Stage 13: Establish documents
Stage 14: Review the HACCP study

Stage 1: Define terms of references

This approach involves the identification and analysis of potential and realistic hazards associated with all stages of food products

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manufacturing from raw material to the consumption of finished products; microbiological, chemical and physical hazards should all be considered if they affect product safety. The study should be carried out on a specific product or process line or a specific range of activity. It is recommended that companies introducing HACCP for the first time should keep the terms of reference simple i.e. restricted to product safety issues only. The company must select the HACCP approach most applicable to their operation. The products and process should be known individual basis or they may combine similar products or processes into modules. It is recommended that the hazards to be considered in the study are clearly defined.

Stage 2: Select the HACCP team

To carry out the HACCP process, management should provide the necessary team and a study period is given to them. The team members are likely to meet several times depending upon the complexity of the process and the type and number of hazards to be identified. In order to carry out the process the team members should follow the basic seven principles of HACCP. It is must more effective if a multi- disciplinary team of specialists are present in the team. The team members should be skilful in microbiology, food science, production, quality assurance, food technology and food engineering. Before the process begins, the team leader must ensure that the management provide all related resource to complete the studies and for implementing including reviews and updates.

In that HACCP team, production specialist, quality assurance/ quality control specialist, an engineer should be present with other relevant specialists like buyers, operators packaging and distribution experts, a hygiene specialist. Team members selected for their relevant skills and expertise will need to work together easily and closely to achieve to defined objective of the HACCP study. The team members may need training in:

- The principles of HACCP
- How to approach the analysis logically, systematically and in sufficient detail
- Benefits of the HACCP system
- The role it plays in product safety

Stage 3 Describe the product

A full description of the finished product or the intermediate product is prepared. The product should be defined in terms of the key parameters which influence the safety of the product, to be used at stage 7

- Composition(e.g. recipe, raw material)
- Chemical & physical structure (e.g. pH, emulsion)
- Processing (e.g. has product been heated and to what extent) and other preservation method9e.g. brining)
- Packaging system (e.g. aseptic packaging)
- Storage and distribution conditions (e.g. is the product to be kept frozen or chilled)
- Required shelf life (e.g. stated “used by” date or “best-before” date) under prescribed conditions.
- Instructions for product use (e.g. storage, handling and cooking instructions)

Stage 4: Identify intended use

The intended use of the product by the customer or consumer and the consumer target groups should be defined to encompass any special considerations, for example target market like is that product is designed for babies, young children or the elderly, consumer group, susceptibility issue.

Stage 5: Constructs a flow diagram

Before we start the HACCP process, it is necessary to carefully examine the product/process under the study and create a flow diagram around which the study can be based. The format of flow diagram is a matter of choice. Each step in the process should be

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clearly outlined in the correct sequence with sufficient technical data available for study to proceed. The diagram must reflect the flow of process and degree of interaction between all raw material, ingredients and packaging. It is necessary to understand the environmental condition. The information related to floor plans, productions plan, time temperature profile of all raw materials through to final product. The members must consider environmental hygiene, personal routes and work practices, possible routes of cross contamination, high/low risk segregation, and storage and distribution conditions.

Stage 6: Verify the flow diagram

It is important than the flow diagram is an accurate representation of the operation. This should additionally include confirmation of activities during night shift or weekend running of the operation. Team member should carry out a walk though questioning those involve at each processes step. It is necessary to ensure that no process steps have been missed. All information related to time temperature and procedure and other data which is collected are accurate.

Stage 7: Identify and analyse hazards and their control measures

Using the flow diagram as a guide identify all potential hazards, as defined in the terms of reference which is expected from primary production, processing, manufacture and distribution until the point of consumption. Mostly hazards are

present in raw materials, so consideration is necessary on it, because that hazard might be entre in the process. It is necessary to count on the hazards survive the process step. The team should also cover the way the process is managed and the realistic things can happen which is not covered in flow diagram. The HACCP team must conduct a hazard analysis to find a kind of hazard which having the nature that their elimination or reduction to acceptable levels is essential to the production of safe food. Then it will become easy to find the control measure. Considerations will always include a combination of the following.

- Likelihood of the hazard occurring and its effects e.g. previous industries experience
- Severity of the hazard e.g. chronic/acute
- Numbers potentially exposed to the hazard-e.g. lot size; distribution
- Age/vulnerability of those exposed-e.g. young/elderly; allergies
- Survival or multiplication of microorganisms of concern
- Production or persistence in foods of toxins, chemicals or physical agents
- Source or cause of the hazard or conditions leading to the above

As a result of the increased emphasis given in the World Trade Organisation's Sanitary and Phytosanitary (SPS) agreement (1994) to the use of risk assessment, data will become increasingly available from Microbiologically Risk Assessment which can be useful in Hazard Analysis and determining the stringency of HACCP plans. The critical control points are searched out, we can call them as control measures. Control measures are those actions or activities that are required to prevent hazards, eliminate hazards or reduce their occurrence to an acceptance level. (3)

Stage 8: Determine Critical Control Point (CCPs)

This stage is a logical consistent approach which is required to identify Critical Control Points. These are those important steps of the process which are used to prevent or eliminate food safety hazards or reduce them to acceptance levels. The professional judgment is require for the identification of Critical Control Points and may be aided by the application of a decision tree. When using a decision tree each

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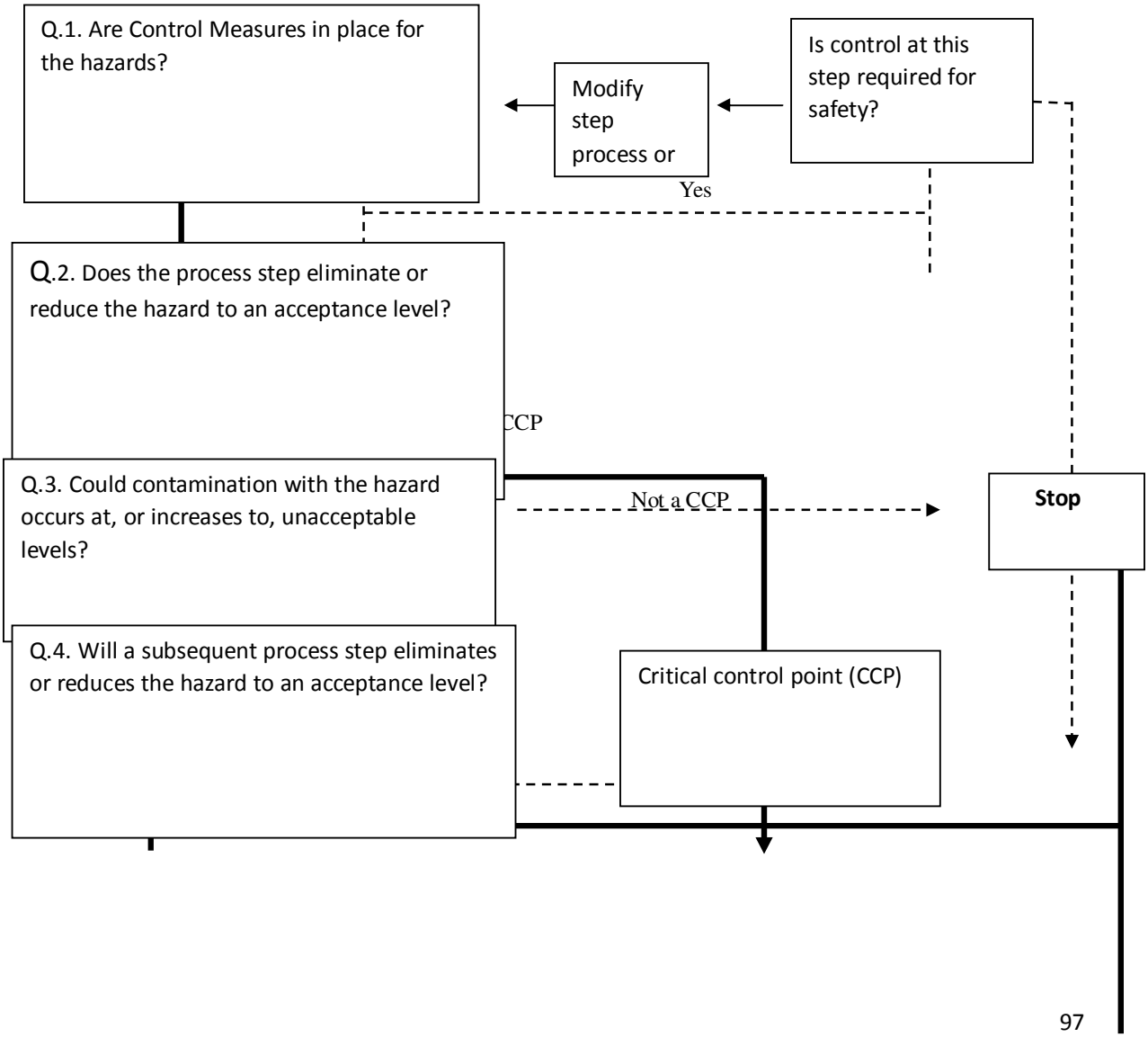
step identified in the flow diagram and must be considered. This decision tree is applied to all hazards. The HACCP team should be trained in the use of a decision tree. The decision tree should not be used for those hazards that are managed by prerequisite programme. Application of a decision tree will determine whether or not the process step is a Critical Control Point for each specific identified hazard.

Q 1. Are Control Measures in place for the hazard? If the answer of this Q 1 is yes, then we proceed to Q 2, but if the answer is no then the team must ask a supplementary question to determine that is the control measure is necessary for food safety at this step. If the control is not necessary, then the process step is not Critical Control Point. If control is required for the safety then the process step, process or the product should be modified so that control can be gained. The HACCP team should then recommend changes to the process step, process or product and then validate its effectiveness as a control measure. Prior to the next formal meeting of the team, agreement must be reached with senior management that an appropriate change is acceptable and will be implemented.



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Q.2. Does the process step eliminate or reduce the hazard to an acceptable level?

If the answer of question is YES. Then we have process step that is a CCP. This is because, for the hazard in question, the process step itself is designed to be the control measure. Having arrived at a CCP decision the HACCP team must then decide exactly WHAT ASPECT IS CRITICAL "to ensure food safety" , e.g. a temperature, a practice or procedure or the level of contaminant that is deemed acceptable or safe. After deciding what aspect of the CCP is critical the HACCP team can move on and apply the decision tree to the next identified hazard for that process step, if application. If the answer of Q.2 is no, the team must ask a supplementary question to determine if control is necessary at this step for product safety. If the control is not necessary then the step is not a CCP and the team should apply the decision tree to the next identified hazard.

Q.3. Could contamination with the hazard occurs at, or increases to unacceptable levels?

The team should consider the flow diagram data and their own working knowledge of the process, to answer this question. The team should also consider whether the immediate processing environment may be a source of the hazard under study and thereby contaminate the product. Account should be taken of past history, case studies and other appropriate data. If the answer of this question is no, then the process step is not a CCP for the hazard in question, since it has been decided that there is no likelihood that contamination could occur at or increase to unacceptable levels. If there is any doubt about the answer to question 3, the answer should favour a yes response, as question 4 will determine whether the identified hazard gives rise to a CCP. If we answer yes to question 3, then we must proceed to question 4.

The team should include consideration of the following:

- Are the ingredients used likely to be source of the hazard under study?
- Is the process step carried out in an environment likely to be source of the hazard?
- Is cross- contamination from another product/ingredient possible?
- Is cross-contamination from personnel possible?
- Are there any void spaces in equipment that will enable product to stagnate and allow increase of the hazard to unacceptable levels?
- Are the cumulative time/temperature conditions such that the hazard will increase in the product to unacceptable levels?

Q.4. Will a subsequent process step eliminates or reduces the hazard to an acceptable level?

Question 4 is considered if the team believe the answer to question 3 is yes. The team must proceed sequentially through the remaining step of the flow diagram. For question 4, the HACCP team must review the process flow diagram in a "downstream" manner, looking at each subsequent process step to see if it will control the hazard in question. If such a step exists then it will become the CCP, when we come to analyse it and this hazard at this process step is not a CCP. If we answer NO to question 4, then we have determined that no later process step can control the hazard in question and therefore this process step contains the CCP.

Stage 9: Establish Critical limits

After identifying all Critical Control Points in the product/process, the team should proceed to identify critical limits for the control measures at each CCP. The critical limit is the criterion which

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separates acceptability from unacceptability or safe product from unsafe product. Some critical limits are defined in legislation, e.g. chilled storage temperature of meat, temperature and time to be used for pasteurisation. While some may need experimental data to be collected to determine the critical limit or advice from specialists with expert knowledge. For many practical purposes, a target level may be specified which is the pre-determined value for the control measure applied at each CCP with the tolerance indicating the degree of latitude allowable. The specific critical limit, target level and tolerance set for each CCP/control measure must represent some measurable parameter related to the CCP.

Stage 10: Establish a monitoring procedure

Selection of the correct monitoring system is an essential part of any HACCP study. Monitoring procedure involves a planned sequence of observations or measurements of CCP control measure and their arrangement of accurate record or documents for future use in verification. Monitoring systems may be either on-line, e.g. time/temperature measurements, or off-line, e.g. measurement of salt, pH, total solids. On-line systems give an immediate indication of performance whereas off-line systems require monitoring to be carried out away from the production line and occasionally may result in a very long time period elapsing before results are available and action can be taken.

Monitoring system may also be continuous like recording continuous process temperature a discontinuous like sample collection and analysis. Continuous system provide a dynamic picture of performance. In ideal situation, a monitoring system should be chosen that gives an on-line continuous monitor of performance and responds greatly to correct changes exceeding the specified tolerance.

Stage 11: Establish corrective actions

The team should specify the actions to be taken either when monitoring results indicate a team towards loss of control or at a CCP, where there is a failure to meet the critical limit. If the monitoring results indicates towards loss of control, then the action must be taken to bring the process back into control before it leads to a deviation and it should be done during the time period that the CCP was 'out of control'. The cause o f deviation should be investigated. Both corrective action and rework actions should be documented in the HACCP records.

Stage 12: Verify the HACCP study

Another name given to this stage is verification including validation. So there are two distinct activities:

Validation

The soul objectives of validation are to ensure that the hazards identified in the study are complete and correct and the selected controls are suitable. The team may be required to perform the validation which includes the HACCP study plus additional internal or external specialists. The team should evaluate the evidence supporting the selection, determination of CCPs, the setting of the critical limits and that the monitoring and corrective action activities will be adequate to assure food safety. Validation should include the formal sign off if the HACCP plan by the person ultimately responsible for product safety management at the business.

Verification

The HACCP team should put into place procedures that can be used to demonstrate compliance with the validated HACCP plan and to determine its effectiveness once in use. There are two main aspects of verification, firstly demonstrating conformance and secondly gathering information that the HACCP system and prerequisites are effective. It should examine the entire HACCP

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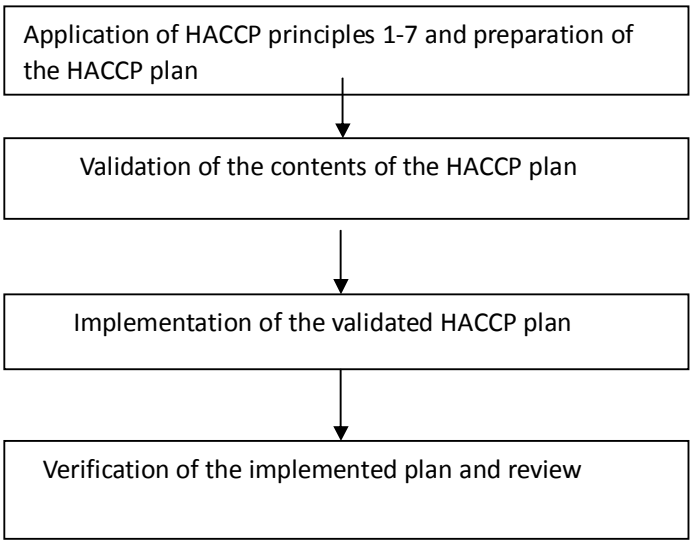
system including all CCPs and its records. Verification activities may include internal/external auditing systems, microbiological and chemical examinations of intermediate and finished product samples. The findings of customer visits and analysis of customer complaints can also form part of the verification procedures.



Stage 13: Establish documents

The documents of HACCP are of three types:

1. The HACCP system(hazard analysis, CCP determination etc)
2. The procedure and work instructions
3. The records resulting from monitoring, corrective actions and verification

The HACCP team should perform a periodic review, the frequency of which should be established based on the risk of the product and its intended use; typically this should be at least annually. A few points determine that whether the review is required

1. Change in raw material/product formulation
2. Change in raw material supplier
3. Change in processing system
4. Change in factory layout and environment
5. Modification to process equipment
6. Change in cleaning and disinfection programme
7. Failure in the system, e.g. corrective actions and the need for product recall.
8. Change in packaging, storage and distribution system
9. Change in staff levels and responsibilities
10. Anticipated change in customer/consumer use
11. Receipt of information from the market place indicating a health risk associated with the product.
12. Emergence of food borne pathogens with public health significance.

Stage 14: Review the HACCP study

The HACCP review is carried out on the bases of level of risk associated with the food being produced. Review is taken when there is any change in any part of the product whether in the raw material, process or the environmental condition. Whenever a new information comes to light which affects the safety considerations in any part of the HACCP study, e.g. any major

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outbreak of food borne illness or the emergence of any new pathogen or the consumers specification is changing, then review is necessary. Documentation of HACCP procedures at all process steps should be assembled and included in a manual or integrated into a controlled Quality Management System.

Hazard Analysis Critical Control Point of Water Treatment Plant

Hazard analysis critical control points are in its inception stage for the water industry but have provided controls for the safety of foods for over three decades. It is the primary risk management system for the food industry. In recent years development countries with conventional water treatment system have still experienced water borne-disease outbreaks. The UK Department of environment, Transport and the regions (1998) reported on 23 corner outbreaks of Cryptosporidiosis associated with consumption of public drinking water supplies in the UK since 1988. Scientifically based, process oriented management systems such as HACCP. The intentions of HACCP system is to focus on preventing or controlling hazards early in the process rather than relying mainly on end-point testing for quality control.

The HACCP guidelines "Codex Alimentarius" (FAQ/WHO 1996), meaning food code, detail 5 prelim 5 preliminary steps and seven principles for implementing HACCP. The preliminary steps are to assemble a HACCP team, describe the product, identify its intended use, construct a flow diagram and confirm the flow diagram on-site. The seven principles are:

- Conduct a hazard analysis
- Determine the CCPs
- Establish critical limits
- Establish a system to monitor control of the CCP
- Establish the corrective action to be taken when monitoring indicates that a particular CCP is not under control.
- Establish procedure for verification to confirm that the HACCP system is working effectively.
- Establish documentation concerning all procedures and records appropriate to these principles and their application

The application of HACCP within as organisation needs to be well supported by management and system. The support by the management is necessary because the HACCP system must be continually updated whenever there are changes in the raw products, equipment design, operations or scientific knowledge on hazards. Quality management systems in accordance with the international standard ISO 9001 are important supports to HACCP. In spite of the fact that HACCP is well established within the food industry, there are some important differences in the water industry which need to be considered. The most obvious are:

I. The diverse range of possible water borne hazards, particularly from multi use catchments
II. The continuous nature of supply between raw water sources and consumption.
III. Treatment facilities that are often monitored and operated remotely via telemetry, and
IV. The large, complex distribution networks

The HACCP guidelines states it is important when applying HACCP to be flexible where appropriate, given the context of the application taking into account the nature and the size of the operations. The raw water from any source always having a characteristic pollution pattern and the treatment

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must be related to the source water quality. A conventional water treatment plant consists of coagulation, flocculation, sand filtration, carbon filtration, lead-lag filtration and micron filtration. Ludhiana beverages are having ground water as source water. As compare to other source water, ground water is having less number of pollutants because of less change of mixing of contamination from outside or external source.

Conduct a hazard analysis

Drinking water should not contain any micro organism known to be pathogenic-capable of causing disease-or any bacteria indicative of faecal pollution (4). Hazards of three types like biological which includes all the microorganisms and chemical includes organic and inorganic substance which can cause harm. Physical hazard can be any external thing which can cause harm like glass piece, paint of the machine etc. Major group of interest includes bacteria (total coli forms, *Escherichia coli*, *Salmonella, Shigella, Yersinia*, and *Vibrio*), viruses (*hepatitis A, enteric viruses*), algae, fungi, protozoa (*Giardia lambia, Entamoeba histolytica, Crypto-sporidium parvum*) and worms (5). As far as the inorganic and organic contaminants are concerned the most important with regard to health are metals (Calcium, Magnesium, and Sodium etc), turbidity, organochlorine and organ phosphorus pesticides and disinfection by products(6). Physical hazard may include the chances of some errors like rat dropping off while the sugar is dumped into the machine for the preparation of sugar syrup, machine used for production loses the dry paint during over production process, persona walking near production area has hair exposed, presence of residues disinfectant after cleaning, growth of microbes at the inlets and outlets, the production sieves sometimes loses metal pieces and when any of the part of process is not working well.

While conducting the hazard analysis in Ludhiana beverages, the hazards which were finded out were microbes like *Escherichia. Coli, Enterococci, Pseudomonas aeruginosa, Cryptosporidium parvum, Enteric virus* and *Helminths* etc. all these are comes under biological hazards and the second hazard is turbidity which comes under physical hazard. *Escherichia. Coli* and *Cryptosporidium parvum* causes diarrheal disease, Pseudomonas aeruginosa causes skin disease, tuberculosis, fecal coli form causes urinary tract infection (7)(8)(9)

Then the total is done. This is to find out whether the process is a Critical Control Point or Operational Pre-Requisite Program. If the total number is under 10-14 then it is OPRP and if the answer is comes under 15-21, and then it is a critical control point.

OPRP is also an important step in HACCP development, it is a prerequisite program identified by the hazard analysis as essential in order to control the likelihood of introducing food safety hazards to and/or the contamination or proliferation of food safety hazards in the product(s) or in the processing environment. This process was performed by the company and the result which came was that the critical control point is chlorination.

Determine Critical Control Points:

The critical control points are the points where the hazards are removed. It is a step which can be applied and is essential to prevent or eliminate a food safety hazard or reduce it to an acceptable level. The raw water is having all biological, chemical and physical hazards. The WTP process starts with pre-treatment. Pre-treatment includes micro strainers, off-stream storage and bank filtration, each of which has a particular function and water quality benefits. Application of pre-treatment includes removal of algae cells, high levels of turbidity, viruses and protozoan cysts. The

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efficiency of the process depends on a number of factors like the quality of the water (turbidity, dissolved organic matter, oxygen, ammonia and nutrients), the composition and porosity of the soil, the residence time of the water in the soil and the temperature. Now when it comes to coagulation and flocculation process its also helps to remove the organic and inorganic metals in the raw water.

Coagulation process is done with the help of few chemicals like calcium hydroxide, calcium chloride and calcium hypochlorite. It all helps to remove the magnesium, calcium and sodium alkalinity. It also helps as disinfectants. Ferrous sulphate helps in the flocculation process. With respect to coagulation and flocculation, most bacteria and protozoa can be considered as particles and most viruses as colloidal organic particles. Calcium hydroxide helps to increase the pH which helps to precipitate high concentration of calcium and magnesium. This calcium hydroxide also helps for the removal and disinfection efficiency of Giardia, Crypt-osporidium, viruses and coli form bacteria. Bacteriophage are also sensitive to lime. Cryptos-poridium and Giardia is also removed in sand filtration (10) (11)

In Ludhiana beverages with all related tests, the result came out that the critical control point is chlorination. This chlorination process is done in coagulation. Here chlorine helps to cleave the cell wall of bacteria leads to the purification of water. Chlorine also helps to remove the turbidity in water which is a physical hazard.

Table.1 : Here in the above table the operational step is selected, and hazard which is analyzed is added. Then it is searched out that characterization of hazard. Then the CCP, target limit, critical limit and action limit is searched out by performing few tests. It is necessary to ask few questions to yourself about the hazard and regarding issues, all these things are added into the record for future references.

S.NO	OPERATION STEP	SIGNIFICANT HAZARD	HAZARD TYPE	CRITICAL CONTROL POINT	TARGET LIMIT	CRITICAL LIMIT	ACTION LIMIT
1.	Coagulation	Microbial contamination	Biological	Chlorination	4ppm	3-5ppm	3-5ppm
		Turbidity	Physical	Chlorination	4ppm	3-5ppm	3-5ppm

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Monitoring					Record	Preventive measures	Correction	Responsibility
Where	What	How	Frequency	Who	Record keeping process of treated water testing	Use of potable water meeting IS: 10500 and WHO standards	Drain the tank	Quality assurance chemist
Treatment	Chlorine	Lovibond comparator and DPD 1 tablet	After every batch preparation	Quality assurance chemist				

Corrective action	Responsibility	Records
1. Training of operators and water treatment chemists. 2. Ensure weighing scale working & calibration as per specified frequency. 3. Raw water analysis for physical, chemical and microbiological parameters. 4. Set the dosage as per jar testing results and available chlorine in calcium hypochlorite.	Quality assurance manager/quality assurance chemist	Training records, raw water analysis record and jar testing records.

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