

Food Quality Management

Hazard Analysis Critical Control Point (HACCP)

Aim

The aim of food hazard analysis is to prevent food safety problems by careful planning.

Introduction and History

HACCP is an acronym for the Hazard Analysis Critical Control Point. HACCP was developed by the Pillsbury Company, the U.S. Army, along with the National Aeronautics and Space Administration (NASA) in the 1960s. It was originally developed as a microbiological safety system to ensure food safety for astronauts. At that time most food safety and quality control systems were based on end product testing, which is an inefficient method due to product waste. Therefore, a preventative system needed to be developed to give a high level of food safety assurance. This system identified potential problems at each operational stage and proposed solutions to such problems before deploying effective control mechanisms.

Originally, HACCP was based on the following principles:

1. Comprehensive hazard analysis and risk assessment.
2. Determination and identification of critical control points (CCPs).
3. Monitoring of CCPs.

HACCP was used in the food processing industry for low-acid canned food production in the 1970s. Subcommittees of both the National Conference on Food Protection and National Academy of Sciences recommended that the HACCP approach be adopted by both the U.S. food industry and other regulatory agencies in 1986. This led to the formation of the National Advisory Committee on Microbiological Criteria for Foods (NACMCF) in 1987.

HACCP was originally developed as a “zero defects” program. HACCP is a science-based system used to ensure that food safety hazards are controlled to prevent unsafe food from reaching the consumer.

This is now widely used in the food industry to ensure safe food production for the consumer. HACCP has been used in the meat and poultry industry that is regulated by the United States Department of Agriculture (USDA). It is also used in the seafood, juice and egg industries, which are regulated by the Food and Drug Administration (FDA). Now, the FDA is considering developing regulations for the dairy industry too. In dairy industries, HACCP is already being applied as a quality control program, from fluid milk to ice cream to cheese. A specific HACCP model can be developed to boost the safety and quality of cheese products in the cheese making plant. It is difficult to get 100% product inspection because of human error.

Salient features or the advantages of HACCP

Being a systematic and scientific program, HACCP has following advantages and many others.

- Pro-active system for assuring safe production of foods
- Emphasizes prevention rather than inspection
- Addresses all types of Hazards-Microbiological, Physical and Chemical
- Reduces contamination
- Reduces recall/product destruction
- Gives consumers more confidence in product safety
- Helps food companies compete more effectively in the world market

Food Quality Management

The FDA is considering establishing the HACCP as the food safety standard in other areas of the food industry, including both domestic and imported food products.

Definitions

HACCP (Hazard Analysis Critical Control Point): A system designed to identify, evaluate, and control of the potential food safety hazards.

HACCP Plan

A HACCP plan is defined as a “document prepared in accordance with the principles of HACCP to ensure control of hazards which are significant for food safety in the segment of the food chain under consideration”.

The term “safe” refers to the processing of food products without contamination from any pathogenic organism or adulteration with harmful chemical or physical material.

Contamination: Exposure of food products to hazards (due to bacteria and viruses and other toxic substances), which can cause illness, disease, or even death.

Cross contamination: One of the most common cause of food poisoning. It happens when harmful germs are spread onto food from other food, surfaces, hands or equipments.

Prerequisite Programs: Procedures, including Good Manufacturing Practices that address operational conditions providing the foundation for the HACCP system.

Critical Control Points (CCPs): points in the process where hazards can occur and controls can be applied to prevent or eliminate a food safety hazard or reduce it to an acceptable level.

Critical Limit: A maximum and/or minimum value to which a biological, chemical, or physical parameter must be controlled at a CCP to prevent, eliminate, or reduce to an acceptable level the occurrence of a food safety hazard.

Monitor: To conduct a planned sequence of observations or measurements to assess whether a CCP is under control and to produce an accurate record for future use in verification.

Corrective Action: Procedures followed when a deviation occurs.

Laboratory Accreditation: laboratory’s quality system conforms to the requirements of an appropriate standard and of a laboratory’s technical competence to perform specific tests or calibrations.

Statistical Process Control Techniques: Statistical process control (SPC) is scientific methods for analyzing data and keeping the process within certain boundaries.

Hazard

A hazard is anything that may cause harm to a consumer. It may be:

1. Microbiological, e.g. Salmonella in chicken.
2. Physical, e.g. contamination by glass in any kind of food.
3. Chemical, e.g. contamination by cleaning chemicals in any kind of food.

Chemical hazards

The effects of chemical adulterants can be seen over the short term (acute) or long term (chronic). Food may become exposed to chemical hazards in a number of ways, including:

1. cleaning chemicals;
2. insecticides, rodenticides, herbicides and fungicides;
3. reaction of acidic foods with certain metal containers;

Food Quality Management

4. food additives when used in incorrect proportions;
5. the solvents used in certain types of packaging;
6. the addition of non-allowable chemicals by design;

Hazardous and/or inedible substances must be clearly labeled and separated from food. The practice of storing cleaning chemicals in old food containers must not be tolerated. Insecticides and rodenticides have also to be handled with considerable care within food establishments. Enamel, zinc, lead and copper containers will all react with acidic foods such as tinned tomatoes and pineapple.

Physical hazards

Food can become contaminated with all manner of foreign material from fingernails to mouse tails, dog hairs to cat teeth, fillings and filings. However, most foreign body contamination is easier to predict and causes usually fall into the following categories:

1. A broken food container, or some constituent from the container or packaging, i.e. broken glass and rubber seals.
2. Objects that fall from people or their clothing, i.e. buttons, hair and jewellery.
3. The food environment, i.e. insects, rubber bands, machinery bits, dirt and old food.
4. Malicious contamination.

Empty jars should be delivered both covered and inverted and visual checks can be made prior to filling. The inside of the container must be washed or air blown. Staff must be provided with clothes that limit contamination risks, i.e. hairnets/hats, coats with inside pockets and fasteners. The food environment and equipment must be kept clean and free from extraneous items. Staff who take pride in the business are less likely to engage in malicious damage.

Microbiological hazards

Biological hazards may fall into several groups, including moulds (predominantly responsible for food spoilage) and viruses. But it is bacteria with their ability to grow invisibly on food which must be of most concern in the determination to make food safe. If the conditions are right, bacteria will multiply exponentially to reach numbers that can cause infection. Some bacteria that cause food poisoning have a low infectious dose and hardly need to grow on food to cause illness. For instance, *E. coli* O157 results in an appalling number of deaths and incidence of renal failure in children. It is thought that as few as 10 organisms can cause illness.

Certain types of bacteria may also cause illness by producing toxins either whilst growing on the food or once inside the body. Toxins are heat-stable and difficult or impossible to remove by cooking. Bacteria may be destroyed but their toxins can remain. Other types of bacteria can survive adverse conditions (such as drying and cooking) by forming spores. These subsequently germinate and form new colonies when conditions are favourable.

High-risk foods

Food that is both suitable for the growth of bacteria and will be eaten as it is, e.g. cooked ham, is known as high-risk food. The protection of high-risk food involves preventing cross-contamination and restricting bacterial growth. This is mainly achieved using separation and strict time and temperature controls, i.e. keeping food outside the danger zone of between 8 and 63°C.

Food Quality Management

General preliminary steps of the HACCP system

There are seven principles of HACCP that relate to developing a HACCP plan. However, before getting started, there are five **presteps** that must first be addressed and documented:

Assemble the HACCP team The HACCP team should include representatives from many different process activities, such as receiving, blending, maintenance, management, quality assurance, and quality control. It is very important to approach this analysis in a manner to provide insight from associates who are familiar with each aspect of the process. During this step, the scope of the HACCP plan is defined.

Describe the product “A full description of the product” must be documented. This includes the product, its processing requirements, storage temperature, and characteristics. Characteristics include such information that will be necessary for evaluation of the hazards, such as compositional factors (e.g., pH, water activity) and processing factors (e.g., heat treatment, chemical agents).

Identify the intended use This activity is intended to identify the use of the product, such as consumption by those segments of the population at high risk for food borne illness (e.g., children, the elderly, pregnant women). For example, a citrus product such as orange juice is consumed under many different types of situations by children, the elderly, and immune-deficient individuals. In a food service situation, the intended use may be defined as being for “fast food” restaurants.

Construct the flow diagram The HACCP team must create a flow diagram of the process for which the HACCP plan will be applied. The definition of a “flow diagram” is “a systematic representation of the sequence of steps or operations used in the manufacture of the specific product.

On-site confirmation of flow diagram The HACCP team must make an onsite evaluation of the flow diagram to confirm that it is complete and that it accurately identifies all the process steps. This is important to add credibility and accuracy to the process analysis.

Once the presteps have been completed, the HACCP team will begin their system analysis in compliance with the seven principles, as detailed below.

HACCP principles

Principle 1 -Conduct a hazard analysis “Assess hazards associated with growing, harvesting, raw materials and ingredients, processing, manufacturing, distribution, marketing, preparation and consumption of the food”. This principle requires conducting a hazard analysis of the process. Hazard analysis is defined as the “process of collecting and evaluating information on hazards and conditions leading to their presence to decide which are significant for food safety and therefore should be addressed in the HACCP Plan.”

The HACCP team must define the criteria for identifying each specific hazard and evaluate each hazard for its potential risk and the significance of its occurrence. Thus hazard analysis consists of two activities: the identification of the hazard and the subsequent evaluation of each hazard. “Risk” and “significance” are two key words in the definition of the HACCP plan. Risk is the likelihood that the hazard may occur. Significance considers how serious the resulting food hazard would be, should the hazard occur.

Food Quality Management

Many existing or potential hazards may be addressed through prerequisite programs.

Prerequisite programs are activities defined and managed through operational-type programs that effectively eliminate or reduce the likelihood of a food safety occurrence. They are the foundation of an effective HACCP Plan. The role of the prerequisite program is to support and eliminate potential hazards.

Principle 2-Identify critical control points

A Critical Control Point (CCP) “is any point in the chain of food production from raw materials to finished product where the loss of control could result in an unacceptable [or potentially unacceptable] food safety risk”. Thus the goal of Principle 2 is to “determine the Critical Control Points required to control the identified hazards”. The application of Principle 2 is to identify CCPs and how they must be controlled to produce a “safe” product. A Control Point (CP) is defined as “any step at which biological, chemical, or physical factors can be controlled”.

HACCP document recommends the use of a “Decision Tree” in the CCP analysis.

Principle 3-Establish critical limits at each CCP

“Establish the critical limits which must be met at each identified Critical Control Point”. A Critical Limit (CL) is the control parameter that is required to ensure that the product is safe. An example of a CL would be the required pasteurization time temperature criteria necessary to deliver a “safe” milk product.

Principle 4-Establish monitoring procedures for critical limits

“Establish procedures to monitor critical limits”. The procedures required to ensure that the CCPs are, in fact, controlled must be established and implemented. “Monitoring” is defined as “the act of conducting a planned sequence of observations or measurements of control parameters to assess whether a CCP is under control.”

Principle 5-Establish corrective actions

“Establish corrective action to be taken when there is a deviation identified by monitoring of a Critical Control Point”. A “deviation” is defined as the “failure to meet a critical limit”.

Principle 6- Establish procedures for verification

This principle requires verification and validation of the CCPs. Verification is defined as “the application of methods, procedures, tests, and other evaluations, in addition to monitoring to determine compliance with the HACCP Plan”. Verification confirms that all the defined requirements of the HACCP plan are being performed. Validation is that element of verification which is defined as the act of “obtaining evidence that the elements of the HACCP plan are effective” or as “that element of verification focused on collecting and evaluating scientific and technical information to determine whether the HACCP plan, when properly implemented, will effectively control the identified food hazards”. Validation confirms that the appropriate activities are being performed to provide a safe product.

Validation would be the confirmation that the time/temperature of the CCP meets the defined criteria for the control of the specific microorganism that must be destroyed and/or prevented to ensure a safe food product.

Verification activities are applicable to the entire HACCP system (not just CCPs). Typical verification activities include verification of preliminary steps and prerequisite programs, review

Food Quality Management

of consumer complaints that relate to food safety, calibration of process control equipment and monitoring instruments, evaluation of end product or in-process testing data, and review of all HACCP records.

Principle 7-Establish documentation and record keeping

It is necessary to have a well-defined process for identifying and maintaining those records required to demonstrate compliance with the HACCP plan. Records must be available to provide the objective evidence (proof) not only that the CCPs have been controlled according to the required procedures but also that the prerequisite programs are being maintained in an effective manner. Without the record there is no proof that the requirement was met. There must be no assumptions and no activity left to interpretation. The record control program should include the identification of the records, retention times, responsibilities, and requirements for completion. Examples of records are “CCP monitoring activities, deviations and associated corrective actions, and modifications to the HACCP system”.

Effectiveness

An essential part of food hazard analysis is that controls must be set for the critical points and monitored to ensure that such mechanisms are effective. In order to make it possible to monitor them, controls should have targets. For example, to prevent growth, the control is not just to ‘keep meat in the fridge’, the target is to keep meat below, say, +5°C. It is important to remember that growth always has two elements, time and temperature. To prevent contamination from equipment, the control is not just to keep it clean. The target should be to clean and disinfect the equipment following a detailed schedule. For food being cooked, the control is not simply to ‘cook thoroughly’, but a precise target should be set, for example ‘cook to centre temperature of 75°C’.

Review

A full review of the system should be carried out fairly soon after it has been put fully into operation to correct any teething problems that may arise.

Management commitment

Management commitment is one of two essential requirements that are not specifically mentioned as part of the seven principles. It further emphasizes that “the successful application of HACCP requires the full commitment and involvement of management and the work force”. Management must convey a positive message of commitment throughout all levels of the operation. This commitment must be shown through words and through actions. It is strongly recommended that management conduct scheduled (i.e., quarterly) formalized meetings to evaluate the compliance status and any issues/concerns with the HACCP plan.

Training

Training is the second of the two essential requirements that are not specifically stated in the seven principles.

Training of personnel in HACCP principles and applications, and increasing awareness of consumers are essential elements for the effective implementation of HACCP. It is essential that associates be trained in their related responsibilities.