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# UNIT 1 INTRODUCTION TO FOOD SAFETY

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## Structure

- 1.0 Objectives
- 1.1 Introduction
- 1.2 Hazards to Safe Food
  - 1.2.1 Biological Hazard
  - 1.2.2 Chemical Hazard
  - 1.2.3 Physical Hazard
- 1.3 Contamination and Spoilage
- 1.4 What is Hygiene?
  - 1.4.1 The Food itself
  - 1.4.2 People – Safety of Food
  - 1.4.3 Facilities and Equipment
- 1.5 Sources of Contamination
  - 1.5.1 Primary Production
  - 1.5.2 Purchase
  - 1.5.3 Storage
  - 1.5.4 Production (Preparation and Packaging)
  - 1.5.5 Distribution and Delivery
  - 1.5.6 Service
- 1.6 Food Quality
- 1.7 The Food Safety Challenge
- 1.8 Protecting Food from Contamination
  - 1.8.1 Biological Food Safety Hazards
  - 1.8.2 Chemical Food Safety Hazards
  - 1.8.3 Physical Food Safety Hazards
- 1.9 Reduce the Effect of Contamination that does Occur
- 1.10 Role of Food Processing Industry / Sector
- 1.11 Let Us Sum Up
- 1.12 Key Words
- 1.13 Answers to Check Your Progress Exercise
- 1.14 Suggested Reading

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## 1.0 OBJECTIVES

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After studying this unit, we shall be able to:

- explain biological, chemical and physical hazards;
- know hazards to safe food;
- how to maintain hygiene; and
- understand how to protect food from contamination.

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## 1.1 INTRODUCTION

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Eating is fun and all of us enjoy doing so. It provides us nutrients necessary for our well being and conduct of our everyday activities. We eat our food both at home and also at places away from home. Today having meals away from home is a social activity that rivals with other activities like watching a movie or a cricket match. Eating helps us to meet our social as well as physical needs. We love to get together over food and friends meet for lunch, for cocktails after work, or go to a dinner after an evening movie. Similarly eating also takes care of business as meetings over food provide a suitable and conducive platform for discussions, negotiation and planning. As enjoyable as eating out is, it is also true that many of us simply have to eat out away from home at some time or the rather, like men and women at work, passengers travelling, guests in a hotel, patients in a hospital, students at school and colleges. This is not to forget the food that we carry home from the market, supermarkets, restaurants/hotels, or simply as packaged food products, and ready to eat foods.

All of us rightfully expect that the food we eat is tasty, of good appearance, safe and suitable for consumption. We all know that some of us sometimes fall sick from what we eat. It doesn't happen too often, and when it does we may not get very sick or else be sick for a long time. Moreover, in many cases we are inclined to shrug off the sickness with the thought that we ate too much. "It was probably something I ate", "It was just a touch of flu" are the very common expressions we use that mask the problem of a food borne illness. Most of us do not readily identify the source of the ailment / sickness and are understandably more concerned about obtaining relief. On getting sick we go to different doctors and hospitals, or else may even do nothing about it. However, the end result more often than not is that we are reluctant to eat that food again from the place where we had last consumed. The reason for this is simply that eating unsafe food is not what we expect. However, there are increasing signs that the public is becoming more aware of the connection between food and illness. Media coverage, newspaper and TV reporting's contributing towards this awareness.

A food borne illness is a disease that is carried or transmitted to us by food. Any kind of food can be a vehicle for the food borne illness. Some of the foods responsible for the foodborne illness are poisonous by nature, for example certain types of mushrooms or fish. However, it is mostly the high protein foods we eat regularly like meat and dairy products that are responsible for most food borne illnesses. These foods are receptive hosts to certain forms of bacteria and other disease agents, and the problem is further made worse by poor storage, preparation, handling and service. And not to forget all the illnesses that are related to drinking water, and food contaminated by water.

Food borne illnesses can occur anywhere, through errors/carelessness in purchasing, receiving, storage, preparing/cooking, packaging, storage of cooked products and service.

Every food producer needs to be aware of the fact that they are selling a food product which is a biological material and is, therefore, susceptible to degradation and/or spoilage. We consume these food products for nourishment and pleasure. The human system has a marvelous defense system, but when a hazardous material is ingested, the chances for food related problems are greatly enhanced.

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## 1.2 HAZARDS TO SAFE FOOD

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The Codex Alimentarius Food Hygiene Committee defined a food hazard as: “A biological, chemical or physical agent in, or condition of, food with the potential to cause an adverse health effect”.

It is generally recognized that food safety hazards are of three types. These are biological, chemical and physical in nature.

### 1.2.1 Biological Hazard

Biological Hazard are micro-organisms and their toxic metabolites which can cause illness when transmitted to humans through food. A great variety of micro-organisms are found in nature. Some can grow on food causing spoilage, others constitute a hazard to man through illness caused either by;

**Food Infections:** Caused by ingestion of sufficient number of micro-organisms of public health significance to cause an illness. Salmonellosis and listeriosis are results of invasions by microorganisms.

**Food Intoxication:** Caused by ingestion of a preformed bacterial toxin. Staphylococcal poisoning and botulism are intoxications.

In most cases micro-organisms use our food supply as a source for their own nutrients for their own growth. By increasing in number, utilizing nutrients, producing enzymatic changes and contributing off flavours by means of breakdown of a product or syntheses of new compounds they spoil or food. It is only when the micro-organisms involved are pathogenic, their association with our food supply becomes critical and assumes importance with respect to food safety. Many of our food support the growth of pathogenic micro-organisms or at least serve as vectors for them. Micro-organisms that can constitute food safety hazards include bacteria, yeast and moulds, viruses and parasites.

Microbiological hazards are of great significance to food safety, because despite technological capabilities the number of cases of food borne illness from micro-organisms of public health significance is staggering. Though many cases may not be reported in our country, like in very many other countries, developed, developing and under developed, the actual cases are much higher. A few examples of micro-organisms of great concern to food safety are: *Clostridium botulinum*, *Salmonella* sp., *Staphylococcus aureus*, *Clostridium perfringens*, *Listeria monocytogenes*, Enterovirulent, *Escherichia coli*, *Shigella* etc.

As society becomes more complex, so too it seems do the hazards to which we are exposed.

Other biological hazards include parasites such as *Trichinella* and *Anisakis*, found in pork products and marine and freshwater fish, respectively. Parasites in the flesh of animals can be transmitted to the consumer if the food has not been properly cooked. Seafood and pork producers should be aware of parasitic concerns and assess these hazards when developing their food safety management system.

### 1.2.2 Chemical Hazard

Chemical hazard is any chemical introduced into the food system, which may cause illness or injury to the individual using the product. Toxic chemicals such as residues of

pesticides, cleaning agents can also find their way into the food and make us fall sick. Chemical hazards also include foods that are in themselves poisonous to humans, such as certain forms of fish and mushrooms. A few examples of chemical hazards are:

- Agricultural Chemicals – These are used to enhance the livestock production, and include Insecticides, Fungicides and Fertilizers in crop production, and pesticides, antibiotics and growth hormones in livestock production. These allow farmers to produce crops more efficiently.
- However there is another class of chemical hazards that enters the food chain at the primary production step on account of pollution. These include toxic metals such as mercury lead, arsenic and cadmium discharged into the sea by industry progressively accumulates in marine life along the food chain.
- Processing Plant / Facility Chemicals – These include the likes of cleansers and sanitizers, oils and lubricants, used by food processing industry for purposes of operations and sanitation of the facility and the equipment. Inappropriate design of manufacturing equipment and selection of chemicals used for operating machines and their maintenance increases the risk of contamination of the food. Chemical residues left on vessels and food contact surfaces due to improper cleaning operations contaminate the food products.
- Naturally occurring toxicants – Some foods contain naturally occurring toxins. The most extreme example is the potentially fatal tetrodotoxin found in puffer fish. The puffer fish is a prized delicacy in Japan served only in licenced restaurants employing highly trained staff to remove the toxin containing organs from the fish. However, it is still not well established whether the fish itself is poisonous or is it the bacteria present in the fish that produces the toxin. Nonetheless it is related to a naturally occurring toxin. Other examples of naturally occurring toxins are mycotoxin - aflatoxins in grains and processed foods, presence of histamine in spoiled fish, ciguatera in fin fish and saxitoxin in shellfish causing paralytic shellfish poisoning.
- Food chemicals – Food additives such as smoke, alcohol, vinegar, oil and spices have been used for thousands of years to preserve food, enhance flavor and improve maintain food consistency. However, changes in the distribution of food and the increase in processed food products, has seen an increase in the use of food additives. It is estimated that more than 2500 different chemicals are currently being used after having undergone extensive toxicological screening. Today food chemicals are being used in actual food processing for imparting flavours, protecting and preserving the food from microbiological deterioration, to impart a functional characteristic, as a processing aid, or even for improving appearance. At established levels, these materials are not toxic or dangerous. But lack of proper controls can result in violation of prescribed levels and may result in illness for consumers.. Consequently adverse health effects such as hypersensitivity to certain substances have been reported. Children tend to be affected more than adults and in most cases the effects reported are of concern but not life threatening. There is, however, a worrying increase in the number of children who develop allergies to naturally occurring products such as peanuts.
- One class of chemicals hazards which is an area of concern is that of allergens. Under FALCPA, The Food Allergen labelling and Consumer Protection Act of 2004 ( FALCPA) (Public Law 108-282) , a “major food allergen” is an ingredient

that is one of the following five foods or from one of the following three food groups or is an ingredient that contains protein derived from one of the following - milk, egg, fish, crustacean shellfish, tree nuts, wheat, peanuts and soybeans

Today, we also have hazards associated with packaging materials, with chemicals, lacquers and polymers migrating from the packaging material into the food product it is holding.

### 1.2.3 Physical Hazard

Physical hazard is defined as any physical materials not normally found in a food, which may cause illness or injury to the individuals using the food product. Physical contaminants like pebbles, chips of glass, piece metal wire, or for that matter a fragment of fish bone all have the potential to injure us when consumed along with food.

Physical hazards include a variety of materials often referred to as extraneous materials or foreign objects emanating from various sources and having a potential to inflict injuries. Some examples are listed below;

Material	Source	Injury Potential
Glass	Bottles, jars, light fixtures, glassware, gauge covers etc.	Cuts, bleeding, may require surgery for removal.
Wood	Fields, pallets, boxes, buildings.	Cuts, infection, choking, may require surgery for removal.
Stones	Fields, buildings.	Choking, broken teeth.
Metal	Machinery, fields, wire, employees.	Cuts, infection, may require surgery for removal.
Insects	Fields, plant, post process entry.	Illness, trauma, choking.
Bone	Fields, Improper processing.	Choking, trauma.

Unlike micro-organisms, whose presence may or may not constitute a problem depending upon the process the food has undergone i.e how it is handled, or how it is prepared, materials which constitute physical concerns may not be able to be removed, inhibited or detected in process. Health and safety problems from these sources commonly occur and can be dangerous to our health and safety. There are five general sources from where physical hazards gain access to our foods;

- Inadvertent materials from the field like stones, metals, insects, thorns, wood, insects.
- Inadvertent materials resulting from processing and handling like bone, glass, metal, wood, nuts, bolts, wire, cloth, rust.
- Material entering the food during distribution like metal, insects, dirt, stones, and other miscellaneous physical objects,
- Materials intentionally placed in food in case of sabotage or tampering by the employees.
- Miscellaneous like struvite and other such materials in this class. Struvite is a hard crystalline material which may be formed in canned proteinaceous seafood. The material resembles glass in appearance to us as a consumer and on ingestion may break teeth and is thus a food safety hazard.

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## 1.3 CONTAMINATION AND SPOILAGE

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Contamination is the presence of harmful substances in food. If a food contains any substance that can cause injury or disease to a person who eats or tastes it, the food is contaminated. The contaminants may be biological, chemical or physical, and may even be tasteless and odorless. However, since contamination may not always result in a food safety issue on account of presence in smaller quantities or size, we are focusing on contaminants that pose a threat to food safety and thus are being identified as food safety hazards.

Spoilage is damage to the edible quality and suitability of food. Food that acquired an unacceptable taste, appearance or aroma can be said to be spoiled. Spoiled food may also be contaminated with food safety hazards, but this is not necessarily the case. Sour milk, for example, is spoiled for such uses as drinking, but it may still be perfectly wholesome and suited for the making of cheese/paneer.

In many cases, however, the micro-organisms that cause diseases will also spoil food. The conditions that lead to spoilage of food are frequently the same that allow pathogenic micro-organisms to flourish. So the presence of spoilage is a strong indication that food has become unsafe to eat. It must always be remembered that food can be contaminated with dangerous micro-organisms or toxins without betraying this condition in its outward appearance at all. Some contaminants cannot be detected by smell or even taste. So do not assume that every food that looks unspoiled is actually safe. In our analysis of the problem of safe food it is clear that the condition of the food itself has to be brought into central focus.

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## 1.4 WHAT IS HYGIENE?

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Contamination of food is preventable, if proper precautions are taken to keep the disease causing agents away from food in the first place or to keep these agents from growing if they do get into food. The existence of a case of a food borne illness usually means that some unhygienic conditions exists that must be identified and eliminated. The most powerful tool for protecting people against illness from food contamination is hygiene.

In the food sector situation, hygiene means wholesome food, handled in a hygienic environment by healthy food handlers in a way that the food is not contaminated with illness causing, harmful agents. In other words, hygiene is what keeps safe food stay safe. There is a direct relationship between hygiene and safe food. Conversely there is a direct relationship between a lack of hygiene and illness caused by food.

But does hygiene simply mean clean? Not necessarily. That which appears clean may not be hygienic.

Clean means free from visible soil. Hygiene means free from disease causing organisms and other hazards/harmful contaminants. Clean refers to aesthetics and relates to outward appearance – a shelf wiped clean of dust or a sparkling glass. However these object, though clean on surface may infact be harbouring disease causing micro-organisms or harmful chemical hazards? On the other hand, baby bottles boiled in water for over ten minutes may be splotched and have water marks. They may not appear to be clean when visually examined, but they would be free from disease causing micro-organisms and can actually be called as hygienic.

In understanding food safety it is useful not only to understand the food safety hazards and the point of entry into the food chain, but also to look at the factors involved in keeping food safe, as well as the inherent risks. They generally fall into 3 categories:

- Food – It's safe condition initially and subsequent protection in preparation and service.
- People – Those involved in handling food both as employees and as customers
- Facilities – The hygienic conditions of the plant facility and the equipment used in food service operation.

### 1.4.1 The Food itself

Not all food is safe when it is under primary production. Agricultural products and animals have a wide range of microbes on them or in them at the time of harvest/slaughter. Soil and seed treatment with chemicals, spraying of pesticides for plant protection, use of veterinary drugs for treatment of diseased animals, fishing from contaminated waters, use of growth promoters in plant and animal kingdom, diseased plants products and diseased animals – in all cases the food emanating from primary production is exposed to the risk of contamination with food safety hazards. Plants become contaminated with pesticide and herbicide sprays and can accumulate toxic materials from contaminated soil. Animals can also build up levels of toxic substances. Substances such as antibiotics and hormones administered to animals to aid growth or prevent diseases are also suspected of having a potential adverse effect on us.

Likewise not all food is safe when it arrives in food processing operations. Food products such as fresh poultry and frozen fish may already be contaminated by the time they are received. We must thus ensure that we source them from reputable suppliers and implement tight receiving procedures to help ensure safe food. Once the food arrives it must be stored, prepared and served using methods that maintain its safety. This is the everyday challenge to the food sector/industry.

### 1.4.2 People – Safety of Food

People – Safety of food depends to a great extent on the people – those who produce and process it, those who transport and deliver it, and finally the food handlers who prepare it for the ultimate consumer. In a most fundamental way the success of a food service in dealing with the food borne illness problems depends on how the human factor is handled, how workers are trained and how managers follow up and reinforce that training. Very often it is observed that food sector concentrate on elementary hygiene and basic rules of personal hygiene. They are fighting plain ignorance on issues of hygiene and food safety with their employees, as with a cook who just refuses to understand the danger in using the hand that has minor but infected cut or burn, or in using a knife without washing for cutting salads, when the knife had previously been used for cutting raw chicken, or a person serving food handles money, clears away soiled tableware, makes a new set up, catches a cigarette, and serves more food, all without once washing hands.

People pose the number one risk to safe food. Employees and customers both pose the biggest threat to food safety. Hiring healthy workers, training them in procedures on hygiene, and supervising and monitoring them on the job, all help prevent safe food from becoming contaminated with food safety hazards.

Well customers pose an equally big problem. The people who hate to see food wasted and put their handled but uneaten slice of bread or Roti, samosa, salad, or a kabab which looked a shade small for that matter back into the serving dish, while another one of our customers is engaged in uncontrolled and unshielded coughing.

### 1.4.3 Facilities and Equipment

Investigations of food borne illnesses often reveal refrigerators with temperatures varying from 11 to 15 °C show presence of pathogenic micro-organisms during laboratory analysis in large numbers in the food product. Breakdown of other hygienic practices aspects are also detected.

Faulty or inadequate equipment is one major threat to safe food. Food should never be allowed to stay in the temperature danger zone for any length of time. The temperature danger zone includes those temperatures in the range where bacterial contaminants multiply most rapidly.

Difficult to clean work areas, faulty or overloaded refrigerators or other equipment, dirty surroundings and conditions attractive to pest infestation add to woes of food safety. Sometimes, the equipment is improperly used - putting the auto flow diversion valve on the pasteurizer in the manual mode, or overloading of a refrigerator or a cold room are few examples. Hygiene thus must be the first concern when choosing equipment. Ease of cleaning, maintenance and regular cleaning of equipment can eliminate the source of food contamination. All features of a plant's should be constructed with clean ability in mind, thus setting the stage for safe operations. Material of construction, design, construction and installation of equipment and layout of equipment – all with a view to facilitating clean ability and maintenance and eliminating entry points and breeding places for pests and insects and rodents need as much attention for creation of hygienic conditions for ensuring food safety.

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## 1.5 SOURCES OF CONTAMINATION

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Complex and multiple operations in a food system increase the chances of contamination. By the time the food reaches us, it has several opportunities to become contaminated. Multiple foods handling from food grower to processor to supplier to finally us multiplies the chances of food contamination.

- a) Firstly, the food could have been contaminated at the source - food grower, food processor, food packaging – through poor control methods or mishandling.
- b) Most if not all food products go through additional steps of warehousing and storage, distribution and retail thus adding to another ladder for food to become contaminated.
- c) Finally, the food reaches the final food processing facility or our homes, and it is here that we need to protect it from the point of receiving, through storage to its preparation for its intended use and upto consumption by us.

The few steps that the food travels before it reaches us are primary production, purchase, storage, production (preparation and packaging), distribution and delivery and service. Each of these steps offers opportunities for contamination if they are performed improperly. Controls at each of these steps need to be built into ensure that the food is safe right upto the time it is consumed by us.

### 1.5.1 Primary Production

Agricultural products and animals have a wide range of microbes on them or in them at the time of harvest or slaughter. The number and types of microbes that comprise the primary contamination of the food varies from one commodity to another, with geographic regions and with the methods employed for harvesting/slaughtering. Care with procedures may limit and reduce the contamination with food safety hazards, this contamination, a point is reached where the cost of such procedure outweighs the benefits. Thus the focus here is to reduce the likelihood of introducing a food safety hazard which may adversely affect the safety of food, or its suitability for consumption, at later stages of the food chain. Mechanization and increased scope of operations would improve the microbiological condition of the food at harvest or slaughter.

### 1.5.2 Purchase

Purchasing safe food is an important step in keeping it safe. Purchase from reputable approved suppliers, proper checking during receiving and accepting only those ingredients that the organisation has the potential to process and handle with respect to food quality and safety are important requirements for purchase and receiving, which gives an assurance that what is received is what had been ordered. Receiving inspection should include inspecting the product for its packaging, if any, appearance of the product – should be characteristic of the product, not rotten, spoilt or damaged, physical and chemical properties for quality and safety, and receiving temperature in case of perishable and frozen supplies.

### 1.5.3 Storage

Until the food is not going to be processed it must be handled and stored safely. Storage is where many breakdowns in hygienic conditions occur. Storage of freshly harvested paddy provides conducive conditions for proliferation of micro-organisms some of which may be pathogenic or toxin producing, storage of raw products above processed food products specially those requiring no further processing within the same storage facility, overcrowding deep freezer with various raw meats increases the risk of cross-contamination and multiplication of disease causing micro-organisms already present in the meat, are examples of faulty storage. Planning ahead for storage space and usage help protect foods.

### 1.5.4 Production (Preparation and Packaging)

Food safety hazards in food are normally controlled by exclusion or removal, inhibition of growth or by destruction. The process to be employed depends on the sensitivity and the type of the hazards to be controlled and the food itself. Microbes in particular need water, nutrients and appropriate conditions of temperature and pH in order to multiply. The inherent properties of the food being processed with respect to its pH, water activity and temperatures largely determine which microbes among those initially present in food can multiply and constitute the spoilage flora and a food safety threat. Microbial Food safety hazards during processing are largely controlled through these factors. It is these characteristics that provide the platform for food safety during chilling, freezing, pasteurizing, canning, drying, salting / brining sugaring, fermenting, using preservatives and radiation.

The possibilities of contamination and introduction of food safety hazards multiplies at this step. Production/processing under unhygienic conditions may lead to not only

contamination of the food, while processing failures lead to survival of such microbes, their toxins and coupled with time and temperature abuse pathogenic bacteria and moulds are allowed to multiply and proliferate. For example, the food handler has a sore throat and a slight cough. He clears his throat and is careful to cover his mouth with his hands, but unfortunately he forgets to wash his hands as he gets prepared to handle the food product again, results in contamination of food. To compound the problem further, the food handler also has other jobs in hand to attend to in the process of production/preparation, and as a result after processing one product he puts it aside as it can wait, but in case he has a chance to further work on it, he leaves it on the processing counter – well may be for a few hours till he gets back to further process it. With the food being in the temperature danger zone, the micro-organism present in the food begins to multiply. Now as this product undergoes further processing, which may be heat processing, the toxins produced may not be destroyed. This food may require further handling like cutting of a roast chicken and the food handler/cook cuts it using a knife previously used for cutting raw chicken and that too on a chopping board scored with old knife cuts.

This may sound like an extreme case, but bear in mind that such breakdowns do occur not only in food processing units but also in our homes in our very own kitchens, the same chopping board and knife being used for cutting salads and boiled eggs while fixing an early morning sandwich in a hurry. Sounds true, doesn't it?

Processing and preparation procedures must be controlled to ensure that:

- a) Food is not held in the temperature danger zone longer than is necessary, during and even after preparation;
- b) Food handlers do not harbor diseases or expose food to contamination through careless and negligent personal habits; and
- c) Food is not contaminated by unclean utensils or equipment or by contact with raw food.

### **1.5.5 Distribution and Delivery**

Food may become contaminated, or may not reach its destination in a suitable condition for consumption, on account of inadvertent variations in conditions of temperature, moisture content (water activity) and integrity of the packaged product due to inappropriate handling, damaging and resulting ingress of moisture and temperatures for storage and transportation. Frozen products like ice creams and frozen peas undergoing a break in the cold chain are bound to deteriorate and pose potential food safety threat. Cold chains should be maintained effectively. Food products need to be protected from contamination and damage during storage, transportation and delivery. Damaged packets of milk powder and biscuits when picked from the shelves of a market store may have imbibed moisture and supported the growth of microbes, or may be even infested with insects. Effective control measures as appropriate to the food being transported are required to be taken during transport and delivery, even where adequate hygiene control measures have been taken earlier in the food chain.

### **1.5.6 Service**

Let's say the food has been processed through all the above stages without being contaminated thus rendering it safe for consumption. However, there is still another step of service in case of a restaurant / hotel / hostel / hospital / in flight etc. which provides one more opportunity for safe food to become unsafe at the very final step of

consumption. The opportunities at this stage may not be as great as the earlier ones, but they exist nonetheless. Unhygienic practices like picking the spoons and knives the wrong way or may be still worse carrying spoons in the front pocket of the apron the persons is wearing. To add to your problems the food server wipes the spoons with the same apron. Other examples include handling the clean spoons and plates after having wiped a dirty table or counter top, wiping hands with the aprons prior to serving of food, or even permitting un-well operators to handle and serve food. Another common instance of unhygienic practice at this point is the absence of sneeze guards in food service areas or buffets. We need to have hygienic procedures while serving of food, because else it is meaningless to implement hygienic procedures in all the preceding steps only to expose them to food safety hazards during food service.

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## 1.6 FOOD QUALITY

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Food safety and food quality are critical to the bottom line. Food that is dry, or appears stale and not pleasant, having off odours does not impress customers. We may even mistake them to be unsafe and not accept any for consumption. Preservation of food quality is another objective of food hygiene. May be it would be an oversimplified statement if we say that hygiene procedures may also address food quality issues to a large extent. Food that is prepared and served properly is more likely to retain its quality. The standards for quality of food include its safety, appearance, texture, chemical properties, consistency, taste and above all its nutritional value. And any of these can be destroyed by unhygienic practices from primary production through processing and upto consumption by the customer.

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## 1.7 THE FOOD SAFETY CHALLENGE

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Providing safe food is a necessary challenge before every food industry, but not an impossible task or barrier. Recognizing the importance of hygiene and its relevance to food safety is the primary task in establishing food safety. Developing procedures and systems to keep the food facility / plant hygienic and protecting its people from disease and illness is the second step. Thus we need to develop a system for food safety revolving around the specific food facility engaged with specific products. However, the two pronged strategy that we need to apply is:

- a) protect food from contamination; and
- b) reduce the effect of contamination that does occur.

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## 1.8 PROTECTING FOOD FROM CONTAMINATION

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### 1.8.1 Biological Food Safety Hazards

We must recognize that pathogenic micro-organisms capable of contaminating a food are present practically everywhere – in soil, air and dust, on insects and rodents, on unclean vessels and utensils, and above all on food handlers themselves. We as human beings and thus as food handlers harbor micro-organisms on our skin and hands as well in their noses, throats, mouth and intestinal tracts.

Besides most raw foods no matter how reliable the supplier or the source, are contaminated to some extent before they arrive at the food processing facility whether that's is a factory, a hotel our kitchen at home. Proper cleaning and processing, cooking helps reduce the disease causing organisms. The food industry has thus to prevent raw foods from contaminating the cooked foods, to reduce the opportunities for further

contamination of food from unhygienic workers / food handlers and facilities. This implies that they need to control the environment in a manner that reduces the likelihood of introduction of food safety hazards in food stuffs.

### **1.8.2 Chemical Food Safety Hazards**

The use of pesticides is generally strictly regulated by the government. For each chemical, usage levels, time and frequency of usage, handling procedures are all well defined. Finally, for most commonly used agricultural chemicals, the regulatory authorities have established and defined maximum allowable limits in the foods. Since a large part of the chemical hazards enter the food chain at the stage of primary production itself, and their elimination during subsequent processing may not be entirely practical or feasible, reliance on Good Agricultural Practices would assist in minimizing the chemical hazards in food. Procurement procedures should be such that emphasis is placed on the purchase of known sources and supplier approvals based on their previous record in supplying the appropriate type of material. Within the processing facilities, the equipments should be so designed that neither the materials of construction nor the lubricants, oils and grease used for facilitating their operations are toxic, reactive and has the potential of gaining entry into the food. Plant chemicals like detergents and sanitizers should be stored in such a way as to prevent the finished products from being contaminated or affected. Hazards resulting consequent to employee sabotage should be controlled through good management and employee education.

### **1.8.3 Physical Food Safety Hazards**

Having understood where the physical food safety hazards come from, manufacturing facilities and food processing operations should be designed to remove or eliminate the inadvertent materials from the field like stones, metals, insects, thorns, wood, insects and those resulting from processing and handling like bone, glass, metal, wood, nuts, bolts, wire, cloth, rust above. While distribution and storage practices along with in store handling practices should control and or be designed to prevent the finished products from being contaminated or affected. Hazards resulting consequent to employee sabotage should be controlled through good management and employee education. The chances of physical contamination are greatly reduced once the containers particularly made of metal, glass or thermoplastics are sealed. Tampering can be controlled by having packages that are designed to prevent tampering or are tamper evident – thus we often read “Do not use if seal is broken / damaged”.

Once again let’s find out how food becomes contaminated with food safety hazards, and the main offenders are:

- a) Improper agricultural and animal husbandry practices;
- b) Infected food handlers;
- c) Contaminated food supplies;
- d) Unhygienic food handlers;
- e) Unhygienic equipment and facility;
- f) Inadequate processing for preservation for minimizing risk from food safety hazards; and
- g) Hazardous chemicals.

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## 1.9 REDUCE THE EFFECT OF CONTAMINATION THAT DOES OCCUR

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As mentioned previously, some foods are contaminated with food safety hazards and other contaminants well before they enter the facility and others will get exposed to harmful micro-organisms during preparation and production. Fortunately, the food industry has several very effective ways of counter acting this contamination.

From ancient times, mankind has apparently had a fairly good idea about how to protect themselves from food safety hazards. They killed animals and sun dried, smoked, salted or even chilled them for preservation and food safety. Even the primitive man knew that purifying by fire improves the taste and texture of meat and probably also rendered it safe. However, we understand the same scientifically. We now know that purification by fire has to do with the value of temperature control, salting and sun drying is to do with reduction in water activity, in keeping the food safe. Even today we sort our rice and pulses before cooking for removal of foreign particles, chop of the green potato while cutting potatoes, thus minimizing the threat from physical and chemical hazards respectively. Very often we resort to washing and peeling of vegetables and fruits for minimizing physical hazards like insects, soil and dirt, hoping that residues of chemical hazards would also be minimized to certain levels.

Micro-organisms require a moist, warm, nutritious environment to prosper and multiply. Their growth can be slowed or stopped by refrigeration and can be destroyed by heating, but at temperatures between 7.2° and 60°C micro-organisms multiply to large numbers at a very hectic pace and may also produce toxins . Food thus needs to be kept out of this temperature zone whenever possible.

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## 1.10 ROLE OF FOOD PROCESSING INDUSTRY/ SECTOR

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Typical food industry personnel may take their activities as activities in any other normal business, that of marketing, procuring, processing, storage and providing food to customers and service to business management. It is quite unlikely that they see their role or identify themselves in the role of a hygiene practioner who is responsible for providing safe food. A knowledge and understanding of good hygienic practices and good management practices coupled with an appreciation of their importance can transform the hygiene aspect and make food safety manageable and achievable. The stumbling block is the awakening people to the existence of the food safety problem and getting them around doing something about it.

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### Check Your Progress Exercise 1



**Note:** a) Use the space below for your answer.

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

1) What is food safety?

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2) Difference between clean and hygienic?

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3) What is a food safety hazard?

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4) List the types of food safety hazards along with five examples of each?

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5) How do these hazards gain entry into the food?

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6) Identify the various steps in the food chain where food may get contaminated with food safety hazards?

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7) What is a food borne illness?

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8) What is the difference between a food infection and a food intoxication?

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- 9) Describe how people, food, equipment and facilities, can contribute to food safety hazards at all steps of the food chain?

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## 1.11 LET US SUM UP

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Eating is a necessity for staying alive and when we eat food we logically expect it to be safe, good and a pleasant experience. A food borne illness is a disease or an injury caused by ingestion of food contaminated with food safety hazards that gain access to the food at any point in the food chain, from primary production, through processing, storage, distribution and upto the point of consumption. Hygiene is the creation and maintenance of healthful conditions to prevent food contamination and meeting customers requirements. Hygiene is directed towards elimination of food borne illness through the reduction of opportunities for food contamination and correction of contamination that does occur. This task gets complicated because pathogenic bacteria are present virtually everywhere. The three hazards to food safety are biological, chemical and physical. Though all are important, but of these biological food safety hazards are of major concern to the food sector, probably because of their presence virtually everywhere and their capability to survive and multiply under various conditions. Three points that merit attention are the food itself as a source of food safety hazards, and these are:

- a) Systems for obtaining safe food, how to keep it safe through receiving inspection and control of temperatures and other measures;
- b) How to train and motivate food handlers and other employees in a food organisation, to learn and apply food hygienic practices; and how to build hygiene in the facility itself; and
- c) Management of operations in a systematic manner.

It is our effort to keep food safe from contamination and food safety hazards, and to reduce their adverse health effects.

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## 1.12 KEY WORDS

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<b>Cleaning</b>	: The removal of soil, food residue, dirt, grease or other objectionable matter.
<b>Contaminant</b>	: Any biological or chemical agent, foreign matter, or other substances not intentionally added to food which may compromise food safety or suitability.
<b>Contamination</b>	: The introduction or occurrence of a contaminant in food or food environment.
<b>Disinfection</b>	: The reduction, by means of chemical agents and/or physical methods, of the number of micro-organisms in the environment, to a level that does not compromise food safety or suitability.

<b>Establishment</b>	: Any building or area in which food is handled and the surroundings under the control of the same management.
<b>Food Hygiene</b>	: All conditions and measures necessary to ensure the safety and suitability of food at all stages of the food chain.
<b>Hazard</b>	: A biological, chemical or physical agent in, or condition of, food with the potential to cause an adverse health effect.
<b>Food Handler</b>	: Any person who directly handles packaged or unpackaged food, food equipment and utensils, or food contact surfaces and is therefore expected to comply with food hygiene requirements.
<b>Food Safety</b>	: Assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use.
<b>Food Suitability</b>	: Assurance that food is acceptable for human consumption according to its intended use.
<b>Primary Production</b>	: Those steps in the food chain up to and including, for example, harvesting, slaughter, milking, fishing.



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## 1.13 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

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Your answer should include the following points:

### Check Your Progress Exercise 1

- 1) Assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use.
- 2) Clean refers to aesthetics and relates to outward appearance, any discharge indicative of free from visible soil. Hygiene means free from disease causing organisms and other hazards / harmful contaminants.
- 3) Physical, Chemical and Biological hazard.
- 4) Physical – stones, wires, wood, glass, insects,  
Chemical – residues of pesticides, veterinary drugs, hormones, heavy metals, aflatoxins, food colours, food additives, and  
Biological – Any five pathogens should include parasites as well.
- 5) Through food itself, people, equipment and facilities, and food production process.
- 6) Primary production, procurement, production, packaging, storage, transportation, and at home / point of consumption.
- 7) i) Food Borne illness: Disease transmitted to humans by eating contaminated food.

- ii) Disease caused by ingestion of sufficient number of micro-organisms of public health significance to cause an illness. Salmonellosis and listeriosis are results of invasions by micro-organisms.
  - iii) Disease caused by ingestion of a preformed bacterial toxin. Staphylococcal poisoning and botulism are intoxications.
- 8) Food Infections: Caused by ingestion of sufficient number of micro-organisms of public health significance to cause an illness. Salmonellosis and listeriosis are results of invasions by micro-organisms.
- Food Intoxication: Caused by ingestion of a preformed bacterial toxin. Staphylococcal poisoning and botulism are intoxications.
- 9) 1.4.1 The food itself
  - 1.4.2 People – safety of food
  - 1.4.3 Facilities and equipment

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## 1.14 SUGGESTED READING

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Codex Alimentarius Commission - Recommended International Code of Practice, General Principles of Food Hygiene, CAC/RCP 1-1969, Rev. 4-20031.