

UNIT 1: INTRODUCTION TO FOOD SAFETY

Food is comprised of an array of chemicals, which are a pure source of nutrients including water, carbohydrates, proteins, fats, vitamins, minerals and roughage, required to sustain life. Some of the foods are consumed as such while others subjected to some processing including cooking and storage before they are eaten. Some of the constituents of foods enhance nutritive value while others, created during processing or added intentionally, decrease the nutritional value or are toxic. The safety of the foods is of utmost significance and has gained a worldwide attention. In western industrialized countries, concerns about safe food have replaced those about adequate food. Many feel that such concerns are a product of our scientific awareness, and corruption in society. The concerns about safe food are definitely not new, but the food safety crisis still exists in several parts of the world including India.

Our food is devitalized, coloured, filled with chemicals, drugs and synthetic ingredients, polluted by agricultural and environmental chemicals and grown on impoverished land puffed up by the use of chemical fertilizers and other aids. Moreover, the chemicals used in the growing or processing of food are frequently alleged to cause adverse effects in humans or animals.

1.1 DEFINITION

In any discussion on food safety, some agreed-upon definitions of safety, hazard and toxicity are crucial, since these are basic concepts. Absolute safety is the assurance that damage or injury from use of a substance is impossible. Foods safe under normal conditions will never qualify for a seal of approval if they are 'consumed in' excessive quantities or used in an unusual manner. Relative-food safety can be defined as the practical certainty that injury or

damage will not result from a food or ingredients used in a reasonable and customary manner and quantity.

An understanding of food safety is improved by defining two other basic concepts, toxicity and hazard. Toxicity is the capacity of a substance to produce harm or injury of any kind under any conditions. Hazard is the relative probability that harm or injury will result when the substance is used in a proposed manner and quantity. Assessments of whether a food-or ingredient is safe should not be based on its inherent toxicity but on whether or not a hazard is created.

1.2 FOOD SAFETY ISSUES

Specific food safety concerns differ markedly and include:

- Additives, colours and flavors
- Drug residues
- Fertilizers and other growing aids
- Irradiation
- Microbiological contamination
- Naturally occurring food toxicants
- Pesticides
- Pollutants
- Processing packaging and labeling
- Adulteration and Misbranding

Consumers are most concerned about pesticides and additives as both are linked in the consumer's mind to cancer. It is also interesting, perhaps even alarming, that most consumers are not concerned about microbiological contamination, despite solid evidence that, of all the hazards, it is the one most likely to occur. Many homes have unsafe food storage and preparation practices. Consumers rarely consider their own food practices a hazard. Food

industry, however, is most concerned about the microbiological safety of its products. In addition, many quality control checks are made to ensure that foods are free of extraneous matter such as glass, machine fillings and insect parts. Large food companies in many parts of the world adhere to a code of manufacturing practice known as 'Good Manufacturing Practice (GMP)'. This code helps to assure that products are manufactured under conditions of proper storage and sanitation. Many also employ an elaborate system known as Hazard Analysis and Critical Control Points (HACCP) to make sure that there is no chance of contamination or error during processing.

1.3 FACTORS AFFECTING FOOD SAFETY

Food hazards are the factors, which are the biggest threat to food safety. ***A hazard is defined as: a biological, chemical, or physical agent in a food, or condition of a food, with the potential to cause an adverse health effect.***

- a) Biological hazards are living organisms, including microbiological organisms, bacteria, viruses, fungi and parasites.
- b) Chemical hazards are in two categories: naturally occurring poisons and chemicals or deleterious substances. The first group covers natural constituents of foods that are not the result of environmental, agricultural, industrial or other contamination. Examples are aflatoxins and shellfish poisons. The second group covers poisonous chemicals or deleterious substances, which are intentionally or unintentionally added to foods at some point in the food chain. This group of chemicals can include pesticides and fungicides and well as lubricants and cleaners.
- c) Physical hazard is any physical material not normally found in food, which causes illness or injury. Physical hazards include glass, wood, stones and

metal, which may cause illness and injury. Examples of hazards are given in Table 1.

Table 1. Hazards associated with food

Biological	Chemical	Physical
Macro biological	Veterinary residues, antibiotics	Glass Hair
Microbiological	Growth stimulants	Metal
Pathogenic Bacteria	Plasticisers and packaging migration	Stones Wood
<ul style="list-style-type: none"> • Sporeforming • Non sporeforming 	Chemical residues, Pesticides, Cleaning fluids	Plastic Parts of pests
Parasites and protozoa	Allergens	Insulation material
Viruses	Toxic metals; Lead and cadmium	Bone
Mycotoxins	Food chemicals; preservatives, processing aids, polychlorinated biphenyls (PCBs), printing inks, Prohibited substances	Fruit pits

1.3.1 Biological Hazards

Biological hazards include bacterial, fungal, viral, and parasitic (protozoa and worms) organisms and/or their toxins. There are many microorganisms, which are pathogenic in humans, but relatively few are associated with foods (Table 2). Those that cause diseases are termed as food-borne pathogens. Diseases

caused by these organisms are sometimes incorrectly called food poisonings. There are two types of food-borne disease from microbial pathogens: infections and intoxications. Infections result from ingestion of live pathogenic organisms, which multiply within the body and produce disease. Intoxications occur when toxins produced by pathogens are consumed. Intoxications can occur even if no viable microorganisms are ingested. This often occurs when foods are stored under conditions, which allow the pathogens to grow and produce toxin. Subsequent processing of the food may destroy the microorganisms but not the toxin



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Table 2. Hazardous Microorganisms and Parasites along with their commonly implicated foods

S N o	ORGANISM/S	FOODS IMPLICATED
1	<i>Clostridium botulinum</i> types A, B, E, and F	Meat, fish, low or medium acid canned foods, home canned products
2	<i>Salmonella</i> spp. (<i>Salmonella typhi</i>; <i>Sal. paratyphi</i>)	Eggs, meat and meat products, bakery products, dairy products (esp. ice-cream)
3	<i>Shigella</i> spp.	Shellfish, fruits and vegetables, chicken, Salad
4	<i>Clostridium perfringenes</i>	Raw meat, poultry and their products
5	<i>Staphylococcus aureus</i>	Custard, cream, bakery foods, poultry, ham, dairy products(esp. khoa)
6	<i>Bacillus cereus</i>	Cereal dishes, puddings, mashed potatoes, sauces, soups
7	<i>Vibrio cholerae</i> 01 ,non-01 <i>Vibrio vulnificus</i> <i>Vibrio parahaemolyticus</i> <i>Listeria monocytogenes</i>	Water, potatoes, eggs, asparagus, salads, seafood (shrimps, oysters, clams, crabs, lobsters and related shellfish), finfish Milk and milk products, raw meat and poultry products, fruit and vegetables, <i>salads</i> , seafood

8	Enterovirulent Escherichia coli (EEC)	Cream pie, mashed potatoes, meat, poultry, dairy products like cheese
9	Campylobacter jejuni	Dressed chicken, meat dishes, raw milk, raw poultry
10	Yersinia enterocolitica	Dairy products, egg products, raw meat and poultry, raw vegetables
11	Brucella abortis; B. suis	Milk and milk products, raw meat
12	Viruses (Hepatitis A and E , Rotavirus ,Norwalk virus group)	Shellfish, raw fruits and vegetables, salads sandwiches, potatoes, lettuce, coleslaw
13	Entamoeba histolytica	Water, raw fruits and vegetables
14	Diphyllobothrium latum	Fish
15	<i>Cryptosporidium paruum</i>	Raw fruits and vegetables, salads
16	<i>Giardia lamblia</i>	Water, lettuce, raw fruits and vegetables
17	<i>Taenia saginata , Taenia solium</i>	Meat(beef and pork)
18	<i>Trichinella spiralis</i>	Raw pork, meat products

1.3.2 Physical Hazards

Foods may contain physical hazards such as stones, hair, and parts of pests, seeds, glass fragments, or small bits of metal. These materials can become part of foods from the natural environment in which they are grown or they may be contaminated during processing and packaging. Small pieces of metal can come loose from processing machinery, for example. For this reason, many food-processing operations have an electronic metal detector, which screens each package for metals. Foreign / extraneous objects represent one of the largest categories of complaints by consumers. All substances within each of the above five categories can be thought of as carrying some degree of health risk because no food is completely risk-free. The acceptability of each risk will depend on a number of factors, including the alternatives available, cost, benefit, and size of the actual risk. It is the job of the government and industry to ensure that these risks are minimal and acceptable.

1.3.3 Chemical Hazards

Chemicals, which cause a harmful response when consumed by animals or humans, are said to be toxic. It turns out that almost everything is a toxicant or "poison" if consumed at a high enough level. Even table salt and vitamins are toxic in large amounts. Thus, nearly everything can be considered a "toxicant" without regard for the origin of the substance. The factors, which determine toxicity, are the dose or amount of exposure and the potency of the chemical. Acute toxicants act within short periods after exposure (minutes, hours, days), whereas chronic toxicants produce an adverse effect after longer periods, often years. Food-borne toxicants can be divided into three categories:

- ❖ Those coming from natural sources, including the food itself. Naturally occurring toxicants are found in plants, microorganisms, and animals. We have learned to avoid foods, which contain naturally occurring acute toxicants. In other cases we process foods in order to remove the toxicant.

However, it is clear that many foods also contain low levels of naturally occurring chronic toxicants. It is unknown if these naturally occurring chronic toxicants pose any risk for human health.

- ❖ Those toxicants, which become food contaminants because of the way in which foods are grown, produced, processed, stored, or prepared. Toxic environmental contaminants like lead, polychlorinated biphenyls (PCBs), and pyrolysis products from cooking are examples of unintended toxicants in foods. Most of these toxicants are in trace amounts and do not pose an acute risk. Often there is little we can do to control these toxicants except to limit the amount of some foods eaten or limit the amount of toxicant permitted in a food. As with naturally occurring toxicants, the size of the risk involved from these contaminants is often unknown.
- ❖ Those that are intentionally added to foods for some desirable function. This may be a food additive, which acts as a preservative, or it may be a pesticide, which is used to reduce insect, or mold damage or it may be a drug, which is used to treat disease in food-producing animals. These intentional additives are often the most controversial. Some feel that they should not be used no matter how small the risk, whereas others feel the risks are very small and the benefits large. Because we have control over intentional additives, governments around the world closely regulate them. Natural as well as highly processed foods contain chemicals, which can be toxic at some dose. Many types of toxicity can occur from food substances, including nerve damage, organ toxicity, anti nutritional effects, birth defects, and cancer. Our bodies cannot tell if a toxicant comes from natural sources or if it is synthetic. The body treats both similarly.

1.3.3.1 Types of Chemical Hazards

a) Naturally Occurring Chemicals

- i) Mycotoxins (e.g., Aflatoxins)
- ii) Scombrototoxin (Histamine)
- iii) Ciguatoxin
- iv) Mushroom toxins
- v) Shellfish toxins
 - Paralytic Shellfish Poisoning (PSP)
 - Diarrhetic Shellfish Poisoning (DSP)
 - Neurotoxic Shellfish Poisoning (NSP)
 - Amnesic Shellfish Poisoning (ASP)
- vi) Pyrrolizidine and other alkaloids
- vii) Phytohemagglutinin

b) Added Chemicals

- i) Agricultural chemicals
 - Pesticides, fungicides, fertilizers, antibiotics and growth hormones
- ii) Toxic elements and compounds
 - Lead, arsenic, mercury, cyanide, cadmium, tin and aluminum
- iii) Food additives (beyond permissible limits) and non permitted food additives

Because most foods are grown in the open environment, they can become contaminated with natural and human-derived environmental toxicants. Lead, in most cases, is one such toxicant. PCBs, dioxin, and other pollutants resulting from human activity are further examples. In addition to environmental pollutants, foods become contaminated with trace toxicants, which are unintentionally or intentionally added to foods. The use of pesticides to control insects, unwanted plants, or fungi can result in trace residues of the pesticide in the food. In some cases, components of packaging materials

migrate from the package to foods. Oils from processing machinery or other processing aids can leave trace residuals in foods. These substances are sometimes called processing aids and are regulated for safety.

Traces of drugs, which are given to food-producing animals to treat diseases in these animals or make them grow more quickly, could, under some circumstances, remain in the food. Traces of antibiotics in milk are one example. These are also considered trace toxicants.

1.4 IMPORTANCE OF SAFE FOODS

A safe food supply that will not endanger consumer health and good quality food is essential for proper nutrition. It would ensure prevention of foodborne diseases, provide consumer unadulterated food of good quality. It also promotes participation in International trade in food products and stimulate economic development.

Maintaining food safety and quality is essential in the entire chain of food production ranging from i) primary food production at the level of farmers; ii) primary food processing at the farm, dairy, abattoir and grain mills; iii) secondary food processing level such as canning, freezing, drying and brewing; iv) food distribution, both at National and International level of import/export; v) Food retailing and Food catering and also vi) Domestic Food preparation level.

During recent years newer challenges such as globalization of trade in food, urbanization, changes in life style, international travel, environmental pollution, deliberate adulteration and natural and man-made disasters have arisen which need to be addressed to help ensure food safety and quality. For example, greater number of people go out and eat meals in catering establishments including partaking street foods. The boom in food service establishments is not matched by effective food safety education and control.

Unhygienic preparation of food provides plenty of opportunity for contamination, growth or survival of food borne pathogens. Also, a considerable public interest, specially in the developed countries have been shown with regard to genetically modified food, and the possible risk of transmission of “mad cow” disease through the consumption of beef.

Food safety is concerned with acute and chronic hazards that make food injurious to the health of the consumer. The term Food quality refers to attributes that influence a product’s value to the consumer. This includes both negative attributes such as spoilage, contamination, adulteration, food safety hazards and positive attributes such as the origin, colour flavour, texture. Food hygiene refers to all conditions and measures necessary to ensure the safety and suitability of food at all stages of the food chain.

Consumer confidence in the Safety and Quality of the food supply is an important requirement and consumers are demanding protection for the whole food supply chain from primary producer to the end consumer, often described as from farm or pond to the plate approach.

It is absolutely essential for countries to protect the safety and quality of their foods entering international trade. Also it is necessary to ensure that imported foods are of good quality and safe to eat. The new World order and global environment for food trade places considerable obligation on the part of both importing and exporting countries to ensure safety and quality of food.

Education and Training plays an important role in improving the safety and quality of food. It is essential to acquire the know-how and skills necessary to understand and manage food safety hazards. Both education and training are needed for the purpose. While education aims at influencing the way of life and

empowering people to make a choice, training is a process by which one is enabled to acquire a skill.

Successful Food Safety programmes need a shared responsibility among producers, industry, trade, Government and the consumer. Food safety management has progressed rapidly in recent years. The International agencies like Food and Agriculture Organization and World Health Organization as well as the Codex Alimentarius Commission, with a membership of 165 countries, recommends risk analysis approach which includes risk assessment, risk management and risk communication. Risk assessment is the scientific evaluation of known or potential adverse health effects resulting from human exposure to foodborne hazards. It involves identification and characterization of a hazard, and assessment of how likely it is that a health effect will result. Risk management is the process of weighing policy alternatives for accepting, minimizing or reducing risks, and selecting and implementing appropriate options. Risk communication is the exchange of information and opinions concerning risk and risk-related factors among risk assessors, risk managers and other interested parties.

The perception of what constitutes a risk depends on a person's culture, education and past experience. But while what is perceived as risk may differ, the basic scientific principles for dealing with risk are the same. Risk communication, as a component of health education in food safety, consists of understanding consumers' perceptions of food safety risks and disseminating the results of risk assessment and decisions regarding risk management. The latter may include measures that governments or industries have to implement or practices that the public as consumers or food handlers should observe.

An integrated approach on food safety and quality facilitates improved consumer protection, reduces incidence of foodborne diseases, effectively stimulates agriculture and the food processing industry, and promotes domestic and international food trade and improves the economy. Preventive approach for improving safety and quality of food and enhancing food hygiene are gaining widespread acceptance. Promoting good manufacturing practices, educating food retailers and consumers about appropriate food handling are essential for promoting good nutrition and better health.



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