INTRODUCTION TO HACCP
(HAZARD ANALYSIS CRITICAL CONTROL POINT)

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INTRODUCTION TO HACCP
(HAZARD ANALYSIS CRITICAL CONTROL POINT)

Objectives of the module:

By the end of this module, participants should be able to

(a) Define HACCP

(b) Explain the following terms: hazard, risk, critical control point (CCP)

(c) List the benefits of the HACCP approach

(d) Describe the different steps in a HACCP study

(e) Construct and use simple flow diagrams

(f) Conduct a simple hazard analysis

(g) Identify critical control points using a CCP decision tree
14.1 WHAT IS HACCP?

Traditionally, industry and regulators have depended on spot-checks of manufacturing conditions and random sampling of final products to ensure safe food. This approach, however, tends to be reactive, rather than pro-active and preventive. HACCP which stands for Hazard Analysis and Critical Control Point, is a prevention-based food safety system which was developed more than 40 years ago to ensure safe foods for astronauts. It has now been adopted by the food industry and regulators to ensure production of safe foods.

HACCP : HAZARD ANALYSIS CRITICAL CONTROL POINT.

HACCP is a systematic approach to ensure food safety by examining every step in a food operation, identifying hazards, assessing their severity and likelihood of occurrence (significance) (risk) and controlling these hazards.

- Examines every step in a food operation
- Identifies the steps that are critical to food safety
- Implements effective control measures
- Monitors procedures at these steps
**Benefits of HACCP**

- The system offers a rational approach to the control of hazards in foods.
- It avoids the many weaknesses inherent in inspectional approach.
- Its implementation focuses attention on the factors that directly affect the safety of a product *at all stages of the food chain*.
- It increases confidence in the food supply.
- Its use will lead to increased market access and reduction in production costs (reduced recall or wastage of food).
- Its application reduces risk of foodborne diseases.

### 14.2 EXPLANATION OF TERMS

**HAZARD**

*A biological, chemical or physical agent in, or condition of, food with the potential to cause an adverse health effect.* (CAC, 2009)

- One of the most serious hazards in the food industry is botulism caused by the toxin of the bacterium *Clostridium botulinum* which can even cause death.

**RISK**

*Risk is the estimate of the probability of a hazard occurring.*

- If the bacterium *Clostridium botulinum* is likely to be present and conditions exist that favour its growth, then there is a *high risk* of a problem occurring.
SEVERITY

Not all hazards are equally dangerous.

Severity is the seriousness of the effect of the hazard

Botulism is a very serious illness in the food industry because it frequently leads to death whilst some other types of food poisoning, although unacceptable, can lead to discomfort for a few days, but are not necessarily fatal.

Hazard Analysis is therefore

1. the identification of potential hazards
2. the determination of the risk of hazards (microbiological, chemical and physical) occurring, considering
   (a) potential sources and specific points of contamination
   (b) the probability that microorganisms will survive and/or multiply during production, processing, distribution, storage and preparation for consumption and
3. the assessment of severity of the hazards identified

CRITICAL CONTROL POINTS.

- Every significant hazard, bearing in mind its risk of occurrence, has to be controlled.
- Control can be exercised at different points in the food chain.

A critical control point is a step in a food operation where control is essential to the safety of the food.
MONITORING
Appropriate methods should be selected to check that a hazard has been controlled at a critical control point. We need certain criteria that indicate whether or not the operation is under control. These criteria are known as critical limits.

**Criteria** can be defined as characteristics that must be specified to ensure the control of product safety and this leads to the definition of a critical limit below:

**Critical limit** is a criterion that separates acceptability from unacceptability (CAC, 2009).
**Examples of critical limits:**

- Monitoring must detect any deviation from the specified critical limit (criteria).
- Any loss of control at a CCP must be quickly detected so that immediate corrective action can take place to regain control at this point and to prevent wastage of product.
- Monitoring should always be a measurement or observation that can be conducted quickly for example, pH test, water activity test etc.

**Monitoring** is the systematic observation or measurement at a CCP of the critical limits for the control of the hazard. It detects any deviation from the specification and thus allows corrective action to be taken.

**Monitoring** is also the act of conducting a planned sequence of observations or measurements of control parameters to assess whether a CCP is under control (CAC, 2009).

**VERIFICATION**

Procedures need to be established to verify that the HACCP system is
effective.

**Verification** is the use of supplementary information and tests to ensure that the HACCP system is functioning as planned.

Verification procedures may include:

- Establishment of appropriate verification inspection schedules
- Review of the HACCP plan
- Review of CCP records
- Visual inspections of operations to observe if CCPs are under control
- Random sample collection and analysis, particularly microbiological analysis

### 14.3 HAZARD ANALYSIS FOR THE INFORMAL SECTOR

It is not possible to apply HACCP principles to any operation unless the following criteria are fulfilled:

- The business is operated hygienically
- Commitment by everybody to “thinking hygienically”
- Appropriate training to all staff in food hygiene

In order to operate the business in a hygienic manner, Good Manufacturing Practices and Good Hygiene Practices must first be implemented. See other IUFoST modules.

HACCP can be applied to large food industries (e.g., large cheese manufacturing plant) as well as to the small scale food business (cottage cheese industry) and to domestic kitchen (preparation of cheese sandwiches). Training of *all staff, at all levels* is important for the successful implementation of the HACCP system.
14.4 HACCP PRINCIPLES

HACCP consists of the following **seven basic** principles (WHO 1996):

**PRINCIPLE 1**  
*Conduct a hazard analysis*  
Prepare a flow diagram of the steps in the process. Identify and list the hazards and specify the control measures.

**PRINCIPLE 2**  
*Identify the Critical Control Points*  
Use a decision tree for identification.

**PRINCIPLE 3**  
*Specify criteria to ensure control*  
Critical limits are established to ensure each CCP is under control.

**PRINCIPLE 4**  
*Monitor each CCP*  
Establish a monitoring system to ensure control of the CCP by scheduled testing or observations.

**PRINCIPLE 5**  
*Establish the corrective actions*  
Establish the corrective actions to be taken when monitoring indicates that a particular CCP is moving out of control.

**PRINCIPLE 6**  
*Establish Verification procedures*  
Establish verification procedures including appropriate supplementary tests, together with a review which confirms that HACCP is working effectively.

**PRINCIPLE 7**  
*Establish documentation*  
Establish documentation concerning all procedures and records appropriate to these principles and their application.
14.5 STEPS IN HACCP

The Codex Alimentarius Commission developed 12 stages of HACCP (CAC, 2009) which are still in use today. These are:

**Stage 1 Assemble the HACCP team**

1. Ideally, there should be one quality assurance / quality control specialist, one production specialist, one food engineer, one person from sales and marketing, one operator.
2. Select a chairperson of the team.

The HACCP team should define the scope of the HACCP study and should consider microbiological, chemical (including allergens) or physical hazards (or any combination of these). The focus should remain on product safety, but microbiological quality may be included if desired, but it should then be stated clearly.

**Stage 2 Describe the product**

Composition, structure, processing, packaging system, storage & distribution conditions, required shelf life, instructions for use.

**Stage 3 Identify intended use of product by consumer**

The intended use should be based on the expected uses of the product by the end user or consumer. In specific cases, vulnerable groups of the population, e.g. institutional feeding, the very young, the old, pregnant women may have to be considered.

**Stage 4 Construct a Flow diagram**

Each step should be outlined in sequence.

**Stage 5 On-site verification of flow diagram**

Verify if the flow diagram is an accurate representation of the actual operation.
List all the potential hazards in each of the three categories (including allergens) that are reasonably likely to occur at each of the process steps as reflected in the flow diagram. Determine acceptable levels of the hazards as well as appropriate control measures for the significant hazards.

Whilst there is no limit to the number of CCPs that may be identified in a HACCP study, too many CCPS are not desirable and may be an indication of incorrect use of the CCP decision tree. In addition, the CCP decision tree is only a guideline and should be used with caution.

Critical limits must be specified and validated for each CCP. In some cases, more than one critical limit will be determined for a particular step. Criteria often used include measurements of temperature, time, moisture level, pH, water activity, available chlorine, and sensory parameters such as visual appearance and texture. Where HACCP guidance developed by experts has been used to establish the critical limits, care should be taken to ensure that these limits fully apply to the specific operation, product or groups of products under consideration. Critical limits should be measurable so that it is possible to conduct a monitoring exercise (see Stage 9 below).
The monitoring system describes the methods by which management is able to confirm that all CCPs are operating with specification. It also produces an accurate record of performance for future reference in verification. Team also decides WHO should monitor, HOW, HOW FREQUENTLY and WHAT should be monitored.

**Stage 10  Establish a corrective action plan.**

When the monitoring of the results shows that a CCP has deviated from its specified critical limit, actions need to be specified and taken to bring the process back into control. Also disposition of the food when CCP is “out of control” must be determined e.g. rework, reject, deviate the product to animal feed etc.

**Stage 11:  Establish record keeping and documentation**

Efficient & accurate documentation and record keeping is essential to the successful application of HACCP to a food process.

A producer should be able to show that HACCP principles have been correctly applied. Documentation examples are are:

- The hazard analysis process
- CCP determination
- Critical limit determination

Examples of records are:

- Nature, source & quality of raw materials
- Listing of the HACCP team and assigned responsibilities;
- Description of the product and its intended use;
- Flow diagram of the food preparation indicating CCPs;
- CCP monitoring activities
- Cleaning & disinfection records
- Deviations file
- Corrective / disposition action file
- Modifications to the HACCP plan

**Stage 12  Verification**
Verification should review the entire HACCP system and records generated. Examples are:

- Internal auditing results
- Review of deviations & product disposition
- Surveys of the market place for unexpected health / spoilage problems
- Review of critical limits to verify that they are adequate to control hazards;
- Microbiological testing of random samples of product
- Review of customer complaints
Q1. Are control measures in place for the hazard?

Q2. Does the step eliminate or reduce the hazard to an acceptable level?

Q3. Could contamination occur at unacceptable level(s) or could it increase to unacceptable level(s)?

Q4. Will a subsequent step eliminate or reduce the hazard to an acceptable level?

Figure 1: The Decision Tree to identify CCP
GROUP EXERCISE ACTIVITY

This is a HACCP group exercise. You are provided with a flow chart for the manufacture of frozen beef burgers. Carefully study the flow diagram and product characteristics.

1. Conduct a hazard analysis for this product and:
   a. Identify the potential hazards that could arise and their possible causes.
   b. Determine acceptable levels for each of these hazards.
   c. Indicate the control measures required to prevent these hazards.

2. Making use of the Critical Control Point decision tree, apply its methodology for each process step in the flow diagram, in sequence, to identify whether the step is a CCP or not.

Each group will be given 3 hours to complete the HACCP study. After the exercise, each group will deliver a 25 minute presentation of the results.
Flow diagram for the production of raw, frozen beef burger

1. Reception of frozen beef burger

2. Storage at –20 °C
   \[\rightarrow\] 2.1 Transfer to chill room for processing

3. Unpacking

4. Weighing of meat

5. Mechanical grinding of meat

6.1 Weighing of ingredients

6.2 Addition and mixing of ingredients

7. Forming/shaping by machine

8. Blast freezing at –40 °C for 3 hours

9. Packaging and labeling (10 °C)

9.1 Packaging and labeling (10 °C)

10. Metal detection

11. Storage of burgers at –20 °C

6. Reception/storage of ingredients

9. Reception/storage of packaging material
## Annex 1: Hazards associated

<table>
<thead>
<tr>
<th>Food item</th>
<th>Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw vegetables</td>
<td>Microbiological&lt;br&gt;Soil particles&lt;br&gt;Pebbles&lt;br&gt;Insects&lt;br&gt;Unwanted plant materials&lt;br&gt;Pesticide residues</td>
</tr>
<tr>
<td>Cooked vegetables</td>
<td>Microbiological&lt;br&gt;Pesticide residue&lt;br&gt;Chemical</td>
</tr>
<tr>
<td>Pulses</td>
<td>Microbiological&lt;br&gt;Soil particles&lt;br&gt;Pebbles&lt;br&gt;Insects&lt;br&gt;Unwanted plant materials&lt;br&gt;Pesticide residues&lt;br&gt;Natural toxins</td>
</tr>
<tr>
<td>Fresh meat</td>
<td>Microbiological&lt;br&gt;Parasite&lt;br&gt;Physical contaminants (feathers, fur)&lt;br&gt;Veterinary residues (Hormones)</td>
</tr>
<tr>
<td>Fresh fish</td>
<td>Microbiological&lt;br&gt;Toxins&lt;br&gt;Parasites&lt;br&gt;Heavy metals</td>
</tr>
<tr>
<td>Water</td>
<td>Microbiological&lt;br&gt;Physical contaminants&lt;br&gt;Metals</td>
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REFERENCES


