HAZARD ANALYSIS CRITICAL CONTROL POINT (HACCP) SYSTEM: AN OVERVIEW

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HACCP is an acronym that stands for Hazard Analysis Critical Control Point. HACCP is a systematic approach to the identification, evaluation, and control of food safety hazards. It is aproactive strategy where hazards are identified and assessed, and control measures aredeveloped to prevent, reduce, or eliminate a hazard. The goal of HACCP is to produce foodproducts that are 'SAFE' for human consumption. The result of the implementation of theHACCP Plan is known as the HACCP System. Use of HACCP system will move a foodproducing company from sole retrospective end product testing approach towards a preventivequality assurance approach.

HACCP Definitions

- **HACCP:** A systematic approach to the identification, evaluation, and control of food safety hazards.
- **Prerequisite Programs:** Procedures, including Good Manufacturing Practices, thataddress operational conditions providing the foundation for the HACCP system.
- **Risk:** an estimate of the likelihood of the occurrence of a hazard
- **Severity of risk:** the seriousness of a hazard if not properly controlled
- **Hazard:** any biological, chemical or physical property that may be expected to cause anunacceptable health risk to consumers if present in the product
- **Hazard Analysis:** The process of collecting and evaluating information on hazardsassociated with the food under consideration to decide which are significant and mustbe addressed in the HACCP plan.
- **HACCP Team:** The group of people who are responsible for developing, implementingand maintaining the HACCP system.

- **Critical control point (CCP)** – a specific point in a process where control can be appliedto eliminate or reduce the risk of a hazard to an acceptable level
- **CCP Decision Tree:** A sequence of questions to assist in determining whether acontrol point is a CCP.
- **Control Measure:** Any action or activity that can be used to prevent, eliminate orreduce a significant hazard.
- **Monitor:** To conduct a planned sequence of observations or measurements to assesswhether a CCP is under control and to produce an accurate record for future use inverification.
- **Validation:** That element of verification focused on collecting and evaluatingscientific and technical information to determine if the HACCP plan, when properlyimplemented, will effectively control the hazards.
- **Verification:** Those activities, other than monitoring, that determine the validity of theHACCP plan and that the system is operating according to the plan.
- **HACCP Plan:** The written document which is based upon the principles of HACCP andwhich delineates the procedures to be followed.

History of HACCP:

The concept of HACCP was first used in the US space program to ensure safe food forastronauts without relying on end-product testing. It was developed in 1960s by a team fromPillsbury company to produce 'zero defects' food products for the NASA astronauts. HACCPwas adopted in 1973 by the USFDA for low acid canned food regulations (pH < 4.6). TheHACCP standard developed by the U.S. National Advisory Committee on the MicrobiologicalCriteria for Food (NACMCF) was later adopted by the Codex Alimentarius Commission andpublished as the first international HACCP standard in 1992. In 1997, the USFDA madeHACCP mandatory for all seafood processors in the US as well as for those foreign plantsexporting to

the US. The Canadian Food Inspection Agency (CFIA) made HACCP mandatoryfor all Canadian seafood processors in 1998. Similar legislation has been imposed in the EUfor food processors within the EU and those exporting to EU countries. The CodexAlimentarius Commission – an organization linked to the WHO (World Health Organization)and FAO (Food and Agriculture Organization of the United Nations), with representatives frommore than180 countries – has published the HACCP approach for managing food safety risks.This approach is being adopted by government agencies and industry organizations globally.Although specific regulations in different parts of the world continue to evolve, they typically feature some common elements from HACCP:

Seven fundamental principles of HACCP

Principle 1 - Conduct hazard analysis for each product.

Principle 2 - Identify Critical Control Points

Principle 3 - Establish critical limits

Principle 4 - Establish CCP monitoring procedures

Principle 5 - Establish Corrective action when critical limits have been exceeded

Principle 6 - Establish HACCP verification procedures

Principle 7 - Establish effective record keeping and documentation

Twelve Steps to Implement HACCP

1. Assemble HACCP team

2. Describe product

3. Identify intended use

4. Construct process Flow Diagram and Plant Schematic

5. On-site verification of Flow Diagram and Plant Schematic

6. List hazards associated with each step – (HACCP principle 1)

7. Apply HACCP decision tree to determine CCP – (HACCP principle 2)

8. Establish critical limits – (HACCP principle 3)

9. Establish monitoring procedures - (HACCP principle 4)

10. Establish deviation procedures - (HACCP principle 5)

11. Establish verification procedures - (HACCP principle 6)

12. Establish record keeping/documentation for steps 6-11 - (HACCP principle 7)

Step 1 - Assemble HACCP Team: A multi-disciplinary HACCP team comprising ofindividuals with different specialties is integral for the successful implantation of HACCP inany seafood processing unit. The members of the team include people from maintenance,quality control, production, cleaning and sanitation, people involved in the day- to-day plantoperations. The HACCP team has to be led by a team leader who must be well-trained, have areasonable scientific background and have the ability to motivate and work well with others.The team must have access to reliable technical information. The main duties of the HACCPteam are to develop the HACCP plan, verify the HACCP plan, implement and continuallyrevise the HACCP plan to accommodate changes. The team approach is preferred as a singleperson cannot be an expert on all operations of the processing unit. Moreover, team approachencourages 'ownership' of the decisions.

Steps 2 & 3- Description and Intended Use of Product: The fish products that are to bemanufactured have to be described in details with its distribution chain. This providesinformation on the ingredients, processing methods, and distribution methods (frozen,refrigerated, or at ambient temperature). Identify how the fish are stored after receipt, how thefinished product will be shipped, how the finished product will be packaged, how the productsare intended to be used and finally identify the intended consumer. The consumers of the foodalso have to be described thoroughly. These may be the general public or a segment of thepopulation such as infants or the elderly.

Step 4-Construct a process flow diagram: A flow diagram describes the process for eachproduct. This diagram provides a clear, simple outline of the steps involved in the making theproduct. A block flow diagram is usually sufficient. The flow diagram details all the processactivities including inspections, transportation, storage and delays in the process as they "flow"from receipt to distribution.

Step 5- On site verification of the process flow diagram: The HACCP team should performan on-site review of the operation to verify the accuracy and completeness of the flow diagram.Perform a walk-through of the process to make sure all process steps are covered. It should bedone by all members of the HACCP team during all stages and hours of operation

Step 6-Hazard Analysis (HACCP Principle 1): The HACCP team reviews the ingredientsused, activities at each processing step, and then makes a list of food safety hazards that arereasonably likely to cause injury or illness if not controlled. Hazard is any biological, chemicalor physical agent that may cause an unacceptable health risk to consumers if present in theproduct. Examples of biological hazards are pathogenic bacteria, viruses, parasites; examplesof chemical hazards are heavy metals, pesticides, antibiotic residues, dyes; examples ofphysical hazards are metal pieces, glass pieces. The hazards may be species related or processrelated. These food safety hazards may already be present in the raw material or, on the otherhand, these may be introduced during the subsequent processing stages, which thus adverselyaffect the hygiene and safety status of the product. The HACCP team must identify steps in theprocess where significant hazards may occur, identify the type and nature of contamination,the stage at which it might occurred (either during or after processing). The team must estimateboth risk and severity of hazards. The risk assessment is based upon experience, epidemiological data and technical information.

Five steps are involved in a hazard analysis:

i. List process steps

ii. Identify potential food safety hazards

iii. Determine if the hazard is significant

iv. Justify the decision

v. Identify control measure

The HACCP team should identify the preventive measures for each hazard to reduceprobability of risk. Biological hazards are controlled through time/ temperature controls,cooking, freezing, fermentation and/or pH controls, adding salt or other preservatives, dryingor other processing techniques. Chemical hazards (natural toxins, pesticides, drug residues,unapproved food and colour additives, histamine) are mainly controlled through source controls,time/temperature controls, production controls and labelling controls. Physical hazards (metal,glass) are controlled through source controls and production controls.

Step 7 - Identify the Critical Control Points (CCP's) (HACCP Principle 2): A CCP is apoint, step or procedure which can be applied to prevent, eliminate or reduce hazards to anacceptable level. Every significant hazard must have a corresponding CCP and a "decisiontree" is used to determine if a process point is a CCP or not.

The decision tree follows a series of questions.

Q1: Does this step involve a hazard of sufficient risk and severity to warrant its control?

Yes – go to Q2

No – Not a CCP

Q2: Does a control measure for the hazard exist at this step?

Yes – go to Q3

No – Is control of step necessary for safety?

Yes – Modify the step process or product

No – Not a CCP – Stop*

Q3: Is control at this step necessary to prevent, eliminate or reduce the risk of the hazard to consumers?

Yes – CCP

No – Not a CCP – Stop*

The examples of CCPs in a fish processing unit

- Reception of raw materials
- Cooking:
- Metal detection point
- Labelling

CCPs are Product and Process Specific. CCPs may change with differences in plant layout,product formulation, process flow, change in equipment, ingredient selection and sanitationand support programs.

Step 8- Establish Critical Limits (HACCP Principle 3): Critical limit is a maximum and/orminimum value to which a biological, chemical or physical parameter must be controlled at aCCP to prevent, eliminate or reduce to an acceptable level the occurrence of a food-safetyhazard. Critical limits are boundaries which cannot be exceeded if the hazard is to be prevented,eliminated or minimized. Critical limits are scientifically determined based on informationavailable in journal articles, food science texts, microbiology texts, regulations and guidelines.Examples: Cooking temperature of 99°C for a specified time depending on the product size toattain core temperature of 72°C to control *Listeria monocytogenes*.

Step 9- CCP Monitoring (HACCP Principle 4): Monitoring involves a planned sequence ofobservations or measurements to assess whether a CCP is under control. These observationsare used to determine whether or not corrective action is required. Monitoring facilitatestracking of the operation, indicates when there is a loss of control and a deviation occurs andprovides written documentation for use during the verification process. Examples of CCPmonitoring are time and

temperature of cooking process, water activity (aw), pH, internalproduct temperature, salt concentration in brine, metal inclusion screening.

Step 10- Corrective Actions (HACCP Principle 5): Corrective actions are the plannedactions that are to be undertaken when monitoring indicates that there is a deviation from anestablished critical limit. A failure to meet a required critical limit for a critical control point isknown a deviation. There is a need for clear corrective action protocols and chain of commandmust be emphasized. The corrective actions taken must bring the CCP back under control toensure that the production process will not cause consumer illness. All the corrective actionstaken to fix the problem that caused the deviation and restore process control must bedocumented and these records will help the firm identify recurring problems. The aim ofcorrective actions is to re-establish control of the process so that production can start again assoon as possible without further deviations. However, it needs to be emphasized that whencritical limit deviations frequently reoccur then, the process and the HACCP plan must be reevaluated.Examples of corrective actions include adding more salt to the brine solution; recookingif possible if the internal temperature was not achieved;

Step 11 - Verification (HACCP Principle 6): Verification includes those activities, other thanmonitoring, that determine the validity of the HACCP plan and that verify the system isoperating according to the plan. The purpose of verification is to provide a level of confidencethat the plan is based on solid scientific principles and control the hazards associated with theproduct and process, and is being followed. The type of verifications are Validation, CCPverification activities, HACCP system verification and verification by the regulatory agencies.Validation involves establishing the scientific basis for the HACCP plan. Validation isperformed initially and whenever there are changes in raw materials, changes in product orprocess, recurring deviations, new information on hazards or control measures, newdistribution or consumer handling practices. A validation example might be the documentation used to select a cook step to control salmonella in a ready-to-eat product, the minimum time and temperature needed to cook the product,

and the frequency of temperature monitoring to ensure safety. The second part of verification is to "verify" that the validated plan is being followed correctly. Examples of "verifying" include: calibration of process monitoring instruments, direct observation of monitoring activities and corrective actions, and review of records generated and maintained in accordance HACCP Plan. HACCP system is verified annually or whenever there is an occurrence of a system failure or significant change in product or process.

Step 12 - Record Keeping (HACCP Principle 7): Systematic record keeping system with filing system is a vital component of the HACCP system. Records pertaining to HACCP plan and supporting documentation, records of CCP monitoring, records of corrective actions, records of verification activities, sanitation Control records, importer verification records are maintained in fish processing units.

Conclusion

The future of fisheries depends on the production of safe and wholesome products, and this goal can be achieved by the strict enforcement of HACCPbased practices, during primary production /harvest stage, processing stage in fish processing units, distribution to domestic and international markets and storage during retail sale. The aim of quality assurance is to ensure that a product conforms as closely as possible and consistently to that standard at all times.