FOOD SAFETY TOOLS

Food safety can usefully be defined as the practice of ensuring that foods cause no harm to the consumer. This simple definition covers a broad range of topics, from basic domestic and personal hygiene to highly complex technical procedures designed to remove contaminants from sophisticated processed foods and ingredients.

Essentially, the practice of food safety can be distilled down to three basic operations:

- Protection of the food supply from harmful contamination
- Prevention of the development and spread of harmful contamination
- Effective removal of contamination and contaminants.

Most food safety procedures fall into one, or more than one, of these categories. For example, good food-hygiene practice is concerned with the protection of food against contamination, effective temperature control is designed to prevent the development and spread of contamination, and pasteurization is a measure developed to remove contaminants.

Along with the regular procedures employed to maintain food safety, let us understand few connected tools mentioned below in this section

1. HACCP
2. MODELS FOR MANAGEMENT SYSTEMS
3. RISK ANALYSIS
4. RISK MANAGEMENT
5. OTHER TOOLS

1. HACCP

The safety management system of food brings a set of processes and procedures designed to control food-safety hazards. The actions provided in this type of system are determined through a risk assessment, and initial analysis of the probability of an adverse health effect and the severity of the consequence of a hazard or hazards that can be found in foods.

To standardize this analysis of hazards and risks to food safety, the system Hazards Analysis and Critical Control Points (HACCP) was developed, which is a systematic and scientific system to ensure food safety. It was developed by Pillsbury in the 1960s for the U.S. Army and NASA in an effort to achieve "zero defects" and ensure total food safety for the first U.S. manned space program, and appeared in the last 20 years as the initial approach to ensure the supply of safe food.

A major shift in emphasis from national legislation to international legislation occurred in 1994, when a GATT agreement recommended acceptance of HACCP as the required standard for free international movement of food. The WTO now evaluates both technical barriers to trade and sanitary controls with reference to Codex HACCP standards.

More recently in the UK, the British Retail Consortium has issued a ‘Technical Standard for Companies Supplying Retailer Branded Food Products’, which is being used by retailers as the definitive standard for suppliers, and forms the basis of their terms of business. It covers six

key areas: HACCP systems, quality management systems, factory environmental standards, product control, process control and personnel, and is implemented through third-party inspection bodies such as European Food Safety Inspection Service (EFSIS).

2. MODELS FOR MANAGEMENT SYSTEMS

Food Safety Management systems

In light of the evolution of the agro-food industrial sector and taking into account the increased perception of the importance of food safety requirements, a number of models have been developed to standardize approaches to food safety management. Standardized models include the International Standard ISO 22000:2005 and several other standards, such as the British Retail Consortium (BRC) standard-food or the IFS model.

The International Standard ISO 22000:2005 is presented as a means to harmonize the requirements for food safety management in food and food-related business on a global level. It applies therefore to all types of organizations in the food chain, from (for example) food producers through to distribution and retail outlets. Specifically, the ISO 22000:2005 standard specifies a number of requirements for operating a food safety management system. It also integrates Good Practices (GMP and GHP) as prerequisites, but without expressing specific requirements in this regard, and incorporates the use of the Hazard Analysis Critical Control Point (HACCP) system to facilitate its implementation. This standard has been developed as an auditable standard. The ISO 22000 standard may be applied in its own right. Nevertheless, its format is aligned with ISO 9001:2000 (quality management) and ISO 14001:2004 (environmental management) to enhance compatibility and foster complementarities.

Other standards have been developed by groups of retailers, with the aim of providing a common reference for their suppliers. These standards can also be used by the manufacturing industry for its own suppliers. For example, the BRC standard-food has been developed in the United Kingdom as a “technical standard for companies supplying retailer-branded food products” by the British Retail Consortium. Additionally, the International Food Standard (IFS) originated in Germany at the initiative of the HDE (*Hauptverband des Deutschen Einzelhandels*) and is rapidly gaining international favour. In essence, these standards express requirements related to the effective and documented implementation of a management system. They require companies to demonstrate that appropriate HACCP systems have been developed and specify a number of detailed requirements related to the site and factory environment, products, processes and personnel. The requirements are expressed in the form of criteria that can be used for auditing, accreditation and rating of suppliers.

Quality management systems

Quality systems cover organizational structure, responsibilities, procedures, processes and the resources needed to implement comprehensive quality management. They apply to, and interact with, all phases of a product cycle. They are intended to cover all quality elements.

A quality system is designed to ensure that all factors affecting the quality of a product will be under control. Such control enables the reduction, elimination and, most importantly, prevention of quality deficiencies. It is intended to perform two basic functions, quality control and quality assurance. Quality control covers the operational techniques and activities that eliminate causes of unsatisfactory performance and also covers the monitoring of processes. Quality assurance provides internal and external confidence that a company or an operational process will fulfill the requirements for quality.

The ISO 9001:2008 standard specifies agreed requirements for quality management systems and serves as a basis for third party audit (EN 45012). This standard and the guidelines on its application to the food and drink industry (ISO 15161) provide organizations with a methodology to initiate, improve or maintain quality management systems.

Environmental management systems

Organizations may consider the ISO 14000 series of standards to develop, implement or enhance their environmental management system. The requirements of this series of standards can be aligned with the requirements for food safety and/or quality management systems.

Total Quality Management (TQM)

TQM represents the "cultural" approach of an organization. It is centered on quality and based on the participation of all members of the organization and the concept of continuous improvement. It aims at long-term success through customer satisfaction, benefits to the members of the organization and benefits to society in general.

A total systems approach to food production, which embraces quality, productivity, food safety and environmental aspects, is provided by a combination of HACCP, food safety management systems, quality management systems, environmental management systems, TQM and business excellence. Collectively, these tools provide a comprehensive, consistent and proactive approach to manage the main industrial risks encompassing food safety, quality, environment, occupational safety (risk of workplace injury) and security (risk of being subjected to criminal activities during production).

3. RISK ANALYSIS

Risk assessment is a scientifically based process consisting of the following steps: (i) hazard identification, (ii) hazard characterization, (iii) exposure assessment and (iv) risk characterization (Codex Alimentarius 2010). Risk assessment would usually follow a statement of purpose, or problem formulation. It is a scientific approach to estimating a risk and to understanding the factors that influence it.

Let us understand each step in detail,

Hazard identification is the identification of biological, chemical and physical agents capable of causing adverse health effects and which may be present in a particular food or group of foods. The key to hazard identification is the availability of public health data and a preliminary estimate of the sources, frequency and amount of the agent or agents under consideration.

Hazard characterization is the qualitative and/or quantitative evaluation of the nature of adverse health effects associated with biological, chemical and physical agents, which may be present in food. For biological agents, factors to be considered are the physiology, the pathogenicity and virulence of the microorganisms, the dynamics of infection and susceptibility of the host. When data are obtainable, a dose-response assessment need to be performed. A dose-response assessment determines the relationship between the magnitude of exposure (dose) to a biological, chemical or physical agent and the severity and/or frequency of adverse health effects (response).

Exposure assessment is the qualitative and/or quantitative evaluation of the likely intake of biological, chemical and physical agents via food, as well as exposure from other sources if relevant. Exposure assessment involves consideration of two important factors. The first is the frequency or likelihood of contamination of foods by the agent under consideration and its prevalence and concentration in those foods over time, up to the moment of consumption. The second is the pattern of consumption of the food in question (i.e., “dietary” information).

For example, the risk assessment of microbiological hazards in food is usually referred to as a Microbiological Risk Assessment (MRA). The methodology for conducting MRAs has made significant advances over a short time span. The Codex Alimentarius Commission has promoted the use of MRA and developed a framework, guidelines and principles for the same. In response, FAO and WHO played a leading role in the conduct of several risk assessments and developed methodological guidelines. Nationally, various countries have developed MRAs suited to various pathogens, products or processing systems.

Risk characterization is the qualitative and/or quantitative estimation including attendant uncertainties, probability of occurrence and severity of known or potential adverse health effects in a given population based on hazard identification, exposure assessment and hazard characterization. It provides an estimate, qualitative and/or quantitative, of the risk. The degree of confidence in the final estimation of risk depends on the variability, uncertainty and assumptions identified in the previous steps.

4. RISK MANAGEMENT

Risk management is the process, distinct from risk assessment, of assessing policy alternatives in consultation with all interested parties and, if needed, selecting and implementing appropriate prevention and control options, including regulatory measures. Risk management

combines scientific inputs (e.g., the results of risk assessment) and other relevant factors (e.g., economics, politics, social preferences, technical feasibility) to arrive at a decision regarding what to do about a particular risk, if anything. Risk management can be applied to biological, chemical and physical hazards in food capable of causing adverse health effects.

Microbiological Risk Management

Risk management of microbiological hazards in food is usually referred to as Microbiological Risk Management (MRM). MRM aims to ensure that the food available is safe and to improve the level of consumer protection. During the past ten years, FAO, WHO and the Codex Alimentarius have advocated the development of a generic MRM framework. The framework includes four basic steps: preliminary risk management activities including the development of a risk profile; identification and selection of MRM options; implementation of MRM options; and monitoring and review of MRM options. The MRM framework is a structured, systematic and on-going process that uses the results of MRA and other relevant evaluations to develop effective MRM options for implementation at appropriate steps along the food chain.

5. OTHER TOOLS

There are other tools of a more specialized nature which have application in areas of food safety management. These include in particular

- Other Safety and Quality assurance tools:
  - – Hazard Analysis and Operability Studies (HAZOP)
  - – Cause-and-effect diagram (fishbone or Ishikawa diagram)
  - – Event tree analysis
  - – Fault tree analysis
  - – Failure Mode and Effect Analysis (FMEA)
- Predictive microbiology tools:
  - – Predictive mathematical modelling (process modelling, microbial growth, death or survival, etc.), such as:
  - – The Pathogen Modelling Programme (http://ars.usda.gov), which is a tool for estimating the effects of multiple variables on the growth or survival of food borne pathogens
  - – The ComBase initiative, which includes a database on microbial response to food environments supplemented by a number of predictive models (http://www.combase.cc).
- Decision analysis tools:
  - – These include commercial computer software programmes aimed at performing risk analysis, Monte Carlo simulation, sensitivity analysis, creating decision trees and influence diagrams, fitting data to distributions and solving optimization problems.

In general the areas of concern to be addressed to achieve the food safety in a food industry is as follows

- Good personal hygiene.
- Employees wear clean clothes/aprons.
- Hair is restrained (e.g. hair net).
- Employees appear in good health. There should not be reports of illness.
- Employees wash their hands in between task/operations (e.g. taking out the trash) and when there is hand contact with hair, skin, and clothes.
- Employees wash their hands only in approved hand wash sinks.
- Hand contact with hair, skin, and clothes should be reduced.
- Employee personal items are stored away from retail food items.

Related to food source the following points need to checked

- Whether the food is purchased from the approved sources (e.g. not made at home).
- All prepackaged foods are properly labeled.
- Food is received at proper temperatures when delivered.
- Food appears in good condition, no signs of tampering.

Along with these, issues listed below related to cold holding and dry storage adds to the success of the food safety

- Cold food is held at 41°F or below (or 45°F as required).
- Food items stored inside the refrigeration unit are covered with approved material.
- Ready-to-eat items are stored above raw foods to prevent cross-contamination.
- There is adequate spacing to allow air flow.
- Food items are stored 6 inches off the floor on approved racks.
- Opened foods are stored in a closed and labeled food grade container.
- Food items, utensils, and equipments are stored in approved areas and protected from contamination.
- Chemical and non-food items are stored away from food items.

While preparing the food the following issues should be kept in mind

- Approved thawing methods are used in the food facility.
- Food preparation is performed diligently, so that food items are not in the temperature danger zone for more than 2 hours.
- Food thawing is performed in an approved sink.
- Thawed foods are not re-frozen.
- Food preparation is performed in an approved and clean area (e.g. no preparation in dining area).
- Produce is washed in an approved sink (e.g. not in mop sink).

- Food items are not left unattended for long periods of time.
- In order to prevent cross-contamination between ready-to-eat foods and raw food, proper preparation practices were observed.
- Utensils are used to handle food.

Even while cooking the following adds up to the food safety

Cooked food items must reach the following internal temperatures for at least 15 sec.

- Fruits and Vegetables are cooked to ≥135 °F.
- Raw shell eggs (for immediate service) are cooked to ≥145 °F.
- Fish is cooked to ≥145°F.
- Single pieces of meat (beef, veal, lamb, pork etc.,) are cooked to ≥145°F.
- Ground beef is cooked to ≥155 °F.
- Poultry is cooked to ≥165°F.
- Stuffed food and stuffing containing animal product are cooked to ≥165°F.

To achieve the mentioned temperatures a calibrated probe thermometer (±2°F) should be available for use in food preparation areas.

Even issued mentioned below will adds up to food safety

- Food is rapidly cooled from 135°F to 70°F within 2 hours and from 70°F to 41°F within 4hours.
- Food is rapidly cooled using an approved method
- Hot food is held at 135°F or above
- Previously cooked and cooled food is reheated rapidly to 165°F for at least 15 seconds prior to being served or placed in the hot holding equipment.
- Reheating of food items is performed within 2 hours.
- Appropriate equipment is being utilized to reheat food items (e.g. food not re-heated in the steam table).
- All food utensils are washed, rinsed, and sanitized after each use.
- Food contact surfaces and equipment are cleaned and sanitized once every 4 hours or as required.
- Approved sanitizer solution is available and maintained on site.
- 3-compartment sink set up is available and maintained when manually washing utensils.
- Sanitizer solution test kit is available.
- A sanitizer solution for storage of wiping rags is available in food preparation areas.
- Wiping rags are stored in a sanitizer solution in between uses.
- Sanitizer solution with rags is stored away from food to prevent contamination.
- Food preparation areas (e.g. kitchen) are maintained clean.

- Refrigeration units are clean and in good repair.
- Food equipment is clean and in good repair.
- Floors, walls, ceilings are clean and in good repair throughout the facility.
- Hand washing facilities are accessible and fully stocked with soap and paper towels.
- Hood/grease filters are clean, free of grease, and installed properly.
- Food contact equipment is smooth and easily cleanable (e.g. cutting boards).
- Restrooms are clean and in good repair.
- Plumbing fixtures are in good repair (e.g. not leaking or clogged).
- Light fixtures are in good repair and are shatterproof or fitted with light shields and end caps.
- Premises around the facility and trash area are clean and free of debris. Trash container lids are maintained closed.

The monthly self-audit food safety checklist involving all the issues mentioned above needs to be designed to monitor practices and procedures related to food handling, sanitation, and facility maintenance. The monthly self-audit food safety checklist will provide a valuable assessment of food facility's performance. This also will identify facility's strengths, weaknesses, and areas that need improvement.

Food inspection report related to cooling temperatures, holding temperatures, employee health, water/sanitation, food storage, utensil and equipment cleanliness and maintenance and facility maintenance will provide more insight into the success of the food safety.

Conclusion

The basis for the general hygienic requirements for any operation is Good Manufacturing Practice (GMP), including Good Hygienic Practice (GHP). The product- and process-specific requirements are established by applying the HACCP system. Other tools described encompass the use of a food safety management system based on recognized standards and use of a quality system as a means of effectively managing total product quality. It should be recognized that the control procedures established in an HACCP plan fit well into such management systems and can be readily incorporated. Total Quality Management (TQM) embraces quality, productivity, safety and environment. It can be thought of as a means of generating greater commitment from all members of an organization in order to achieve these aims, and will provide added confidence that products will conform to safety needs.