UNIT 1

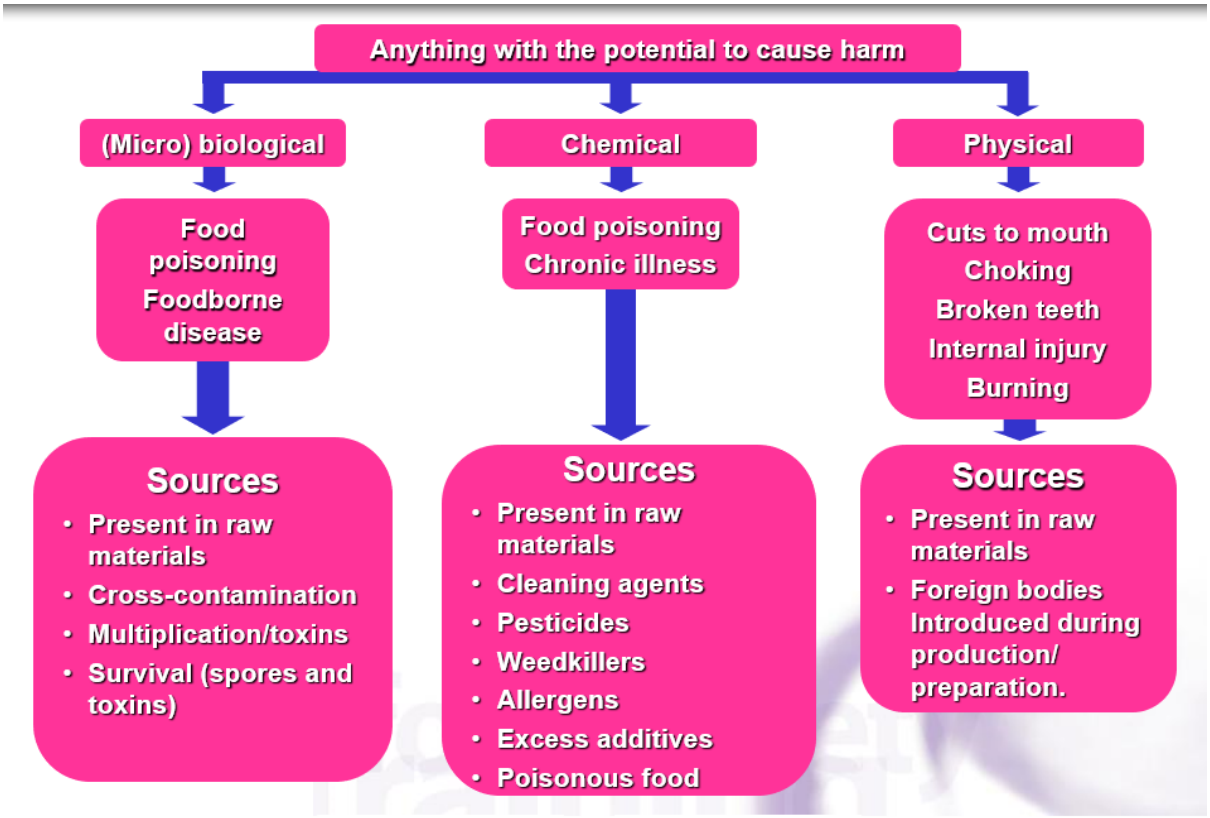
INTRODUCTION

NEED AND IMPORTANCE OF FOOD SAFETY

Importance of Food Safety

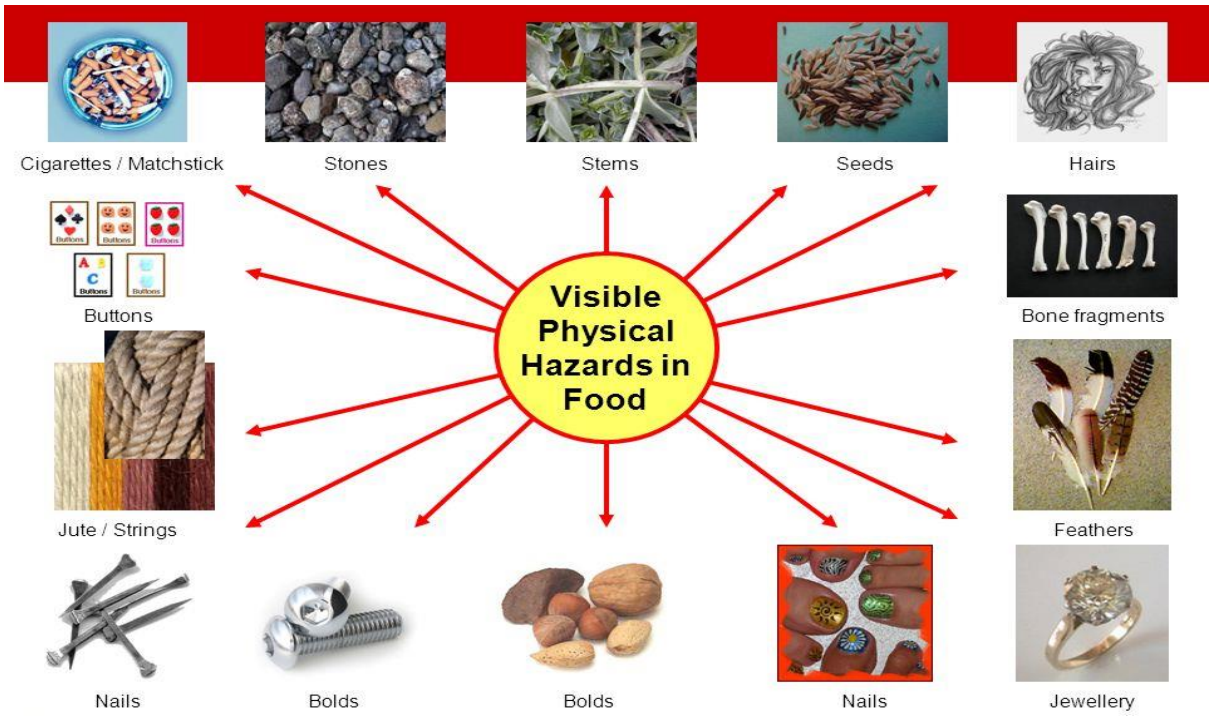
Food safety involves the food containing harmful bacteria, viruses, parasites or chemical substances can cause more than 200 different diseases. These five simple keys to safe and healthy food are: keep clean, separate raw and cooked, cook thoroughly, keep food at safe temperatures, and use safe water and raw materials.

Food Hazard / Contaminations



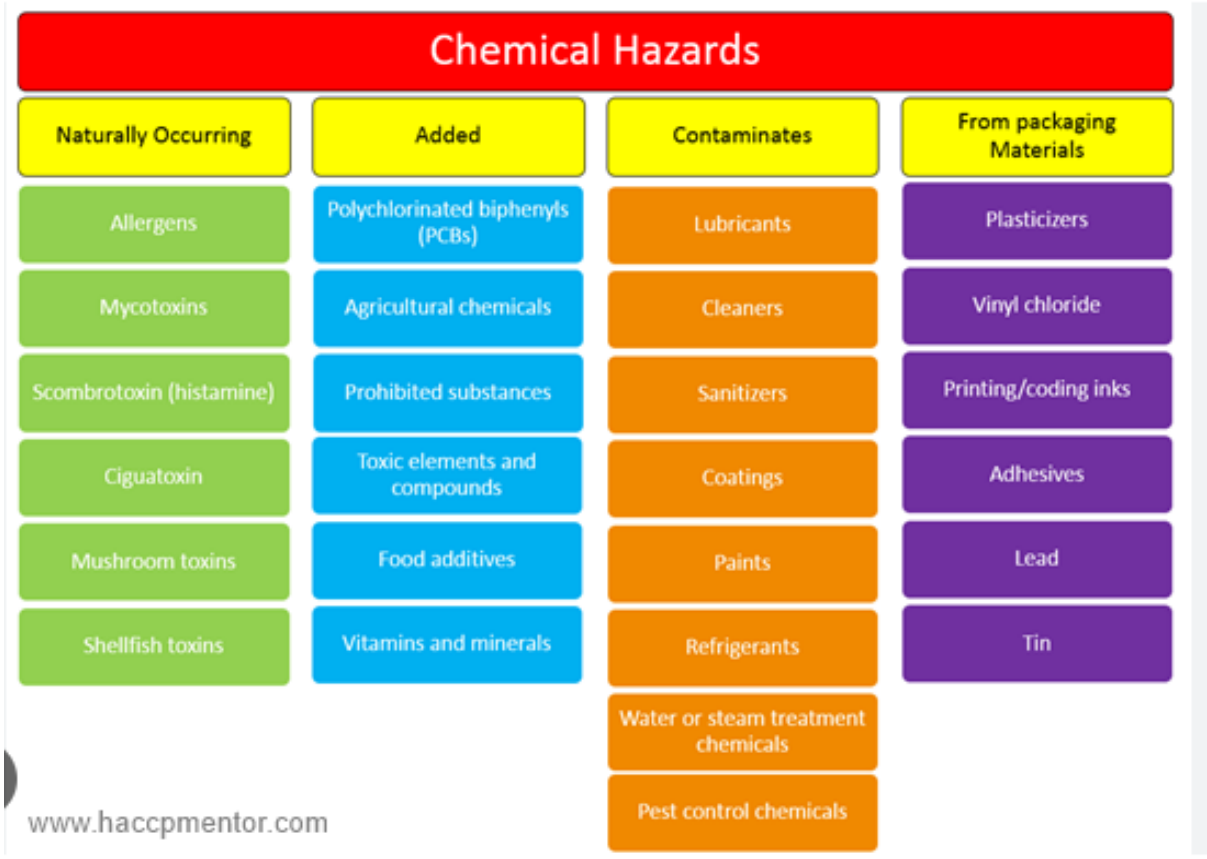
Physical Contaminants

Physical hazards are either foreign materials unintentionally introduced to food products (ex: metal fragments in ground meat) or naturally occurring objects (ex: bones in fish) that are hazardous to the consumer. A physical hazard contaminates a food product at any stage of production. Physical hazards can either be natural or unnaturally present in foods. Natural physical hazards include pieces that are part of the food being processed. On the other hand, unnatural physical hazards are foreign objects introduced to the food from the surrounding environment.



Chemical Hazard

Chemical hazards include water, food contact materials, cleaning agents, pest control substances, contaminants (environmental, agricultural and process e.g. acrylamide), pesticides, biocides and food additives.

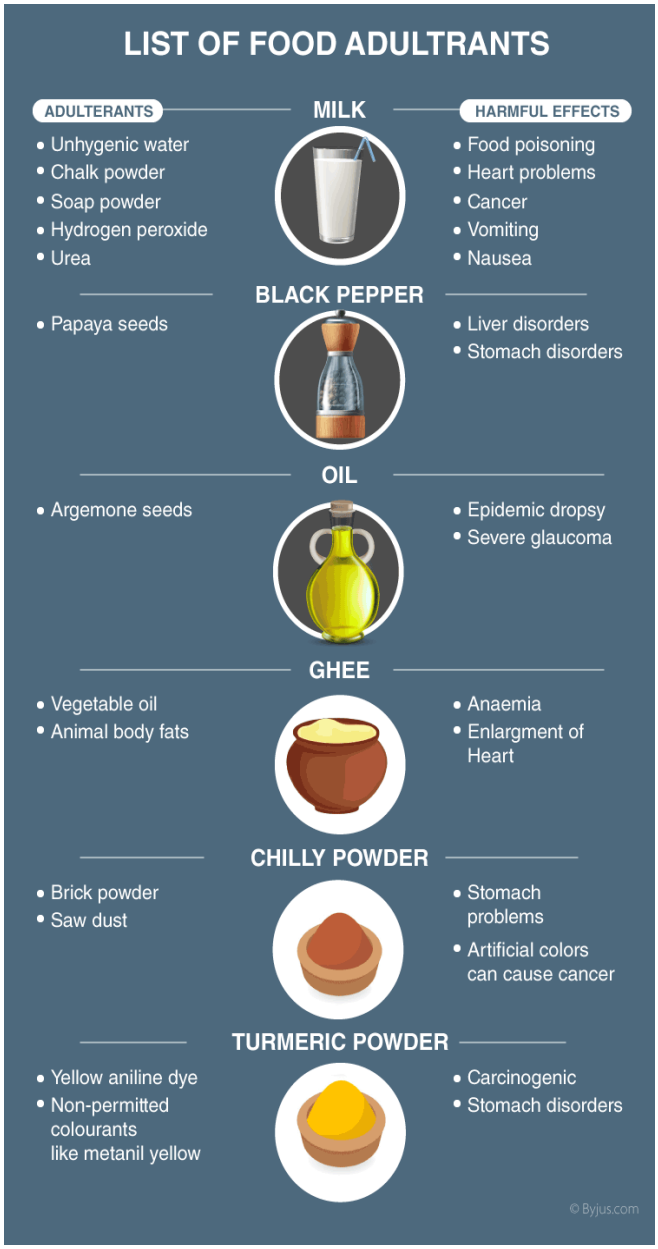


Biologial Hazard

Biological hazards are organisms, or substances produced by organisms, that pose a threat to human health. They are a major concern in food processing because they cause most food borne illness outbreaks.

PHYSICAL HAZARD

Adulteration



Adulteration of food commonly defined as “the addition or subtraction of any substance to or from food, so that the natural composition and quality of food substance is affected". Adulteration is either intentional by either removing substances to food or altering the existing natural properties of food knowingly.

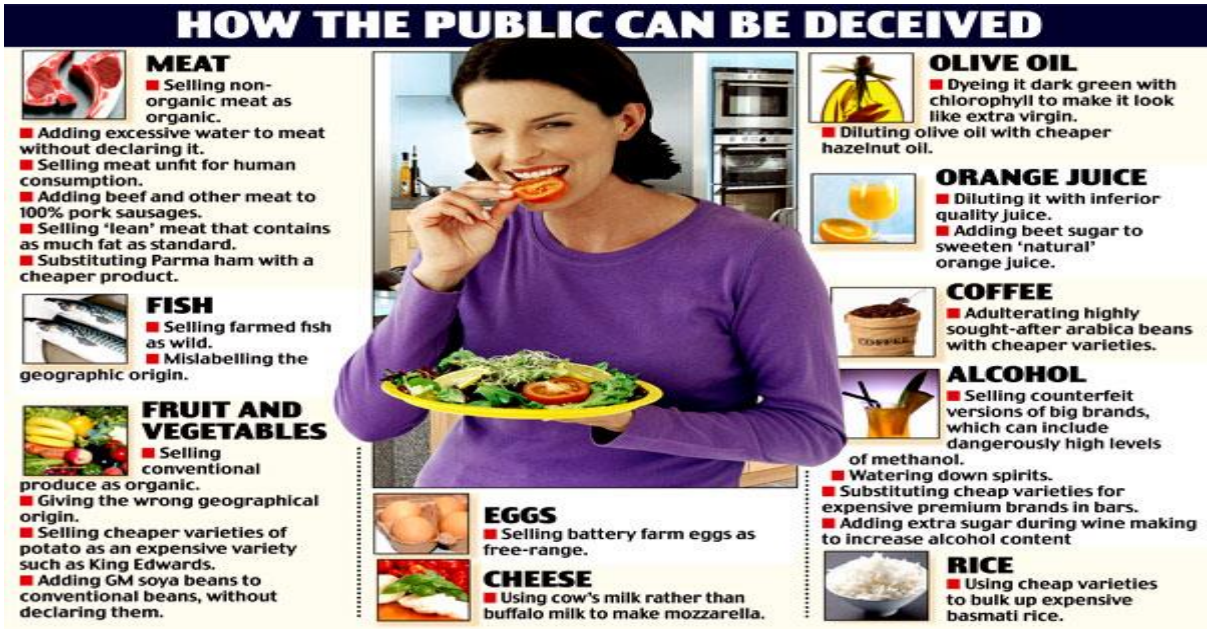
Milk can be diluted by adding water to increase its quantity and starch powder is often added to increase its solid content.

Listed below are the main reasons for adulterating food products:

- Practised as a part of the business strategy.
- An imitation of some other food substance.
- Lack of knowledge of proper food consumption.
- To increase the quantity of food production and sales.
- Increased food demand for a rapidly growing population.
- To make maximum profit from food items by fewer investments.

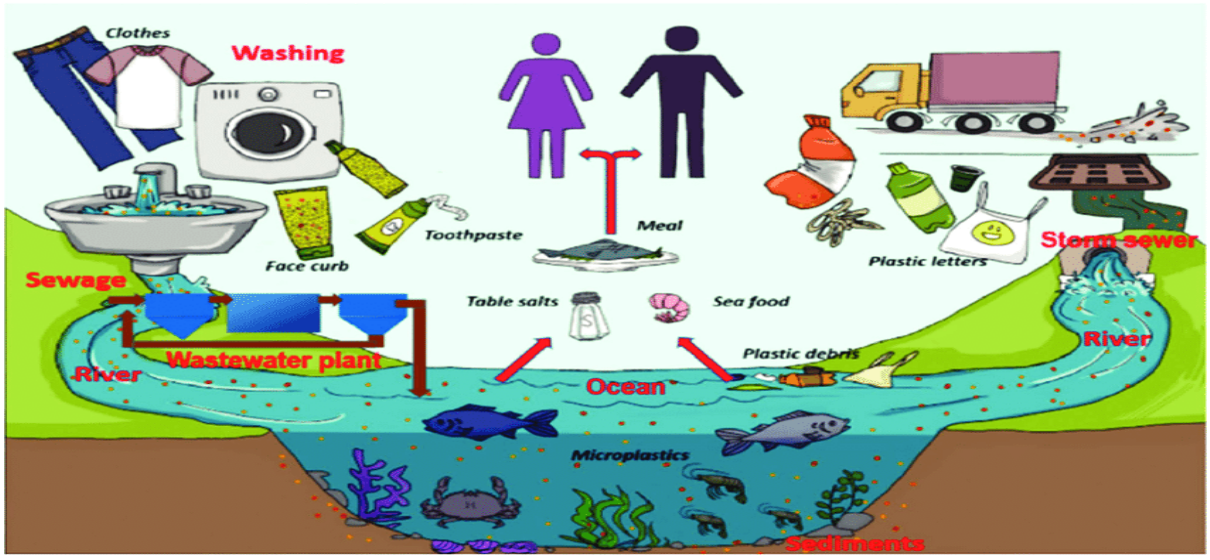
Filth

Some contaminants, however, are not altogether harmless to the consumer. The presence of high levels of filth in food indicates that at some point the food has been subjected to insanitary handling. Depending on whether the contamination occurred before or after the last heat-processing (sterilizing) step in manufacture or preparation, the significance of filth in food ranges from merely aesthetically unappealing to allergenic, toxic, injurious, or pathogenic.



Plastic Contaminants

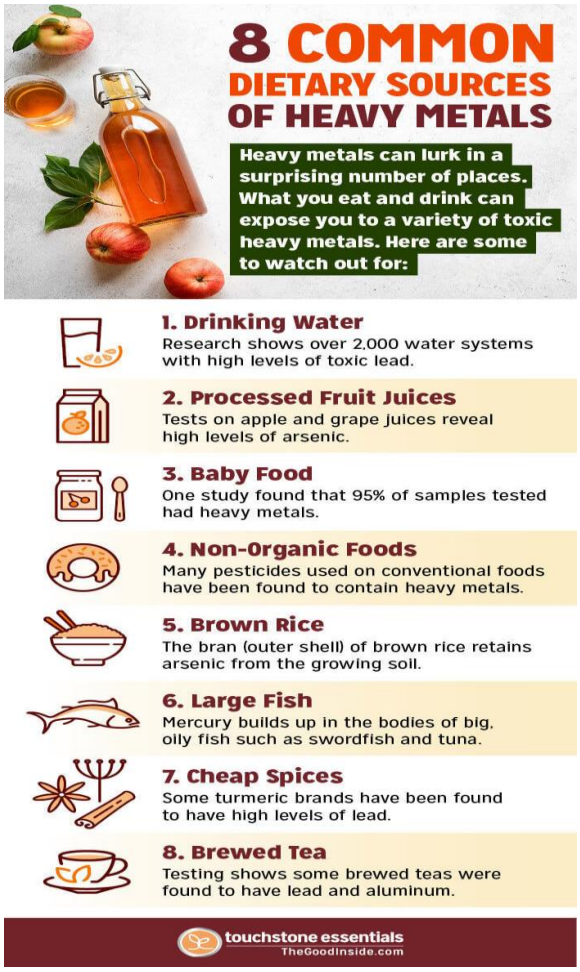
Most of the plastics produced globally are used for food and beverage packaging. During its use, however, plastic becomes worn and breaks into small fragments called microplastics. Exposure to some environmental conditions, such as heat, causes plastic to break into smaller fragments called microplastics, which can migrate into food. Single-use water bottles, to-go containers, food cans, and storage wraps are examples of common plastic-based food packaging that contains microplastics. Heating food in plastic packaging, long storage times, and the type of plastic packaging a person uses all affect trusted Source the amount of the microplastics and their harmful chemicals that migrates into food.



CHECMICAL HAZARDS

Toxic Constituents in Food

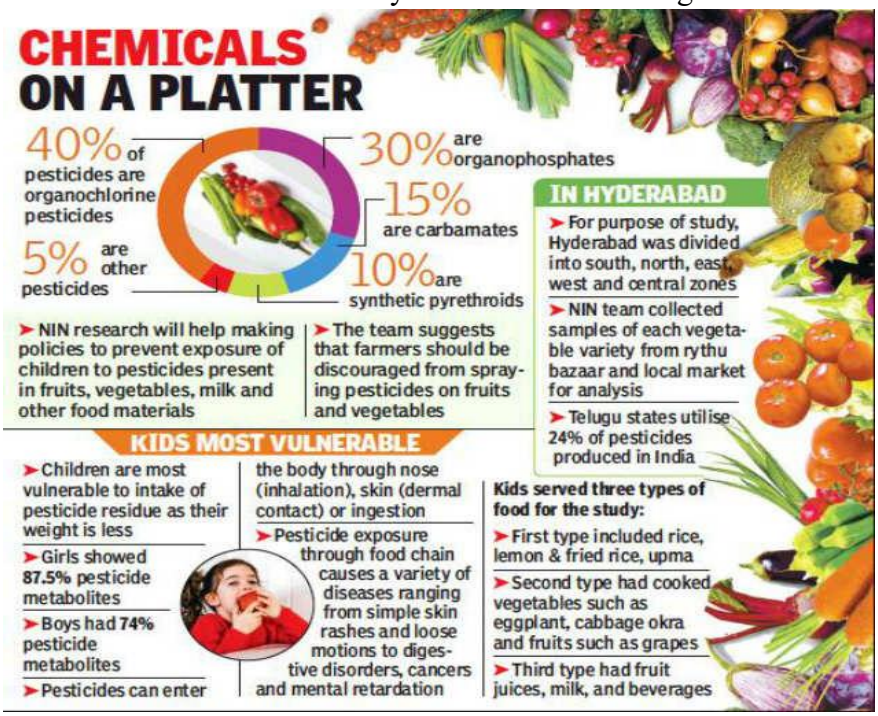
Environmental contaminants can be present in foods because they are in the soil, water, or air where foods are grown, raised, or processed. Arsenic, Lead, Mercury, and Cadmium, sometimes referred to as heavy metals or toxic elements, that may occur naturally in the environment and are often at higher levels from past industrial uses and pollution. These contaminants have been prioritized due to their potential to cause harm during times of active brain development—in the womb through early childhood. Learn more at: Closer to Zero: Action Plan for Baby Foods and Advice About Eating Fish.



Heavy metals have harmful effects on human health, and exposure to these metals has been increased by industrial and anthropogenic activities and modern industrialization. Contamination of water and air by toxic metals is an environmental concern and hundreds of millions of people are being affected around the world. Food contamination with heavy metals is another concern for human and animal health.

Pesticide residues

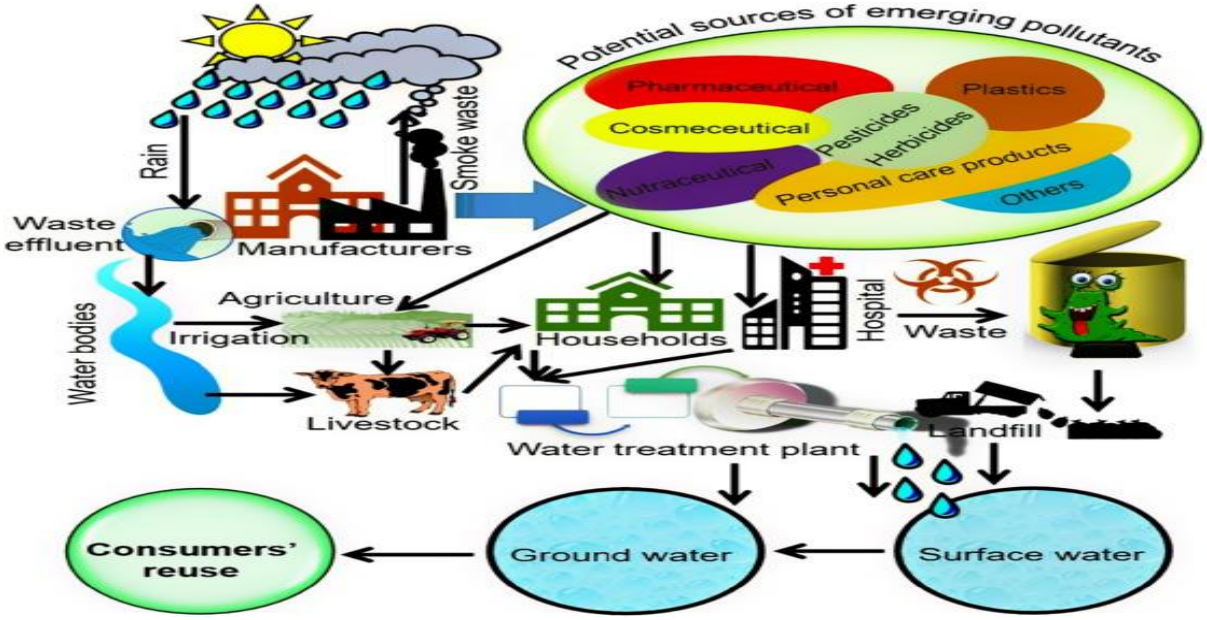
Pesticide residue is defined by the World Health Organization as "any substance or mixture of substances in food for man or animals resulting from the use of a pesticide and includes any specified derivatives, such as degradation and conversion products, metabolites, reaction products, and impurities. Pesticides are chemicals used in agriculture to protect crops against insects, fungi, weeds and other pests. In addition to their use in agriculture, pesticides are also used to protect public health in controlling the vectors of



tropical diseases, such as mosquitoes. But pesticides are also potentially toxic to humans. They may induce adverse health effects including cancer, effects on reproduction, immune or nervous systems. Before they can be authorized for use, pesticides should be tested for all possible health effects and the results should be analysed by experts to assess any risks to humans.

Environmental Pollution and Chemicals

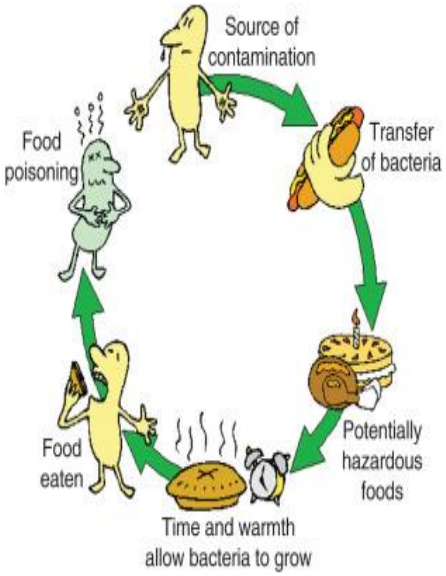
Environmental contaminants include substances from natural sources or from industry and agriculture. Many of the naturally occurring contaminants in food are of microbiological origin and consist of harmful bacteria, bacterial toxins, and fungal toxins. (Aflatoxin, a contaminant of peanuts and grains, is an example of a fungal toxin or mycotoxin) The second category of environmental contaminants includes organic chemicals, metals and their complexes, and radionuclides. Only those environmental contaminants introduced into food as a result of human activities such as agriculture, mining, and industry are considered in this assessment.



Biological Hazard

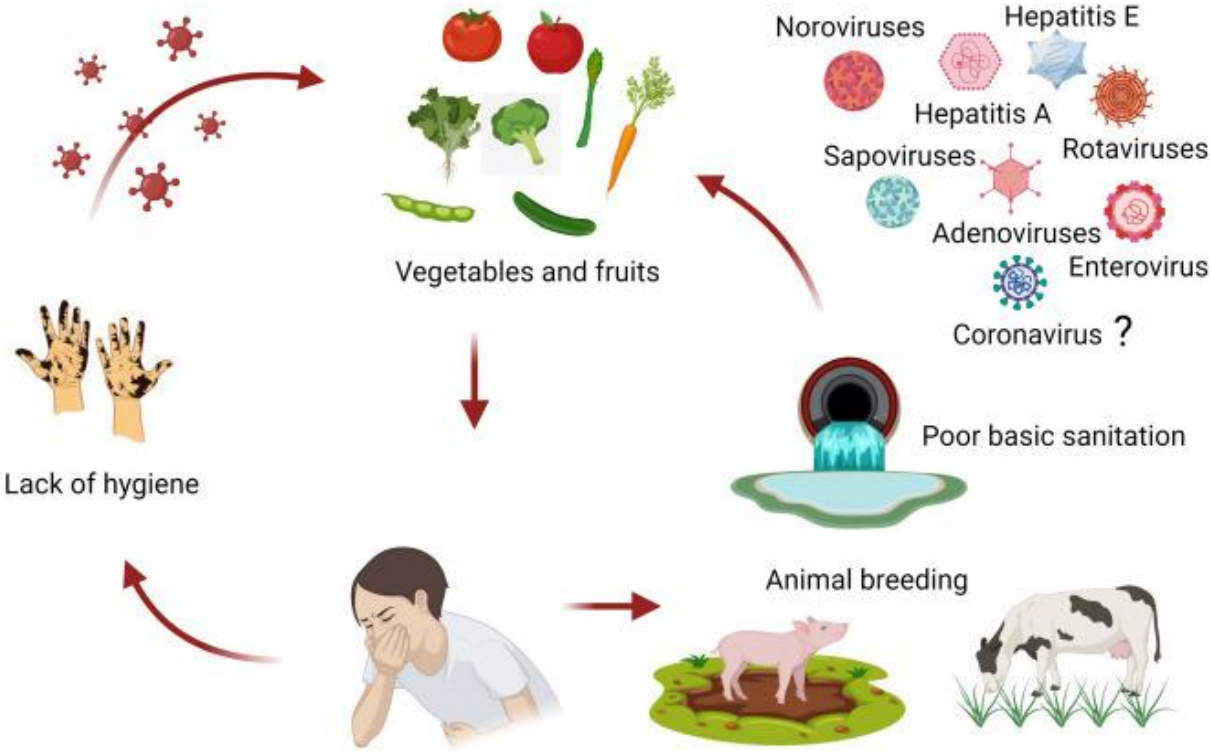
Bacteria

Bacterial contamination is the main cause of foodborne illness, which is when a person becomes ill from eating food. Food poisoning is another term for foodborne illness. Bacterial contamination occurs when bacteria multiply on food and cause it to spoil. Microbial food contamination can be more precisely explained as some unwanted microbes present in a particular food. The common microbial contaminants are *Pseudomonas, Listeria monocytogenes, Salmonella* sp., *Shigella flexneri, Vibrio cholerae, Bacillus* sp., and *Campylobacter jejuni*. Microbial biofilms are a great threat to the food industry because most of the microbes are capable of forming biofilms in the presence of even minimal amount of moisture and nutrients. The source of food contaminations is due to clinical infections resulting from the biofilm by pathogenic microbes of food industry. Prevention of the microbial contamination is essential to decrease the rate of food-borne diseases.



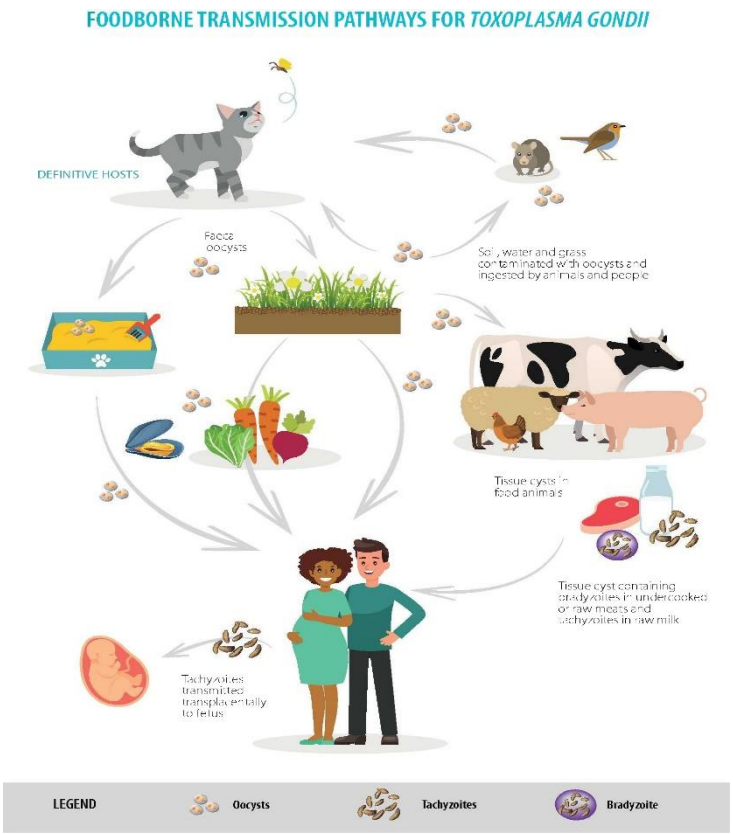
Virus

The presence of viruses in food can be the result and consequence of the environmental contamination during primary production contaminated irrigation waters by sewage as well as manure, which in turn contaminate produce on the field, during the processing and storage phases by water contaminated with viruses.



Parasites

Numerous parasites can be transmitted by food including many protozoa and helminths. In the United States, the most common foodborne parasites are protozoa such as Cryptosporidium spp., Giardia intestinalis, Cyclospora cayetanensis, and Toxoplasma gondii; roundworms such as Trichinella spp.



MICROBIOLOIGICAL MONITORING OF WATER

Water

Microbiological/Chemical Limits			
Tests	**Potable Water**	**Purified Water**	**Water-for injection**
pH	N/A	5.0 - 7.0	5.0 - 7.0
TOC	N/A	500 ppb	500 ppb
Conductivity	N/A	4.7 to 5.8 µS/cm	USP 24 Specification/ Method
Bacteria	500 cfu/mL	100 cfu/mL	10 cfu/100mL
Endotoxins	N/A	Not Specified	0.25 EU/mL
cfu: Colony Forming Units			

The determination of microbiological quality of water is essential. Simple routine testing of the bacteriological quality of drinking water is designed to detect the presence of coliform bacteria and virological assessment is to detect the presence of enteric viruses, especially hepatitis A virus (HAV). The microbiological quality characteristics of foods depend on the viable numbers of microorganisms. The number of viable microorganisms in foods can provide information about certain conditions related to production, processing, and distribution.

Air

Microbiological quality of indoor air is created not only by a total concentration of bacteria and fungi but by the presence of some particular microorganism species, which is very important for the health of people occupying the room. Since air can play a central role as a reservoir for microorganisms, in controlled environments such as operating theatres regular microbial monitoring is useful to measure air quality and identify critical situations. The aim of this study is to assess microbial contamination levels in operating theatres using both an active and a passive sampling method and then to assess if there is a correlation between the results of the two different sampling methods.

Room Classification	Active Air Sample (%)	Settle Plate (9 cm) 4h Exposure (%)	Contact Plate or Swab (%)	Glove or Garment (%)
Isolator/Closed RABS (ISO 5 or better)	<0.1	<0.1	<0.1	<0.1
ISO 5	<1	<1	<1	<1
ISO 6	<3	<3	<3	<3
ISO 7	<5	<5	<5	<5
ISO 8	<10	<10	<10	<10

CONTROL OF RODENTS AND PESTS

UNIT 2

FOOD SAFETY MANAGEMENT SYSTEMS

QUALITY SYSTEM STANDARDS IN INDIA

Quality system standards in India

Food Safety and Standards Act

Food Safety and Standards Authority of India, established under the Food Safety and Standards Act, 2006, is the regulating body related to food safety and laying down of standards of food in India. The objective of new Food Safety and Standards Act is to lay down science-based standards for articles of food to regulate their manufacture, storage, distribution, sale and import, to ensure availability of safety and wholesome food for human consumption. This Act brings together different issues and legislations pertaining to food safety and its control under a single law and under a single authority. The major benefits of this new Act would be harmonization of all Acts related to food industry, establishment of science-based standards, removal of anomalies, clarity and uniformity with regard to novel foods including nutraceuticals, functional foods, establishment of food recall system that will ensure food safety and ultimately food security.

Bureau of Indian Standards (BIS)

Bureau of Indian Standards is the mainstream standards setting body in India for all the products and commodities including agriculture and allied commodities. It represents India in the International Organization for Standardization (ISO). BIS standards are both mandatory and voluntary. Mandatory standards are enforced directly by BIS. Along with prescribing product and commodity standards BIS also prescribe method of sampling and analysis. BIS is under the Ministry of Consumer Affairs, Food and Public Distribution, Department of Consumer Affairs, Government of India. BIS is head

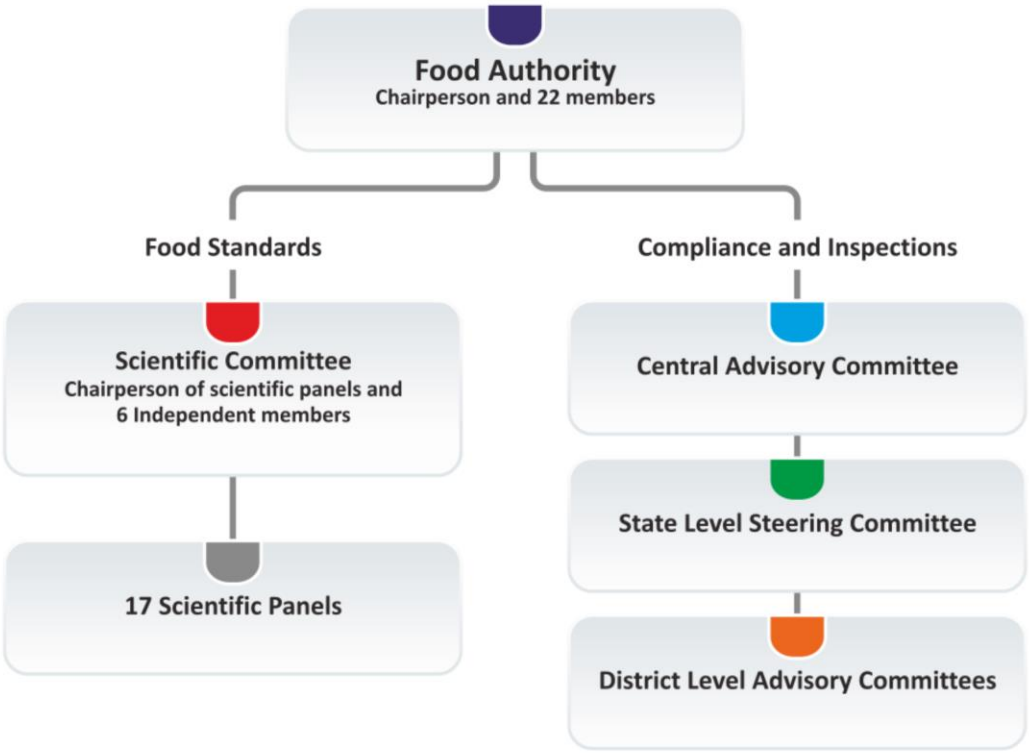
FSSAI

The Food Safety and Standards Authority of India (FSSAI) was established in 2008 under the aegis of the Ministry of Health and Family Welfare with the mandate for laying down science based standards for articles of food and to regulate their manufacture, storage, distribution, sale and import, to ensure availability of safe and wholesome food for human consumption and for matters connected therewith or incidental thereto to enforce the provisions of the FSS Act.

At the Apex level there is Food Authority which is a single reference point for all matters related to food safety and standards in the country. The Food Authority is assisted by Scientific Committees and Panels in setting standards and the Central Advisory Committee in coordinating with enforcement agencies. The Food Authority guides and regulates all persons engaged in manufacturing, processing, import transportation, storage, distribution and retail of food, on issues of food safety and nutrition with primary responsibility for enforcement largely with the State Food Safety Commissioners. The Chairperson and Chief Executive Officer of FSSAI are appointed by the Central Government. The Head office of the Authority is located at FDA Bhawan, Kotla Road, New Delhi-110002

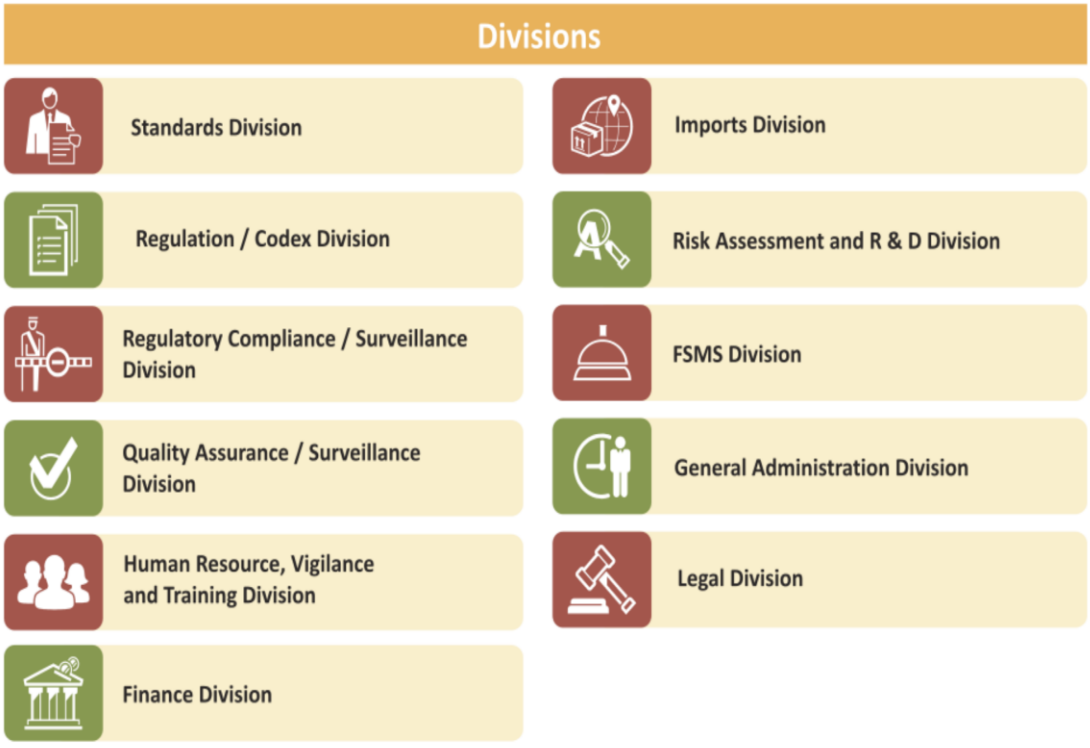
Organizational Chart

2. The Governing Structure of FSSAI is given below:



Divisions of FSSAI

3. FSSAI works through 11 Divisions



FSSAI State Presence

Enforcement of the Act

The Food Authority and the State Food Safety Authorities shall be responsible for the enforcement of this Act. The Food Authority and the State Food Safety Authorities shall monitor and verify that the relevant requirements of law are fulfilled by food business operators at all stages of food business. The authorities shall maintain a system of control and other activities as appropriate to the circumstances, including public communication on food safety and risk, food safety surveillance and other monitoring activities covering all stages of food business.

The Food Safety Officers shall enforce and execute within their area the provisions of this Act with respect to which the duty is not imposed expressly or by necessary implication on some other authority. The regulations under this Act shall specify which of the Food Safety Officers are to enforce and execute them, either generally or in relation to cases of a particular description or a particular area, and any such regulations or orders may provide for the giving of assistance and information by any authority concerned in 11the administration of the regulations or orders, or of any provisions of this Act, to any other authority so concerned, for the purposes of their respective duties under them. The Commissioner of Food Safety and Designated Officer shall exercise the same powers as are conferred on the Food Safety Officer and follow the same procedure specified in this Act.

Food Safety Officer

Food Safety Officers are the field officers and the backbone of entire food safety compliance structure. Food Safety Officers are appointed by the Commissioner of Food Safety, through notification, for such local areas as he may assign to them for the purpose of performing functions under this Act and the rules and regulations made there under. The State Government may authorise any officer of the State Government having the qualifications prescribed to perform the functions of a Food Safety Officer within a specified jurisdiction.

For effective discharge of its functions, the Food Safety Officer is required to have adequate knowledge of the FSS Act, Rule and Regulations and their application in discharge of their duties, proper procedure for inspection and sampling and various other aspects of food safety.

Powers of Food Safety Officer

B. Powers & Duties of Food Safety Officer:

A Food Safety Officer has a very important role to play as an enforcement officer and in ensuring food safety and quality. The powers and duties of a Food Safety Officer include the following:

(i) To issue registration for small and petty food business operators in their capacity as a Registering Authority within the area assigned to him.

(ii) To inspect the premises of small and petty food business operators and ensure compliance as per Schedule 4 (Part I) of Food Safety and Standards (Licensing and Registration of Food Businesses), Regulations, 2011, within the area assigned to him.

(iii) To inspect, as frequently as may be prescribed by the Designated Officer, all food establishments licensed for manufacturing, handling, packing or selling of an article of food within the area assigned to him.

(iv) To satisfy himself that the conditions of licenses are being complied with by each of the Food Business Operators carrying on business within the area assigned to him and report to the Designated Officer.

(v) To recommend Designated Officer to issue of improvement notices to the Food Business Operator whenever necessary giving the food business operators an opportunity in order to comply with the conditions of license within a prescribed time limit.

(vi) To make such inquiries and inspections as may be necessary to detect the manufacture, storage or sale of articles of food in contravention of the Act or rules framed there under.

(vii) To investigate any complaint which may be made to him in writing in respect of any contravention of the provisions of the Act, or rules framed there under.

(viii) To stop and inspect any vehicle suspected to contain any unsafe food or food which does not comply with the provisions of this Act and rules, intended for sale or delivery for human consumption.

(ix) To recommend to the Designated Officer giving specific grounds, suitable action in regard to licenses issued to any Food Business Operator, if on inspection the Food Safety Officer finds that the Food Business Operator had violated the conditions for grant of license.

(x) Take a sample of any food, or any substance, which appears to him to be intended for sale, or to have been sold for human consumption.

(xi) Take a sample of any article of food or substance which is found by him on or in any such premises; which he has reason to believe that it may be required as evidence in proceedings under any of the provisions of this Act or of the Regulations or orders made there under.

(xii) Take a sample and keep it in the safe custody of the food business operator such article of food after taking a sample; and in both cases send the same for analysis to a Food Analyst for the local area within which such sample has been taken. Where the Food Safety Officer keeps such article in the safe custody of the food business operator, he may require the food business operator to execute a bond for a sum of money equal to the value of such article with one or more sureties as the Food Safety Officer deems fit and the food business operator shall execute the bond accordingly.

(xiii) To procure and send for analysis if necessary, samples of any article of food which he has reason to believe or on the basis of information received including from a purchaser are being manufactured, stocked or sold or exhibited for sale in contravention of the provisions of the Act, or rules and regulations framed there under.

(xiv) To draw samples for purposes of surveillance, survey and research, which shall not be used for prosecution.

(xv) Where any sample is taken, its cost calculated at the rate at which the article is usually sold to the public shall be paid to the person from whom it is taken.

(xvi) To carry out food safety surveillance to identify and address the safety hazards.

(xvii) To seize any article of food which appears to the Food Safety Officer to be in contravention of this Act or the regulations made there under.

(xviii) Where any article of food seized is of a perishable nature and the Food Safety Officer is satisfied that such article of food is so deteriorated that it is unfit for human consumption, the Food Safety Officer may, after giving notice in writing to the food business operator, cause the same to be destroyed.

(xix) Any adulterant found in the possession of a manufacturer or distributor of, or dealer in, any article of food or in any of the premises occupied by him as such and for the possession of which he is unable to account to the satisfaction of the Food Safety Officer and any books of account or other documents found in his possession or control and which would be useful for, or relevant to, any investigation or proceeding under this Act, may be seized by the Food Safety Officer and a sample of such adulterant submitted for analysis to a Food Analyst. No such books of account or other documents shall be seized by the Food Safety Officer except with the previous approval of the authority to which he is subordinate.

(xx) Where any books of account or other documents are seized, the Food Safety Officer shall, within a period not exceeding thirty days from the date of seizure, return the same to the person from whom they were seized after copies thereof or extracts there from as certified by that person. Where such person refuses to so certify and a prosecution has been instituted against him under this Act, such books of account or other documents shall be returned to him only after copies thereof and extracts there from as certified by the court have been taken.

(xxi) Where the Food Safety Officer is of the opinion or he has reason(s) to be recorded in writing that in the given situation it is not possible to comply with the provision of Section 38 (1) (c) or the proviso to section 38(1) for reasons like non availability of the Food Business Operator, the Food Safety Officer may seize the adulterant or food which is unsafe or sub-standard or misbranded or containing extraneous matter, may seal the premises for investigation after taking a sample of such adulterant or food for analysis.

(xxii) Where the Food Safety Officer is of the opinion or he has reason(s) to believe that any person engaged in selling, handling or manufacturing any article of food is suffering from or harbouring the germs of any infectious disease/ contagious disease, he may cause such person to be examined by a qualified medical professional duly authorized by the Designated Officer. Provided that where such person is a female, she shall be examined by a qualified lady medical professional duly authorized by the Designated Officer. If on such

examination the qualified medical professional certifies that such person is suffering from any such disease, the Food Safety Officer may by order in writing under intimation to the Designated Officer direct such person not to take part in selling or manufacturing any article of food.

(xxiii) To respond to incidents of food poisoning in his area and to send report to and assist the Designated Officer to enable him to initiate corrective action.

(xxiv) To maintain a data base of all Food Business within the area assigned to him.

(xvi) To maintain a record of all inspections made and action taken by him in the performance of his duties, including the taking of samples and seizure of stocks, and to submit copies of such records to the Designated Officer as directed in this regard.

(xvii) When any adulterant is seized under, the burden of proving that such adulterant is not meant for purposes of adulteration shall be on the person from whose possession such adulterant was seized.

(xviii) To facilitate preparation of Food safety plans for Panchayat and Municipalities in accordance with the parameters and guidelines given in schedule IV of Chapter 3 of Regulations.

(xxix) To detain imported packages which are suspected to contain articles of food, the import or sale of which is prohibited.

(xxx) To coordinate with the Food Business Operators within his area of operation and facilitate the introduction of food safety systems by the Food Business Operator.

(xxxi) To perform such other duties, as may be entrusted to him by the Designated Officer or Food Safety Commissioner having jurisdiction in the local area concerned.

(xxxii) Food Safety Officer shall launch prosecution before courts of ordinary jurisdiction or Special Court, as the case may be; and such communication shall also be sent to the purchaser if the sample was taken under section 40, i.e. legal sample.

Regulations pertaining to Food Analysis Labs

- Selection, identifying building facilities and construction, if required for various analyses
- Developing an organizational structure and assigning responsibilities
- Selection of analyses to be performed
- Selection and purchase of equipment/chemicals
- Appointment and maintaining qualified analysts/technicians/skilled and unskilled staff
- Establishing standard operational and working procedures.
- Establishing a Quality Assurance system based on ISO/IEC 17025:2017 and obtain the NABL accreditation within 6 months of setting up of a basic Food Testing Laboratory

Offences and Penalties

D. Offences & Penalties

1. Chapter IX of the Food Safety & Standards Act, 2006 contains the general provisions for penalties for various offences / contravention of provisions of the Act, Rules & Regulations committed by an individual. A person may render any article of food injurious to health by means of one or more of the following operations, namely:-

   (a) adding any article or substance to the food;

   (b) using any article or substance as an ingredient in the preparation of the food;

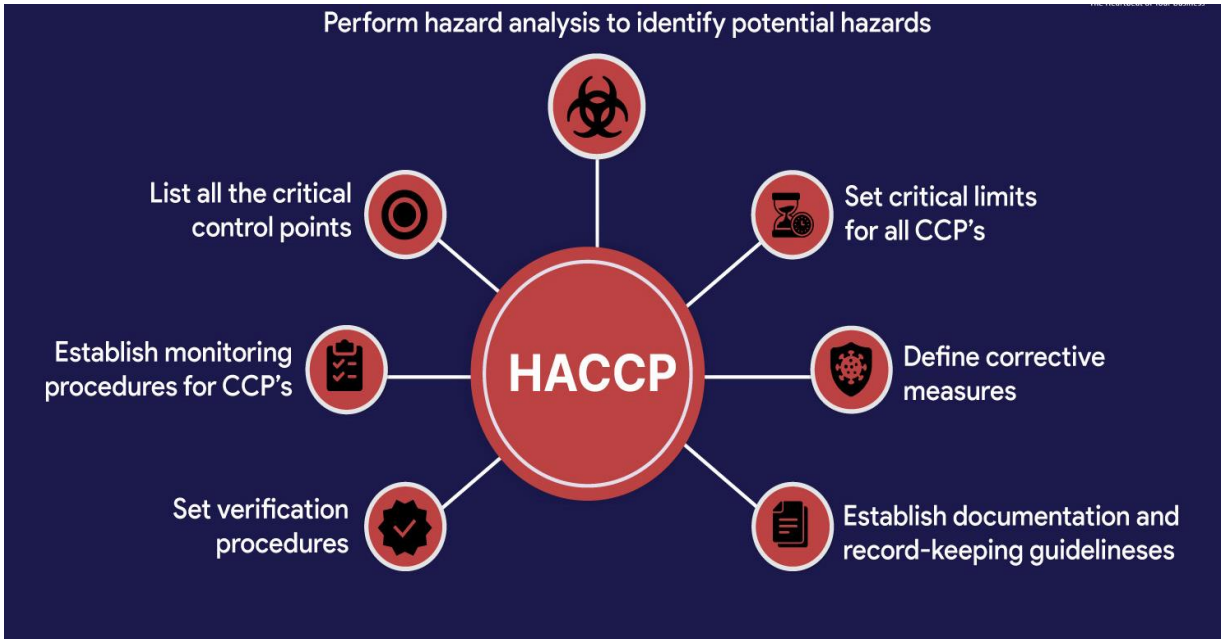
(c) abstracting any constituents from the food; or

(d) subjecting the food to any other process or treatment, with the knowledge that it may be sold or offered for sale or distributed for human consumption.

2. In determining whether any food is injurious to health, regard shall be given not only to the particular health sensitivities of a specific category of consumer where the food is intended for that category of consumers but also to the probable cumulative effect of food of substantially the same composition on the health of a person consuming it in ordinary quantities.
3. While adjudging the quantum of penalty, the Adjudicating Officer/the Tribunal, shall have due regard to:-
   (a) The amount of gain or unfair advantage, wherever quantifiable, made as a result of the contravention,
   (b) The Amount of loss caused or likely to cause to any person as a result of the contravention,
   (c) The repetitive nature of the contravention,
   (d) Whether the contravention is without his knowledge, and (e) Any other relevant factor,
4. Various Penalties and Punishments under the Food Safety & Standards Act, 2006

HACCP

HACCP is a management system in which food safety is addressed through the analysis and control of biological, chemical, and physical hazards from raw material production, procurement and handling, to manufacturing, distribution and consumption of the finished product. For successful implementation of a HACCP plan, management must be strongly committed to the HACCP concept. A firm commitment to HACCP by top management provides company employees with a sense of the importance of producing safe food. HACCP is designed for use in all segments of the food industry from growing, harvesting, processing, manufacturing, distributing, and merchandising to preparing food for consumption. Prerequisite programs such as current Good Manufacturing Practices (cGMPs) are an essential foundation for the development and implementation of successful HACCP plans. Food safety systems based on the HACCP principles have been successfully applied in food processing plants, retail food stores, and food service operations. The seven principles of HACCP have been universally accepted by government agencies, trade associations and the food industry around the world.



GMP

Current good manufacturing practices (cGMP) are those conforming to the guidelines recommended by relevant agencies. Those agencies control the authorization and licensing of the manufacture and sale of food and beverages, cosmetics, pharmaceutical products, dietary supplements, and medical devices. These guidelines provide minimum requirements that a manufacturer must meet to assure that their products are consistently high in quality, from batch to batch, for their intended use. The rules that govern each industry may differ significantly; however, the main purpose of GMP is always to prevent harm from occurring to the end user. Additional tenets include ensuring the end product is free from contamination, that it is consistent in its manufacture, that its manufacture has been well documented, that personnel are well trained, and that the product has been checked for quality more than just at the end phase. GMP is typically ensured through the effective use of a quality management system

GLP

The Principles of Good Laboratory Practice (GLP) are a managerial quality control system covering the organizational process and the conditions under which non-clinical health and environmental studies are planned, performed, monitored, recorded, reported and retained (or archived).

Role of NABL

NABL is a Constituent Board of Quality Council of India. NABL has been established with the objective of providing Government, Industry Associations and Industry in general with a scheme of Conformity Assessment Body's accreditation which involves third-party assessment of the technical competence of testing including medical and calibration laboratories, proficiency testing providers and reference material producers.

BENEFITS OF LABORATORY ACCREDITATION

Formal recognition of competence of a laboratory by an accreditation body in accordance with international criteria has many advantages:

- A ready means for customers to identify and select reliable testing, measurement and calibration services that are able to meet their needs.
- Increased confidence in Testing/ Calibration Reports issued by the testing, calibration and medical testing laboratories which emphasise on accuracy and reliable results.
- The results from accredited laboratories are used extensively by regulators for the public benefit in the provision of services that promote an unpolluted environment, safe food, clean water, energy, health and social care services.
- Better control of laboratory operations and feedback to laboratories as to whether they have sound Quality Assurance System and are technically competent.
- Helpful in participating in tenders that require independently verified laboratories.
- Users of accredited laboratories enjoy greater access for their products, in both domestic and international markets.
- Potential increase in business due to enhanced customer confidence and satisfaction: Accredited laboratories receive a form of international recognition, which allows their data and results to be more readily accepted in overseas markets. Accreditation helps to reduce costs for manufacturers and exporters who have their products or materials tested in accredited laboratories, by reducing or eliminating the need for retesting in another country.
- Customers can search and identify the laboratories accredited by NABL for their specific requirements from the NABL website or Directory of Accredited Laboratories.
- Users of accredited laboratories enjoy greater access for their products, in both domestic and international markets.
- Savings in terms of time and money due to reduction or elimination of the need for re-testing of products.

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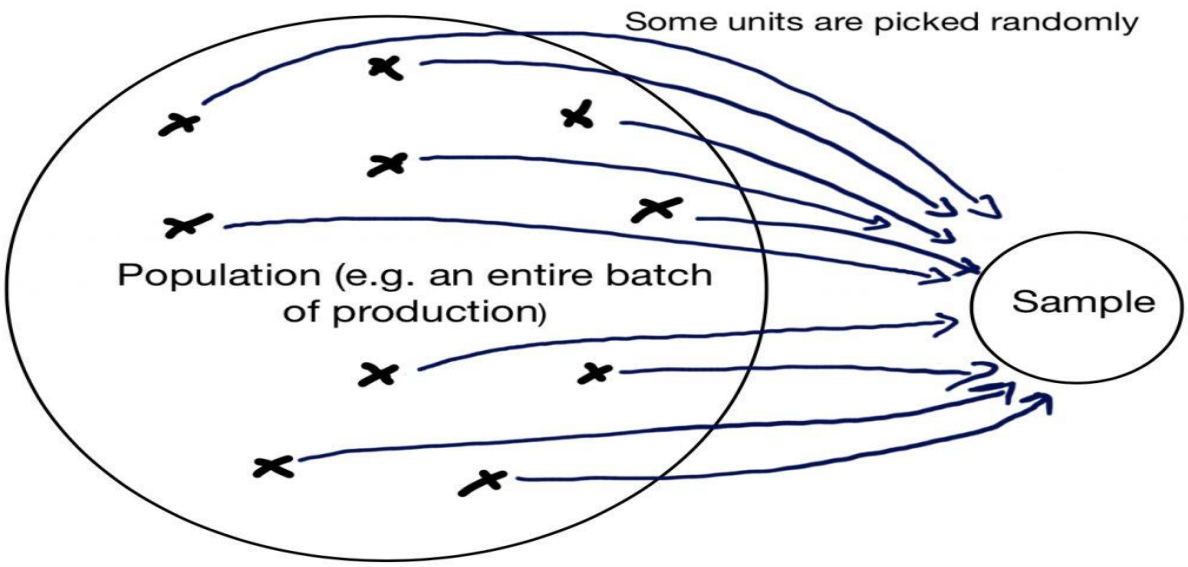
50 FT 801 & FOOD SAFETY AND QUALITY CONTROL

UNIT 3

STATISTICAL QUALITY CONTROL

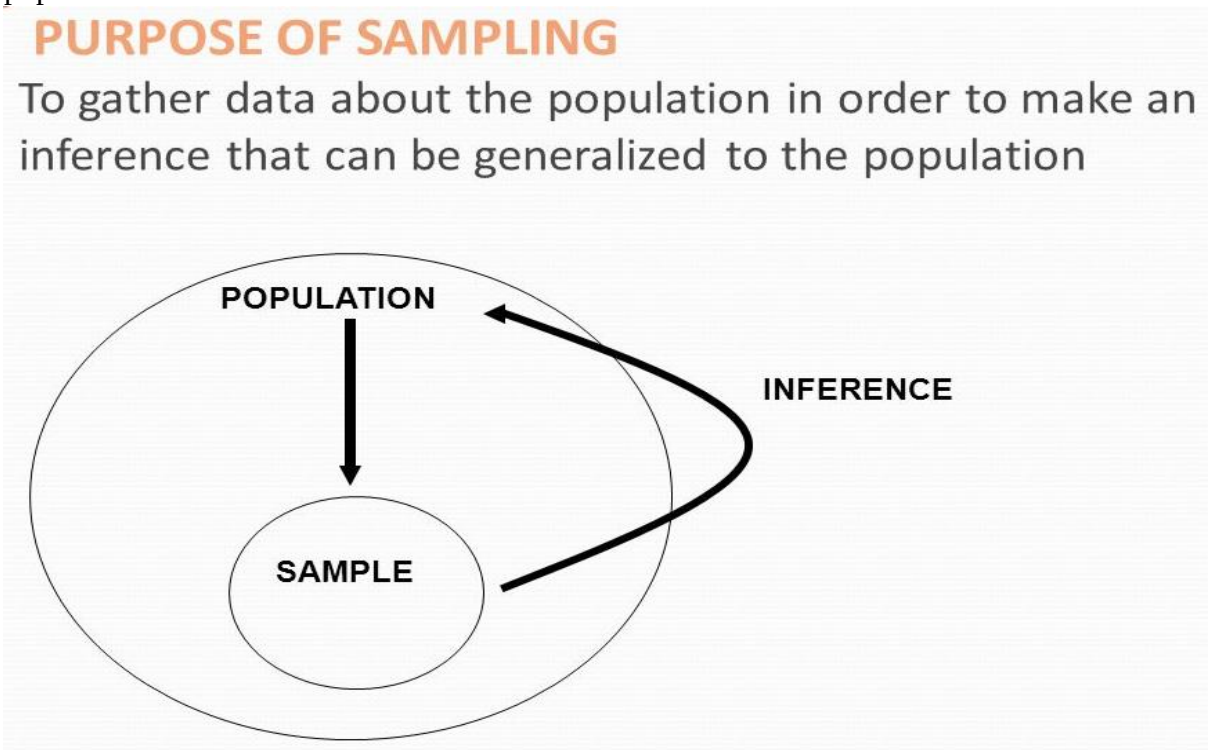
SAMPLING

Sampling is the selection of a set of elements from a target population or product lot. Sampling is frequently used because gathering data on every member of a target population or every product produced by a company is often impossible, impractical, or too costly to collect.



Purpose of Sampling

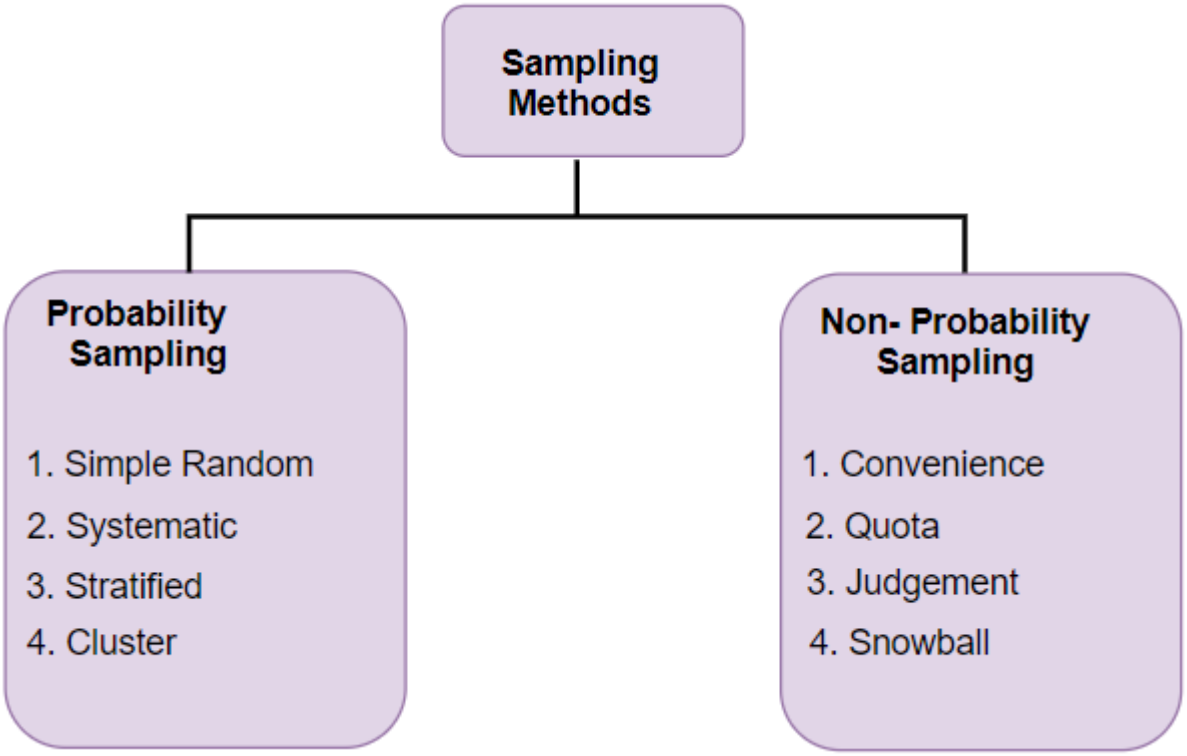
The aim of sampling is to approximate a larger population on characteristics relevant to the research question, to be representative so that researchers can make inferences about the larger population.



Sampling Plan

A sampling plan gives management information on the production process after the process is completed and allows some regulation of the process. Each plan contains a specific degree of certainty about the sampling results, as well as an average outgoing quality level (AOQL).

Types of Sampling



Differences Between Probability and Non-Probability Sampling

Probability sampling	Non-probability sampling
The samples are randomly selected.	Samples are selected on the basis of the researcher's subjective judgment.
Everyone in the population has an equal chance of getting selected.	Not everyone has an equal chance to participate.
Researchers use this technique when they want to keep a tab on sampling bias.	Sampling bias is not a concern for the researcher.
Useful in an environment having a diverse population.	Useful in an environment that shares similar traits.
Used when the researcher wants to create accurate samples.	This method does not help in representing the population accurately.
Finding the correct audience is complex.	Finding an audience is very simple.

Probability Sampling

Probability sampling uses statistical theory to randomly select a small group of people (sample) from an existing large population and then predict that all their responses will match the overall population.

1. **Simple Random Sampling:** This method involves randomly selecting a sample from the population without any bias. It's the most basic and straightforward form of probability sampling.
2. **Stratified random Sampling:** This method involves dividing the population into subgroups or strata and selecting a random sample from each stratum. This technique is useful when the population is heterogeneous and you want to ensure that the sample is representative of different subgroups.
3. **Cluster Sampling:** This method involves dividing the population into groups or clusters and then randomly selecting some of those clusters. This technique is useful when the population is spread out over a large geographical area. But It is not possible or practical to survey everyone.
4. **Systematic Sampling:** This method involves selecting every nth member of the population after a random starting point is chosen.

Non-Probability Sampling

Non-probability sampling is defined as a sampling technique in which the researcher selects samples based on the subjective judgment of the researcher rather than random selection. It is a less stringent method. Non-probability sampling is most useful for exploratory studies like a pilot survey (deploying a survey to a smaller sample compared to pre-determined sample size).

1. **Convenience sampling:**
   Convenience sampling is a non-probability sampling technique where samples are selected from the population only because they are conveniently available to the researcher. Researchers choose these samples just because they are easy to recruit, and the researcher did not consider selecting a sample that represents the entire population.
2. **Consecutive sampling:**
   This non-probability sampling method is very similar to convenience sampling, with a slight variation. Here, the researcher picks a single person or a group of a sample, conducts research over a period, analyzes the results, and then moves on to another subject or group if needed. Consecutive sampling technique gives the researcher a chance to work with many topics and fine-tune his/her research by collecting results that have vital insights.
3. **Quota sampling:**
   Hypothetically consider, a researcher wants to study the career goals of male and female employees in an organization. There are 500 employees in the organization, also known as the population. To understand better about a population, the researcher will need only a sample, not the entire population. Further, the researcher is interested in particular strata within the population. Here is where quota sampling helps in dividing the population into strata or groups.
4. **Judgmental or Purposive sampling:**
   In the judgmental sampling method, researchers select the samples based purely on the researcher's knowledge and credibility. In other words, researchers choose only those people who they deem fit to participate in the research study. Judgmental or purposive sampling is not a scientific method of sampling, and the downside to this sampling

technique is that the preconceived notions of a researcher can influence the results. Thus, this research technique involves a high amount of ambiguity.

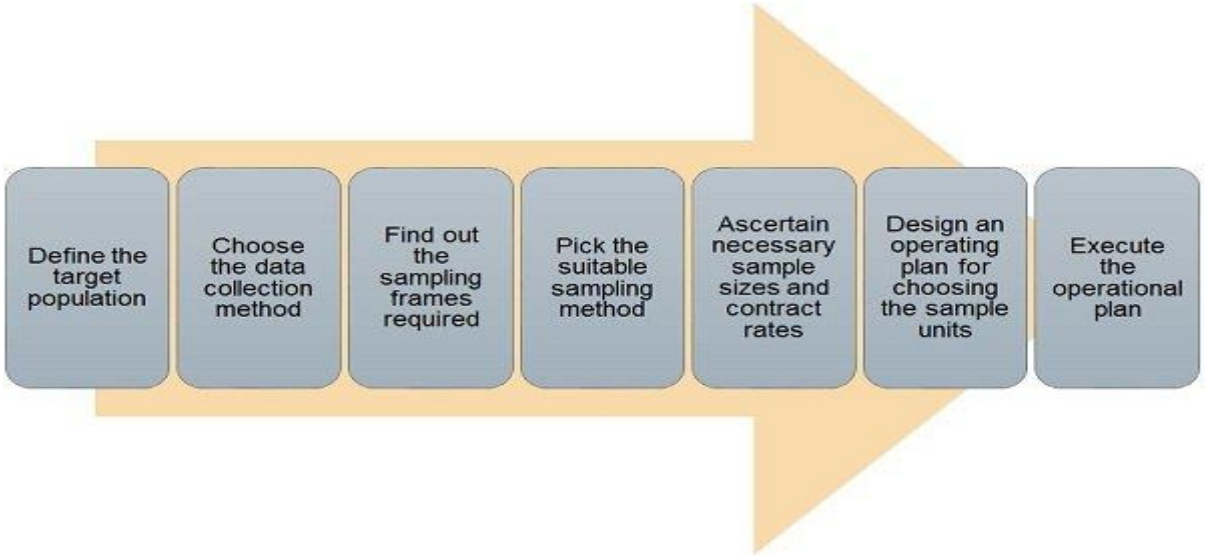
5. **Snowball sampling:**
   Snowball sampling helps researchers find a sample when they are difficult to locate. Researchers use this technique when the sample size is small and not easily available. This sampling system works like the referral program. Once the researchers find suitable subjects, he asks them for assistance to seek similar subjects to form a considerably good size sample.

Sample Plan

A sampling plan is a detailed outline of which measurements will be taken at what times, on which material, in what manner, and by whom. Sampling plans should be designed in such a way that the resulting data will contain a representative sample of the parameters of interest.

Steps involved in the preparation of Sampling Plan

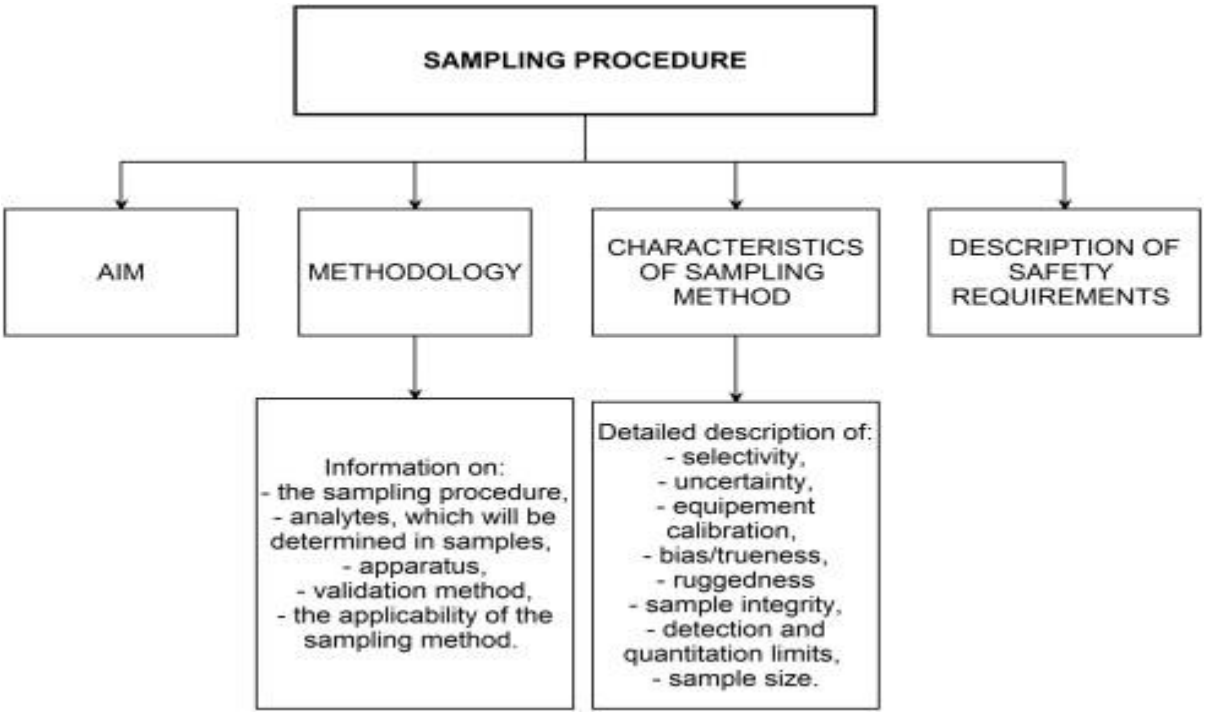
1. Identify the parameters to be measured, the range of possible values, and the required resolution
2. Design a sampling scheme that details how and when samples will be taken
3. Select sample sizes
4. Design data storage formats
5. Assign roles and responsibilities



Sample Preparation

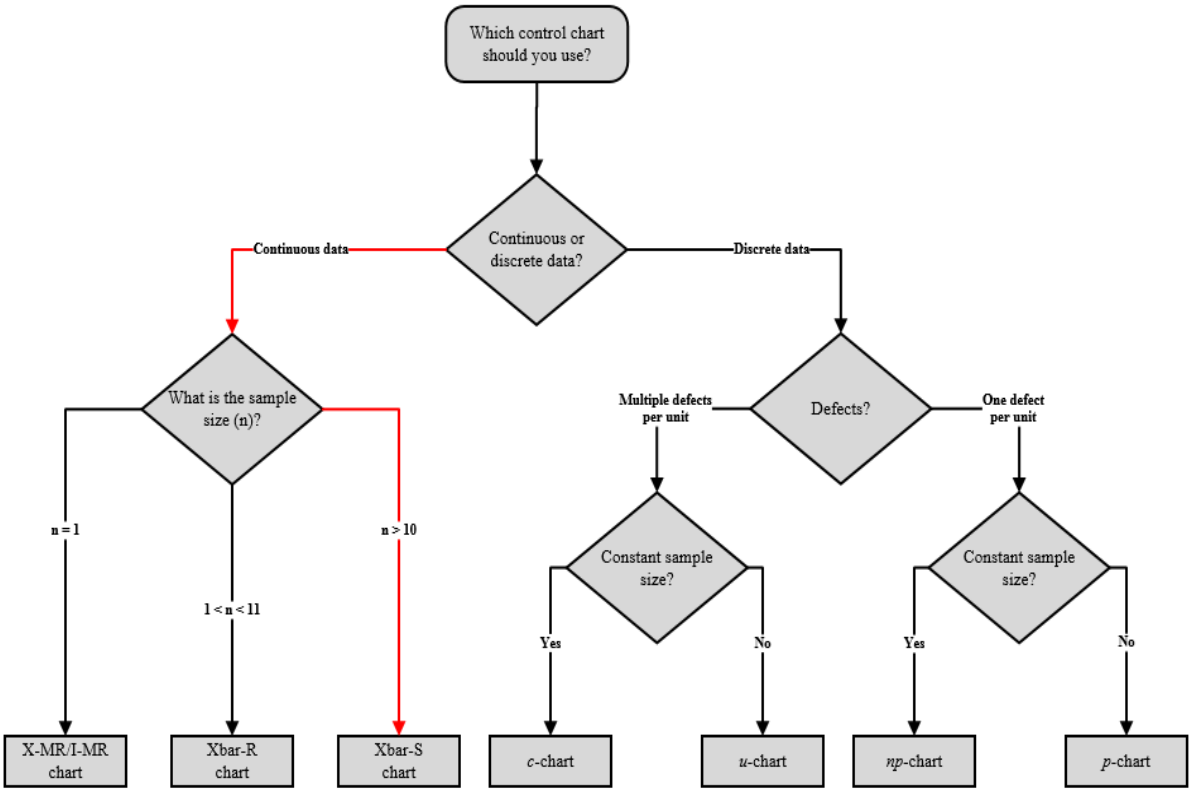
Sampling and sample preparation are the mean steps for the good analytical results because the results of the experiments depend on the quality of the starting material. The sample needs to be both representative, homogeneous, and with an even surface in order to eliminate factors that can influence the results.

Sampling Procedure



CONTROL CHARTS

The control chart is a graph used to study how a process changes over time. Data are plotted in time order. A control chart always has a central line for the average, an upper line for the upper control limit, and a lower line for the lower control limit. These lines are determined from historical data.



Control Chart for variables

Variables control charts plot continuous measurement process data, such as length or pressure, in a time-ordered sequence. In contrast, attribute control charts plot count data, such as the number of defects or defective units. Variable charts are meant for variable type of data. X bar and R Chart, X bar and sigma chart, chart for the individual units. Attribute charts are meant for attribute type of data.

X Bar R Control Chart Definitions

X-bar chart:

The mean or average change in a process over time from subgroup values. The control limits on the X-Bar bring the sample's mean and centre into consideration.

R-chart:

The range of the process over time from subgroups values. This monitors the spread of the process over time.

Hedonic Scale of Food Rating

The 9-point hedonic scale has been used routinely in food science, the same way for 60 years. Now, with advances in technology, data from the scale are being used for more and more complex programs for statistical analysis and modelling. Accordingly, it is worth reconsidering the presentation protocols and the analyses associated with the scale, as well as some alternatives.

Attributes	9 Like extremely	8 Like very much	7 Like	6 Like slightly	5 Nether like or dislike	4 Dislike slightly	3 Dislike moderately	2 Dislike	1 Dislike extremely
Appearance									
Flavor/taste									
Aroma									
Texture of Insulin Plant leaves pesto sauce									
Texture of Zucchini Noodles									
Overall acceptability									

UNIT 4

FOOD SAFETY ON GLOBAL TRADE

WORLD TRADE ORDER

The World Trade Organization (WTO) is the only global international organization dealing with the rules of trade between nations. At its heart are the WTO agreements, negotiated and signed by the bulk of the world's trading nations and ratified in their parliaments.

Functions of WTO

- Operating under the principle of non-discrimination, WTO lowers the trade barriers across countries to regulate trade through negotiations. It results in lower cost of production which leads to lower cost of finished goods thereby reducing the cost of living.
- WTO functions as a negotiator between countries by making rules that are acceptable to all. Further, it also provides a dispute resolution channel between countries.
- It cuts the cost of doing business internationally; and also stimulates economic growth and development.
- WTO encourages good governance by encouraging transparency in trade transactions.
- It helps developing countries foster their economies by providing a level playing field for developing trade relations across countries.

The broad reach of WTO and its functions have been mentioned below.

- **Implementation of Rules for Review of Trade Policy**

  The international rules of trade provide stability and assurance and lead to a general consensus among member countries. The policies are reviewed to ensure that even with the ever-changing trading scenarios, the multilateral trading system thrives. It also helps in the facilitation of a transparent and stable framework for conducting business.

- **Forum for Member Countries Discuss Future Strategies**

  The WTO, as a forum, allows for trade negotiations in the multilateral trading system. In the absence of trade negotiations, growth may stunt, and issues related to tariff and dumping may go unaddressed. Further liberalization of trade is also subject to consistent trade negotiations.

- **Implementing and Administering Bilateral and Multilateral Trade Agreements**

  The bilateral or multilateral trade agreements have to be necessarily ratified by the parliaments of respective member countries. Unless such ratification comes through, the non-discriminatory trading system cannot be put into practice. The executed agreements will ensure that every member is guaranteed to be treated fairly in other members' markets.

- **Trade Dispute Settlement**

  The dispute settlement by the WTO is concerned with the resolution of trade disputes. Independent experts of the tribunal interpret the agreements and give out judgment mentioning the due commitments of the concerned member states. It is encouraged to settle the disputes by way of consultation among the members as well.

- **Optimal Utilization of the World's Resources**

  Resources across the world can be further optimally utilized by harnessing the trade capacities of the developing economies. It requires special provisions in the WTO agreements for the least-developed economies. Such measures may include providing greater trading opportunities, longer duration to implement commitments, and also support to build the sue infrastructure.

Codex Alimentarius

The Codex Alimentarius, or "Food Code" is a collection of standards, guidelines and codes of practice adopted by the Codex Alimentarius Commission. Codex standards ensure that food is safe and can be traded. The 188 Codex members have negotiated science-based recommendations in all areas related to food safety and quality. Codex food safety texts are a reference in WTO trade disputes.

Segments Under Codex Alimentarius

Current Issues Under Consideration

- Physical Activity and Nutrition.
- Overweight and Obesity.
- Tobacco.
- Substance Abuse.
- HIV/AIDS.
- Mental Health.
- Injury and Violence.
- Environmental Quality.

International Food Standard

IFS Food is an international standard for assessing product and process compliance in relation to food safety and quality. The IFS Food standard applies to suppliers at all steps of food

processing subsequent to the agricultural stage. IFS food meets the criteria of the Global Food Safety Initiative

ISO 9000

- ISO (International Organization for Standardization) is a worldwide federation of national standards bodies, at present comprising 140 members, one in each country.
- The object of ISO is to promote the development of standardization and related activities in the world with a view to facilitating international exchange of goods and services, and to developing cooperation in the spheres of intellectual, scientific, technological and economic activity.
- The results of ISO technical work are published as International Standards.
- ISO 9000 is for standardization for quality management and quality assurance with a main focus on finding and preventing nonconformities during production and supply process and preventing their recurring appearance.

The family of ISO 9000 standards is made up of four core standards:

a. ISO 9000:2000 – Fundamentals and Vocabulary
b. ISO 9001:2000 – Quality Management Systems – Requirements
c. ISO 9004:2000 – Quality Management Systems – Guidelines for performance improvements
d. ISO 19011: 2002 – Guidelines for quality and/or environmental management systems auditing

ISO in India : Bureau of Indian standards represents (BIS)India in ISO. The Technical Committee (TC) number 176 (ISO/TC 176), and its Sub-committees of ISO are responsible for the development of ISO 9000 standards.

BIS has adopted the ISO 9000 standards and they are numbered as

a. **IS/ISO 9000:2000;**
b. **IS/ISO 9001:2000;**
c. **IS/ISO 9004:2000;**
d. **IS/ISO 19011:2002.**

These standards published by BIS are same as ISO 9000 standards. BIS also provides certification against IS/ISO 9001:2000 under its Management Systems Certification activity.

The system has detailed 20 requirements to be addressed and controlled:

1. Management responsibility
2. System for quality documentation management
3. Contracts overhaul
4. Design control
5. Data and documentation control
6. Purchase (materials, skills and services)
7. Control of production and data provided by the customer
8. Product identification and traceability
9. Control of processing
10. Inspection and tests
11. Inspection, measuring, and test instruments
12. Status of inspection and test procedures
13. Control of non-conformable products
14. Correction and prevention measures
15. Processing, storage, packing, conservation and supply
16. Quality assurance documentation archive
17. Internal quality supervision
18. Training

19. Service and maintenance
20. Statistical methods

WORLD HEALTH ORGANISATION

WHO is the directing and coordinating authority for health within the United Nations system. It is responsible for providing leadership on global health matters, shaping the health research agenda, setting norms and standards, articulating evidence-based policy options, providing technical support to countries and monitoring, and assessing health trends. WHO operates in an increasingly complex and rapidly changing landscape. The boundaries of public health action have become blurred, extending into other sectors that influence health opportunities and outcomes. WHO responds to these challenges using a six-point agenda. The six points address two health objectives, two strategic needs, and two operational approaches. The overall performance of WHO will be measured by the impact of its work on women's health and health in Africa.

1. Promoting development

During the past decade, health has achieved unprecedented prominence as a key driver of socioeconomic progress, and more resources than ever are being invested in health. Yet poverty continues to contribute to poor health, and poor health anchors large populations in poverty. Health development is directed by the ethical principle of equity: Access to life-saving or health-promoting interventions should not be denied for unfair reasons, including those with economic or social roots. Commitment to this principle ensures that WHO activities aimed at health development give priority to health outcomes in poor, disadvantaged or vulnerable groups. Attainment of the health-related Millennium Development Goals, preventing and treating chronic diseases and addressing the neglected tropical diseases are the cornerstones of the health and development agenda.

2. Fostering health security

Shared vulnerability to health security threats demands collective action. One of the greatest threats to international health security arises from outbreaks of emerging and epidemic-prone diseases. Such outbreaks are occurring in increasing numbers, fuelled by such factors as rapid urbanization, environmental mismanagement, the way food is produced and traded, and the way antibiotics are used and misused. The world's ability to defend itself collectively against outbreaks has been strengthened since June 2007, when the revised International Health Regulations came into force.

3. Strengthening health systems

For health improvement to operate as a poverty-reduction strategy, health services must reach poor and underserved populations. Health systems in many parts of the world are unable to do so, making the strengthening of health systems a high priority for WHO. Areas being addressed include the provision of adequate numbers of appropriately trained staff, sufficient financing, suitable systems for collecting vital statistics, and access to appropriate technology including essential drugs.

4. Harnessing research, information, and evidence

Evidence provides the foundation for setting priorities, defining strategies, and measuring results. WHO generates authoritative health information, in consultation with leading experts, to set norms and standards, articulate evidence-based policy options and monitor the evolving global heath situation.

5. Enhancing partnerships

WHO carries out its work with the support and collaboration of many partners, including UN agencies and other international organizations, donors, civil society and the private sector. WHO uses the strategic power of evidence to encourage partners implementing programmes

within countries to align their activities with best technical guidelines and practices, as well as with the priorities established by countries.

6. Improving performance

WHO participates in ongoing reforms aimed at improving its efficiency and effectiveness, both at the international level and within countries. WHO aims to ensure that its strongest asset – its staff – works in an environment that is motivating and rewarding. WHO plans its budget and activities through results-based management, with clear expected results to measure performance at country, regional and international levels.

The role of WHO in public health

WHO fulfils its objectives through its core functions:

- providing leadership on matters critical to health and engaging in partnerships where joint action is needed.
- shaping the research agenda and stimulating the generation, translation, and dissemination of valuable knowledge.
- setting norms and standards and promoting and monitoring their implementation.
- articulating ethical and evidence-based policy options.
- providing technical support, catalysing change, and building sustainable institutional capacity; and
- monitoring the health situation and assessing health trends.

SAFETY OF GM FOODS

A GMO (genetically modified organism) is a plant, animal, or microorganism that has had its genetic material (DNA) changed using technology that generally involves the specific modification of DNA, including the transfer of specific DNA from one organism to another. Scientists often refer to this process as genetic engineering.

LABELLING OF GM FOODS

Labelling provides information for consumers and allows them to make an informed choice. In the case of **pre-packaged GM food/feed products**, the **list of ingredients must indicate "*genetically modified*"** or "*produced from genetically modified [name of the organism]".* In the case of products without packaging these words must still be clearly displayed near the product (e.g a note on the supermarket shelf).

These labelling requirements do not apply to GM food/feed products in a proportion no higher than 0.9 percent of the food/feed ingredients considered individually and if this presence is adventitious or technically unavoidable. In 2006, India proposed a draft rule requiring the labelling of all genetically modified (GM) foods and products derived thereof. In this paper, we use primary and secondary market data to assess the economic implications of introducing such a mandatory labelling policy for GM food. We focus on four products that would likely be the first affected by such a regulation in India: cottonseed oil, soybean oil, brinjal (eggplant), and rice. We find that GM food labelling would generate a specific market outcome for each of these products.

With GM labelling, virtually all cottonseed oil would be labelled as GM, with limited costs for all actors involved, but also limited benefit for consumers. Labelling soybean oil derived from GM crops could affect market shares for edible oils at the benefit of domestic oils, and non-GM soybean oil could appear on the market at a very limited scale. Labelling GM brinjal would be extremely challenging.

EXAMPLE OF A GMO LABEL

Assuming it was implemented, some non-GM brinjal would be sold at a premium in high-income retail outlets, while virtually all others would be labelled GM. A similar outcome would occur for rice, with high-quality rice used for both domestic consumption and exports markets certified non-GM and most of the remaining rice labelled as GM. In each of the cases, labelling would generate significant adjustment costs for the industry and large enforcement costs, and consumer benefit would not always be visible and would highly depend on the degree of enforcement.

In fact, voluntary labelling could achieve less-distorted results with lower costs and therefore appears to be a superior regulatory solution. Still, provided enforcement is ensured, a well-designed mandatory labelling regulation with limited product coverage, a non-zero labelling threshold, and an informative labelling content would lead to a much better outcome and lower costs in India than the current draft rule, especially if it is accompanied by a large awareness campaign regarding GM food and consumer safety in India.

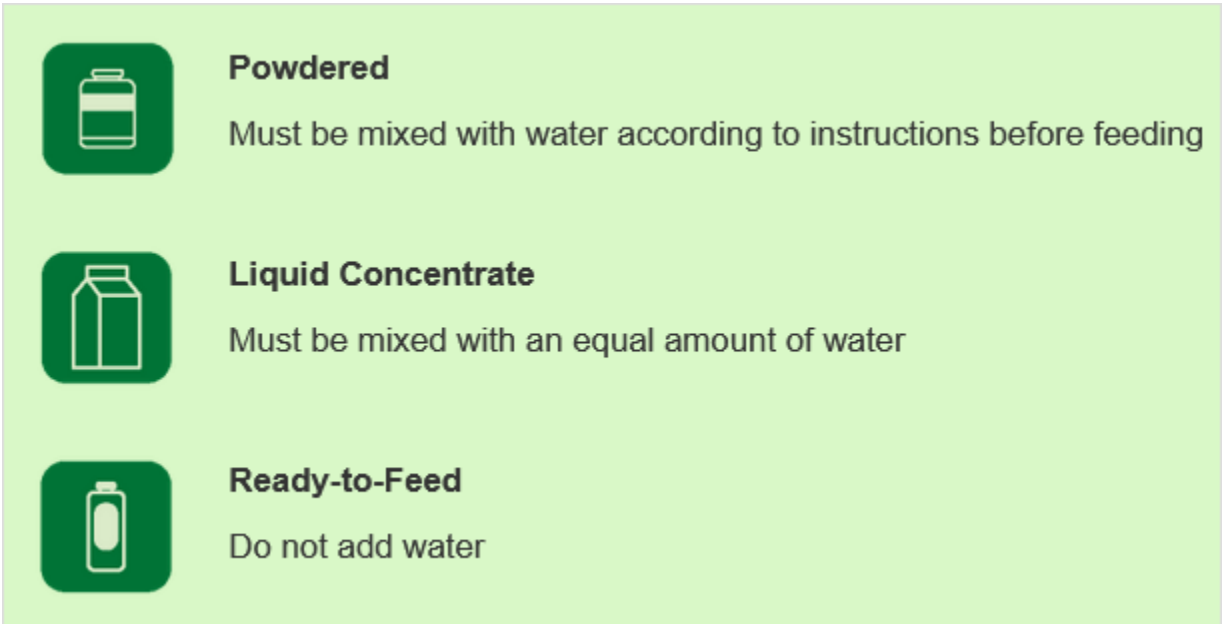
UNIT V

SPECIAL FOODS SAFETY, HEALTH CLAIMS AND LABELLING

HEALTH AND FOOD SAFETY CLAIMS

Infant Foods

Once an infant formula product is formulated, current laws require that the manufacturer must provide FDA assurance of the nutritional quality of that formulation before marketing the infant formula. FDA has provisions that include requirements for certain labeling, nutrient content, manufacturers quality control procedures (to assure the nutrient content of infant formulas), as well as company records and reports. Based on the nutritional needs of infants, FDA requires minimum amounts for 30 nutrients. FDA sets maximum amounts for 10 of those nutrients that can be harmful to an infant's growth and development in high amounts, such as Vitamins A and D. Some infant formulas are made and labeled for infants that have certain medical conditions, such as metabolism issues, low birth weight, or an unusual medical or dietary problem. These specialized formulas do not have to meet these requirements.



Formulated Foods

A formulated product consists of a minimum of two, but often many more, ingredients selected, processed and combined in a specific manner to provide a product with the desired properties. Properties that differ from those of the individual ingredients alone. Describing the role of nutrients in the functioning of the body. Other Function Claims- describing beneficial effects of food or constituent in normal body functioning or bringing a positive contribution to health.

SPECIAL DIEATRY FOODS

Foods for special dietary use can be beneficial because (unlike medical foods) they are widely available. They also may have fewer side effects than pharmaceuticals, and your body digests them similarly to the way it digests conventional food. You don't need any sort of medical supervision to purchase and consume them the common types of special diets are,

- Gluten free and coeliac.
- Dairy free and lactose free.
- Vegetarian.
- Vegan.
- Paleo.
- FODMAP.
- Tree nut and peanut allergies.
- Fish and shellfish allergies.

THERAPUTIC FOODS

Therapeutic foods are prepared foods that provide calories and nutrients in easily accessible packaging. They are useful in the fight against childhood malnutrition. Ready-to-use therapeutic foods (RUTF) are a type of therapeutic food that provides carbohydrates, proteins, fats, vitamins and minerals. There are multiple examples of therapeutic foods currently used around the world. A few examples are Nutri bun, Medika Mamba, BP-100, K-Mix 2, and Citadel. All of these foods are used to treat malnutrition.

FORTIFIED FOODS

Fortified foods have added vitamins, minerals, and other micronutrients. Micronutrients are necessary for many important body functions. Your body can't make its own micronutrients. They need to come from your diet. Food makers add micronutrients to their products during production. They create chemicals that have vitamins and minerals. These chemicals don't have noticeable tastes, textures, or smells when added to food. Some foods naturally have certain micronutrients but lose them through cooking or storage. Food enrichment is when food producers add those nutrients back in. Unlike enriched foods, fortified foods don't naturally include those nutrients. Most fortified foods are processed and packaged. Common ones include:

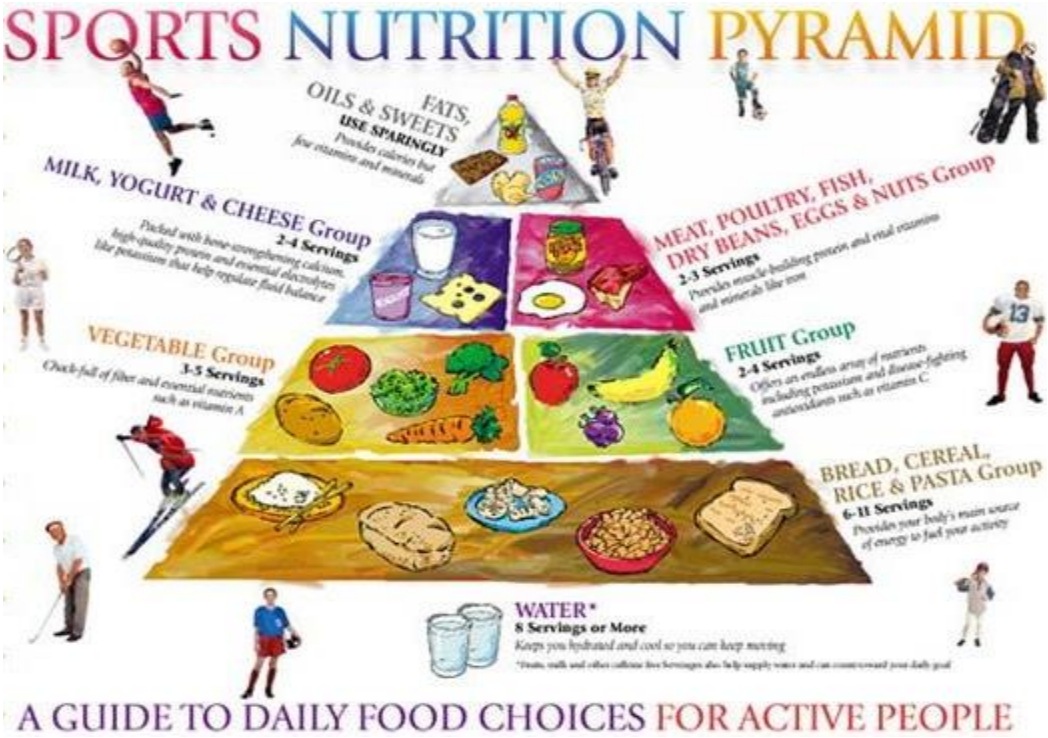
- Breakfast cereals
- Bread
- Eggs
- Fruit juice
- Soy milk and other milk alternatives
- Milk
- Yogurt
- Salt

Nutrients added to fortified foods include:

- Folic acid
- Vitamin A
- Vitamin B6
- Vitamin B12
- Calcium
- Vitamin D
- Vitamin E
- Iron
- Iodine

SPORTS NUTRITION

Sports nutrition focuses its studies on the type, as well as the quantity of fluids and food taken by an athlete. In addition, it deals with the consumption of nutrients such as vitamins, minerals, supplements, and organic substances that include carbohydrates, proteins, and fats. An ideal diet comprises 45% to 65% carbohydrates, 10% to 30% protein and 25% to 35% fat. Fluids are very important for maintaining hydration and should be consumed before, during and after athletic events to prevent dehydration.



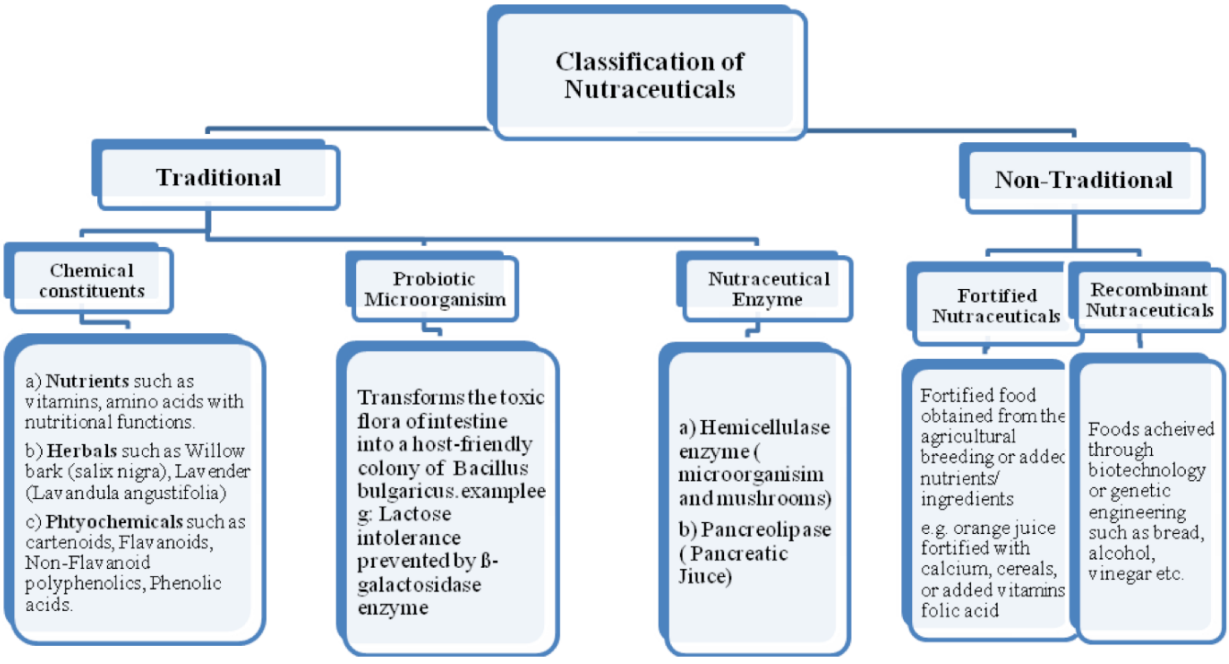
PROBIOTICS AND PREBIOTICS

Prebiotics	Probiotics
Prebiotics are defined as nonliving nondigestible special from of fiber or carbohydrates	Probiotics are referred to as live active microorganisms that when administered in administered in adequate amount will have beneficial effects to its host
The powder form of prebiotics can survive heat, cold, and acid	More fragile Vulnerable to heat Maybe killed over time
Prebiotics perform their role by nourishing the bacteria that live in the intestines	Probiotics fight the harmful bacterial species present in the gut

Probiotics are foods or supplements that contain live microorganisms intended to maintain or improve the "good" bacteria (normal microflora) in the body. Prebiotics are foods (typically high-fiber foods) that act as food for human microflora. The most used probiotic strains include the lactic acid bacteria (LAB), Gram-positive microbes that have been used for centuries in food production processes. Prebiotic was described as “a non-digestible food ingredient that beneficially affects the host by selectively stimulating the growth and/or activity of one or a limited number of bacteria in the colon, and thus improves host health Some prebiotic ingredients, such as resistant starch, wheat dextrin, and polydextrose are less likely to cause symptoms. Others, such as inulin, sometimes cause symptoms, especially when used in large amounts.

NUTRACEUTICALS AND FUNCTIONAL FOODS

Nutraceuticals or functional foods can be classified based on their natural sources, pharmacological conditions, or as per chemical constitution of the products. Based on natural source, it can be classified as the products obtained from plants, animals, minerals, or microbial sources. A functional food for one consumer can act as a nutraceutical for another consumer. Examples of nutraceuticals include fortified dairy products (e.g., milk) and citrus fruits (e.g., orange juice), Several naturally derived food substances have been studied in cancer therapies.



FOOD SAFETY IN FOOD BUSINESS

Good food hygiene ensures that food prepared for customers is safe to eat. It prevents harmful microorganisms that can cause serious illness from contaminating food, prevents cross contamination, enables businesses to comply with the law, and protects the reputation of the business.

APPLICATION OF CURRENT HYGENIC PRACTISES IN FOOD INDUSTRIES

The codex general principles of food hygiene

- identify the *essential* principles of food hygiene applicable *throughout the food chain* (including primary production through to the final consumer), to achieve the goal of ensuring that food is safe and suitable for human consumption.
- recommend a HACCP-based approach to enhance food safety.
- indicate *how* to implement those principles; and
- provide guidance for specific codes which may be needed for - sectors of the food chain, processes; or commodities; to amplify the hygiene requirements specific to those areas.