UNIT 7 HACCP

Structure

7.0 OBJECTIVES

After reading this unit, you will be able to:

- explain the potential food borne health hazards;
- justify the relevance of HACCP in monitoring and managing the safety of food products;
- discuss the process flow chart of HACCP;
- discuss on hazards analysis worksheet; and
- conclude on the uses of the HACCP system.

7.1 INTRODUCTION

You will be surprised to know that over the last few years, the lifestyle of people around the world has changed drastically. Even their eating habits have changed. The traditional cook and eat has given way to ready-to-eat and fast foods. The entire food industry has become more market-driven, providing products that meet consumer demand. Consumers want more convenient, ready-to-eat and value-added products. The industry is using new processing and packaging technologies, such as vacuum packaging and pre-cooked, microwaveable products. As a result, all over the world, there is also a growing concern over food poisoning and food borne diseases. Consequently, all national and international agencies are enforcing control measures to minimize food poisoning and food borne diseases.

7.2 CONCEPT OF HACCP

The concept of HACCP (Hazard Analysis Critical Control Point) can be applied to entire food chains where food is grown, harvested / slaughtered / processed / manufactured and prepared for final consumption, through a variety of food industry sectors using different techniques. The HACCP concept can be applied during planning and development stage so that potential hazards can be excluded from process and products.

7.2.1 Potential Hazards

Now, let us take a closer look at some common food borne health hazards.

Algal bloom (mass scale multiplication of algal cell) is a common phenomenon along sea coasts. Some algal blooms are caused by toxic algae. The animals in the sea which directly or indirectly consume these algae accumulate the toxin in their body. The mussels feed on algae. If a mussel feeds on algae, which are toxic, the algal toxin is retained by the mussel. When this mussel is eaten by the man, the toxin finds way into his body.

Some organisms in inland water bodies and certain big fishes in marine waters can be found accumulating toxic metals like Cadmium, Mercury, Lead etc. Consuming such contaminated fish is a major cause for food borne toxicity in many countries. The infamous “Mina Mata” disease which occurred in Japan is one such concern caused by mercury contamination.

The squid and cuttle fish are known to accumulate toxic cadmium. This in turn can be a cumulative toxin for consumers. All heavy metal residues are seen in very low doses in almost all food items. Depending on the quantity consumed per day, they can accumulate in the body of the consumers. Raw foods like chicken, fish, meat, egg, ready-to-eat items like cheese, fruit juice, milk chocolate, cake, bread etc. and drinking water in freezers and fridge can at times trigger cross-contamination of pathogens like *Salmonella, Vibrio cholerae, Listeria monocytogenes* etc. This will lead to contagious diseases like cholera, typhoid, listeriosis etc. Inadequate processing of ready-to-eat products can also result in such problems. For example, pathogens and parasites like tapeworms infect through improperly cooked fish, meat, pig meat (pork), vegetables etc.

In your day-to-day life, you consume farmed products such as farmed meat, aqua products, milk products, poultry, oilseeds etc. This can be another source for food poisoning due to pesticide residues found in it. Most of the pathogenic bacteria are able to survive common preserving techniques like chilling and freezing. Such surviving pathogens multiply at ambient conditions and cause food borne infections. In view of these problems, the food processors employ utmost care while processing the food. But, the need to sell products at competitive prices is pressing food processors to adopt more economic processing methods, which can lead to under-processed and risky products.

The food-borne diseases are caused by a variety of agents, which can be classified as biological hazards, chemical hazards and physical hazards.

Biological hazards include pathogenic bacteria, parasites, protozoa and viruses. *Salmonella, Vibrio cholera, V. parahaemolyticus, Listeria, Campylobacter,*

S. aureus etc. are the commonly encountered pathogens involved in food-borne infections. *Salmonella* alone account for over a million food-borne infections per year in the world. Parasites like tapeworm, *cryptosporidium* and *giardia* are also responsible for severe incidences of food-borne infections. Obviously, microbes and parasites are the most important agents in food poisoning.

Hydrocarbons in drinking water, staple pins in packed foods, cleaning chemicals in baby foods etc. are causes of public health concern.

To ensure the safety of food items, Govt. of India has enforced the *PFA* Act and introduced the Food Safety Bill in 2005 and passed Food Safety Act in 2006 in the Parliament. These acts recommend severe punishments to those processors, who produce or sell defective/hazardous foods for human consumption. The food can get contaminated during raw material production, processing, storage and distribution, and hence all those involved in food production and distribution shall be liable for heavy fines and imprisonment, if a safety issue arises. This can pose serious problems on sales, brand image and finally liquidity.

Check Your Progress 1

Note: a) Write your answers within the space provided.

b) Check your answers with those given at the end of the unit.

1) What is the classification of food-borne diseases?

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2) Write two major agents which cause food poisoning?

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3) Name the disease which occurred in Japan caused by mercury contamination?

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4) Name two shellfish which are known to accumulate toxic cadmium?

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7.3 RELEVANCE OF HACCP

How food safety can be ensured in the production process? This is where HACCP comes into the picture. HACCP is a food safety system for the food industry and now applied for all manufacturing industries, aquaculture and also for agriculture. It is a procedure that identifies where potential food safety hazards can occur in a food processing line and strictly manages and monitors these points to ensure that the process is under control and that the safest possible product is produced. HACCP is designed to prevent rather than just detect potential hazards. Today,

HACCP or Hazard Analysis Critical Control Point is a safety procedure recognized and practiced world over to ensure food safety. HACCP Program is one of the most effective steps adopted for the control of hazards in food production process. This unit will equip you with the latest developments in food safety so that you can implement them in any food production process to ensure safety of the food produced.

7.4 ORIGIN OF HACCP

Let us now learn more on the origin of this concept.

7.4.1 History of HACCP

The HACCP concept had its origin in the USA.

Chronology of its development:

1958- Foundation of the NASA (National Aeronautics and Space Administration)

1959- Development of the HACCP concept to assure one hundred per cent safety of food to be used in space.

1971- The HACCP system was published and documented in the USA.

1985- The National Academy of Science (NAS) recommended the use of the system. Worldwide, the system became used and the FAO/WHO *Codex Alimentarius* (Food and Agriculture Organization/World Health Organization) cited the system in the Codex.

1993- The European regulation 93/43 EG from 14.7.93 provides the use of the system for the production of food.

1998- With the coming into force on the 8th August 1998, the Hygiene Verordnung (German Hygiene Rule) demands the use of the HACCP system in Germany.

The HACCP system was developed in 1959 by Dr. Howard Bowman of the US based Pillsbury Company, to provide safe food for the astronauts of Apollo Mission. This was later refined and approved by several scientific agencies like NAS (National Academy of Sciences), NACMSF (National Advisory Committee on Microbiological Criteria for Foods), ICMSF (International Committee on Microbiological Certification of Food), Codex and several other national and international agencies. Currently, HACCP is a mandatory requirement for food manufacture and distribution in developed and most of the developing countries to ensure food safety and public health.

Canada, USA, Iceland, European Union and many other fish producing countries have taken to HACCP as a food safety standard. Now, it has been identified as a global unified quality assurance system for producing safe and better quality food product at a global level. The FAO's *Codex Alimentarius* Commission has formulated guidelines for implementation of HACCP system in the food industry.

The HACCP concept offers good possibility to secure the safe production of food. It helps the processor perform the analysis and control the process to prevent

known hazards that are likely to occur. Documentation is an important aspect of HACCP. In the United Sates, by implementing HACCP, the company and the FDA assure food safety and wholesomeness.

The ICMSF (International Committee on Microbiological Certification of Food) has given in its handbook "HACCP in Microbial Safety and Quality" (1998), a comprehensive overview of the system.

HACCP is a scientific system designed to eliminate all possible hazards in food manufacturing process. It operates based on the seven principles of HACCP formulated by NMFS in 1992. Recently, International Standards Organization formulated a standard for food safety called ISO 22000 FSMS 2005, which covers HACCP and pre-requisite programmes. Now, you will learn about the principles of HACCP.

7.5 PRINCIPLES OF HACCP

The seven major principles of HACCP are designed in such a way to identify and exclude all possible hazards. Let us now know them in detail.

Principle I: Identify the hazards

Here, you have to look at each processing step (e.g. purchasing raw material, transportation, storage, preparation, cooking, chilling etc.) in your operation and identify what can go wrong to cause a food safety problem and evaluate their significance. e.g. *Salmonella* in cooked chicken or fish (biological hazard), histamine in tuna and mackerel, cadmium in cuttle fish and squid (chemical hazard) or a piece of glass or pin in a pack of salad (physical hazard) which are some significant hazards. In this way, find out all significant hazards relevant with respect to the product and the processing steps.

Principle II: Determine the Critical Control Points (CCPs)

Identify the points in your operation that ensures control of the identified significant hazards. e.g. Cooking burgers to a minimum of 70°C for 2 minutes will kill *E. coli* O157 and other pathogens. In case of chemical hazards like heavy metals, practice raw material control by procuring raw materials only from contamination free area. For prevention of histamine in scombroid fishes, use time-temperature control, which means keeping the fish at 0° to 4°C, immediately after catch and processing within the shortest time.

By definition, CCP is that processing step, which gives maximum control of an identified significant hazard. This decision will help you identify the critical control points easily.

Principle III: Establish critical limit(s)

For any hazard, there will be a tolerance limit, below which the hazard will not cause infection or injury to the customer. Such tolerance limits are available in standards and hazard guides. Using them as set tolerance limits for each significant hazard so as to monitor the Critical Control Points and to ensure that the hazard is well within this tolerance limit (Table 7.1). Example, 70°C at the centre of a prawn during cooking for 2 minutes to eliminate possible pathogens. Valid data on critical limits are readily available in the US FDA hazard guide.

Table 7.1: Critical Limits of Hazards in Fish/fish Products

Sl. No.	Significant Hazards	Critical Limit
1.	PSP	0.8 mg/kg (0.8 ppm)
2.	DSP	0.2 mg/kg (0.2 ppm)
3.	Histamine	50 mg/kg (50 ppm)
4.	*Staphylococcus* toxin	Absent
5.	Botulinum toxin	Absent
6.	Lead	1.5 mg/kg
7.	Cadmium	3 mg/kg
8.	Mercury	1 mg/kg
9.	Pesticides	5 mg/kg
10.	Antibiotics	Absent (2 ppm tetracyclins 0.1 ppm sulpha drugs)
11.	Hormone residues	Absent
12.	Sanitizers and lubricants	Absent
13.	Pathogens	Absent per 25g
14.	Parasites	Absent
15.	Foreign matter- fish hook, metal fragments etc.	Absent

Principle IV: Establish a system to monitor the CCP

When critical control points and critical limits have been identified, it is important to have a procedure to monitor and record what is happening at each level. Typically, monitoring will involve examining parameters such as supplier/ farmer guarantee in case of raw material control, temperature and time evaluation in case of cooking/ pasteurization of ready-to-eat items. However, how to monitor and how often to monitor will depend on the size and nature of your business. Monitoring should in all cases be simple, quick and easy to use. e.g. instead of looking for survival of *Salmonella* in cooked chicken product, lethality of *Salmonella* can be ascertained by monitoring the cooking temperature and cooking time.

Principle V: Establish the corrective action

When monitoring indicates that a Critical Control Point is not under control and the identified hazard is exceeding tolerance limit, corrective action must be taken e.g., the temperature of the food in a cooking line is 5°C below the desired cooking temperature due to a technical fault of cooker. The corrective action in this case will be, stop production, correct the temperature setting of the cooker and continue cooking of fresh raw materials. The already under-cooked material, if otherwise edible can be introduced for re-cooking. Discard the food in case it is inferior in edible quality.

Principle VI: Establish procedures for verification

Verification involves review and cross checking the system periodically and whenever you make changes to your operation with online data and random analysis and calibration e.g., microbiological analysis of a chicken product to verify that it is free of *Salmonella* bacteria along with online monitoring of time and temperature and verifying validity of calibration of thermometer and stop watch for measurement accuracy. Conformity during verification will confirm HACCP system is effective, critical limits are not exceeded and the product is safe.

Principle VII: Establish documentation

Monitoring of Critical Control Points, Standard Sanitation Operation Procedure (SSOP), Good Manufacturing Practice (GMP) etc. will generate lot of data to show that HACCP and pre-requisite programmes are in operation. There shall be an established procedure to document these data so that at any time, the customers and enforcement authorities can be convinced that all food safety requirements as per HACCP are in operation. It is unrealistic to operate HACCP or to demonstrate compliance with the current legislation without providing evidence such as written records. The complexity of the record keeping will very much depend on the nature and complexity of the business. The aim should be to ensure that control is maintained without generating excessive paperwork e.g. records of CCP monitoring like supplier guarantee and time-temperature records for raw material control, cooking temperature and time for high risk products, SSOP records for hygiene and sanitation, records of corrective action, recall etc. are few such essential HACCP documents.

Let us go through the important definitions.

Hazard

With hazard every risk of the health of the consumer are meant. Excluded are all events which are not related to health. This is the difference of the Quality Management of ISO 9000 which covers every event of quality.

Critical Point

It is every point in the production of food where risks of the health of the consumer can be present.

Critical Control Point

A Critical Control Point (CCP) is a point in the production line where a risk of hygiene may be put under control or eliminated. With appropriate measures at that point, the risk can be:

- avoided;
- eliminated; and
- or reduced to an acceptable level.

Examples of Critical Control Points (CCPs) are:

- Source of raw materials;
- Storage and cooling of food;

- Recipes, handling and processing of food;
- Defrost, heating, warm hold phase and cooling;
- Distribution of food in restaurant, fast-food;
- pH of food;
- Correct separation between clean and unclean sectors;
- Cleaning and disinfection; and
- Hygiene of the surroundings and hygiene of the stuff.

In case of deviations of the specifications, it is proceeded as follows:

- The product is given to rework.
- The product is mixed with another charge in order to bring the analytic to acceptable values.
- The customer is informed about the deviation and accepts the product.
- When no rework is possible and the customer does not agree with the deviation, selling to other customers at reduced price is to be considered.
- When above procedures are not indicated the product must be rejected.

7.5.1 Impact of HACCP

By employing the principles of HACCP, food-borne diseases can be effectively controlled. HACCP provides business with a cost effective system to achieve food safety from ingredients through production, storage and distribution to sale and service to the final consumer. The preventive approach of HACCP not only improves food safety management but also complements other quality management systems.

7.6 BENEFITS OF HACCP

The main benefits of HACCP are:

1) Organizes your process to produce safe food.
2) Increase food safety standards of the company.
3) Avoids food poisoning of your customers.
4) Ensure public health and food safety.
5) In general, food quality standards increase.
6) Ensures you are compliant with the law.
7) Increased customer satisfaction.
8) Saves your business with increased returns in the long run.
9) Organizes your staff promoting teamwork and efficiency.

Check Your Progress 2

Note: a) Write your answers within the space provided.

b) Check your answers with those given at the end of the unit.

1) What is HACCP?

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2) When HACCP was developed and by whom?

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3) Explain on HACCP concept?

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4) Define Critical Control Point?

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5) Define the benefits of HACCP?

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7.7 LET US SUM UP

HACCP is a method now widely used in all industries in the manufacturing system. It is very popular in the food industries, as the Critical Control Points monitoring of HACCP can prevent food poisoning thereby preventing "food recall" from market country, and financial loss to management/company. In food industries, the hazards are listed mainly into three categories, chemical, microbiological and loss in quality. There are seven principles to be followed while implementing HACCP. Monitoring of Control Points assumes good manufacturing practice and thereby prevents hazards due to eating contaminated/ spoiled food.

7.8 GLOSSARY

Algae	:	Plants capable of photosynthetic activity living in water.
Algal Bloom	:	Excessive growth of algae covering water.
Contagious	:	Infectious.
Hazard	:	Danger.
Mandatory	:	Obligatory.
Pasteurization	:	Heat treated.

Pathogens : Agent of disease.

Slaughtered : Killing animals for meat.

Toxicity : The degree to which something is poisonous.

7.9 SUGGESTED FURTHER READING

Donald A. Corlett, J.R. 1998. *HACCP User's Manual*. Aspen Publishers, Inc, Gaithersburg, Maryland.

HACCP Concepts, 2nd Ed. 2005. CIFT, ICAR, Cochin, Kerala, India.

Pearson and Dutson, T.R. 1995. (Eds.). HACCP in Meat, Poultry and Fish Processing. *Advances in Meat Research Series, Volume 10*. Blackie Academic and Professional, London

UN/FAO. 1997. HACCP System and Guidelines for its Application. *Codex Alimentarius* Commission, Joint FAO/WHO Food Standards Programme, FAO, 00100, Rome, Italy.

7.10 REFERENCES

Venugopal, V. 2006. *Seafood Processing*. Published by CRC Taylors & Francis Group.

7.11 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

1) Food-borne diseases are classified as biological hazards, chemical hazards and physical hazards.
2) Microbes and parasites are the most important agents in food poisoning.
3) Mina Mata.
4) The squid and cuttle fish are known to accumulate toxic cadmium.

Check Your Progress 2

1) Hazard Analysis Critical Control Point.
2) The HACCP system was developed in 1959 by Dr. Howard Bowman.
3) The HACCP concept offers good possibilities to secure the safe production of foods. It helps the processors perform the analysis and control the process to prevent known hazards that are likely to occur.
4) A Critical Control Point ("CCP") is a point in the production line where a risk of hygiene may be put under control or eliminated.
5) Organizes your process to produce safe food, increase food safety standards of the company, avoids food poisoning of your customers, ensure public health and food safety are some of the basic benefits of HACCP.