FSQR BOOK Final - Notes

Computer Science and Engineering (Anna University)

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COLLEGE OF ENGINEERING

(AUTONOMOUS) - HOSUR

DEPARTMENT OF CHEMISTRY

OFD355 – FOOD SAFETY AND QUALITY REGULATIOS

NAME : _____

REG.NO. : _____

DEPT. : _____

SECTION: _____

OFD355 FOOD SAFETY AND QUALITY REGULATIONS L T P C
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COURSE OBJECTIVES:

- To characterize different type of food hazards, physical, chemical and biological in the industry and food service establishments
- To help become skilled in systems for food safety surveillance
- To be aware of the regulatory and statutory bodies in India and the world
- To ensure processed food meets global standards

UNIT I **10**

Introduction to food safety and security: Hygienic design of food plants and equipments, Food Contaminants (Microbial, Chemical, Physical), Food Adulteration (Common adulterants), Food Additives (functional role, safety issues), Food Packaging & labeling. Sanitation in warehousing, storage, shipping, receiving, containers and packaging materials. Control of rats, rodents, mice, birds, insects and microbes. Cleaning and Disinfection, ISO 22000 – Importance and Implementation

UNIT II **8**

Food quality: Various Quality attributes of food, Instrumental, chemical and microbial Quality control. Sensory evaluation of food and statistical analysis. Water quality and other utilities.

UNIT III **9**

Critical Quality control point in different stages of production including raw materials and processing materials. Food Quality and Quality control including the HACCP system. Food inspection and Food Law, Risk assessment – microbial risk assessment, dose response and exposure response modelling, risk management, implementation of food surveillance system to monitor food safety, risk communication

UNIT IV **9**

Indian and global regulations: FAO in India, Technical Cooperation programmes, Bio-security in Food and Agriculture, World Health Organization (WHO), World Animal Health Organization (OIE), International Plant Protection Convention (IPPC)

UNIT V **9**

Codex Alimentarius Commission - Codex India – Role of Codex Contact point, National Codex contact point (NCCP), National Codex Committee of India – ToR, Functions, Shadow Committees etc.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1 Thorough Knowledge of food hazards, physical, chemical and biological in the industry and food service establishments

CO2 Awareness on regulatory and statutory bodies in India and the world

REFERENCES:

1. Handbook of food toxicology by S. S. Deshpande, 2002
2. The food safety information handbook by Cynthia A. Robert, 2009
3. Nutritional and safety aspects of food processing by Tannenbaum SR, Marcel Dekker Inc., New York 1979
4. Microbiological safety of Food by Hobbs BC, 1973
5. Food Safety Handbook by Ronald H. Schmidt, Gary E. Rodrick, A John Wiley & Sons Publication, 2003

UNIT - I

What is Food?

- Food is a complex mixture of nutrients, including water, carbohydrates, proteins, fats, vitamins, minerals, and roughage.
- These components sustain life and are essential for our well-being.
- Some foods are consumed as- it is, while others undergo processing (such as cooking or storage) before consumption.

Introduction to Food Safety

- Food safety refers to the handling, preparation, and storage of food in ways that prevent foodborne illness and ensure that food remains safe to eat.
- It involves various practices, procedures, and regulations aimed at reducing the risk of contamination, spoilage, and other health hazards associated with food.

Introduction to Food Security

- Food security exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life.

Definition of Food Safety

- Food safety means assurance that food is acceptable for human consumption according to its intended use.
- Food safety refers to handling, preparing and storing food in a way to best reduce the risk of individuals becoming sick from foodborne illness.
- Food safety refers to the conditions and practices that preserve the quality of food to prevent contamination and foodborne illnesses.

Definition of Food Security

- Food security exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life.

Hygienic Design of Food Plants

- Hygienic design plays a critical role in ensuring food safety, preventing contamination, and maintaining product quality in food processing facilities.

Definition:

- Hygienic design refers to the design of equipment, facilities, and processes in a way that minimizes the risk of food contamination, facilitates effective cleaning, and ensures hygienic conditions throughout the production process.

Objectives:

- Ensure sanitary conditions, prevent microbial growth, minimize allergen cross-contact, and protect food products from physical and chemical hazards.

Key Principles of Hygienic Design

Smooth and Cleanable Surfaces:

- Design equipment and surfaces with smooth, non-porous materials (e.g., stainless steel) that are easy to clean and disinfect.
- Avoid crevices, seams, and areas where dirt and microorganisms can accumulate.

Minimize Standing Water and Condensation:

- Ensure proper drainage and slope surfaces to prevent pooling of water, which can harbour bacteria and facilitate cross-contamination.

Access for Inspection and Cleaning:

- Design equipment and facilities to allow easy access for cleaning, maintenance, and inspection of all surfaces, including under and behind equipment.

Compatibility with Cleaning Agents:

- Select materials and finishes that are resistant to cleaning chemicals and sanitizers used in food processing, without compromising their effectiveness.

Equipment and Facility Design Considerations

Layout and Flow:

- Plan the layout to minimize the movement of personnel, equipment, and materials between different processing areas, reducing the risk of contamination.

Segregation of Processes:

- Separate raw and cooked food processing areas, implement barriers (e.g., air curtains, physical partitions) to prevent cross-contamination.

Air Quality and Ventilation:

- Install effective ventilation systems to control airborne contaminants and maintain positive pressure in sensitive areas (e.g., packaging) to prevent ingress of contaminants.

Sanitary Design Requirements

Equipment Design:

- Ensure equipment is designed with rounded corners, sloped surfaces, and sealed joints to facilitate complete drainage and prevent bacterial growth.

Piping and Conduits:

- Use hygienic piping and conduits that are easy to clean, sanitize, and inspect. Avoid dead legs, pockets, and valves that can trap product or bacteria.

Seals and Gaskets:

- Select seals and gaskets made from food-grade materials that are resistant to degradation from cleaning chemicals and do not pose a risk of contamination.

Hygienic Practices and Standards

Compliance with Regulations:

- Ensure compliance with food safety regulations, industry standards (e.g., FDA, EU regulations), and guidelines specific to hygienic design and food processing.

Documentation and Validation:

- Maintain detailed documentation of hygienic design specifications, cleaning procedures, validation of cleaning effectiveness, and preventive maintenance schedules.

Training and Awareness

Employee Training:

- Train personnel on hygienic design principles, proper cleaning techniques, sanitation procedures, and the importance of maintaining hygienic conditions in food processing.

Continuous Improvement:

- Encourage a culture of continuous improvement by soliciting feedback from employees, conducting audits, and implementing corrective actions to address identified issues.

Risk Assessment and Management

Hazard Analysis:

- Conduct hazard analysis to identify potential risks associated with equipment design, materials, and processes.
- Implement controls to mitigate identified risks.

Preventive Controls:

- Establish preventive controls, such as monitoring critical control points (CCPs), to prevent contamination and ensure compliance with food safety objectives.

Audits and Verification

Internal Audits:

- Conduct regular internal audits to verify compliance with hygienic design standards, assess effectiveness of cleaning procedures, and identify areas for improvement.

External Audits:

- Prepare for and participate in external audits conducted by regulatory authorities or certification bodies to achieve and maintain compliance with industry standards.

Hygienic Design of Equipment in Food Processing

- Hygienic design of equipment is crucial in ensuring food safety, preventing contamination, and maintaining product quality throughout the food processing chain.

Importance of Hygienic Design

Food Safety Assurance:

- Ensures equipment is designed to prevent microbial growth, contamination, and allergen cross-contact during food processing.

Quality Maintenance:

- Helps maintain product integrity, taste, texture, and nutritional value by minimizing exposure to contaminants and maintaining hygienic conditions.

Regulatory Compliance:

- Meets food safety standards and regulations (e.g., FDA, EU regulations) to ensure consumer protection and compliance with legal requirements.

Key Principles of Hygienic Design

Smooth and Cleanable Surfaces:

- Design equipment with smooth, non-porous surfaces (e.g., stainless steel) to prevent microbial adhesion and facilitate easy cleaning and disinfection.
- Avoid crevices, joints, and rough surfaces where dirt, debris, and microorganisms can accumulate.

Accessibility for Cleaning:

- Ensure equipment is designed with accessibility for thorough cleaning and sanitation.
- Design features should allow easy disassembly and access to all components for cleaning purposes.

Material Selection:

- Use food-grade materials that are resistant to corrosion, degradation, and chemical reactions with food products and cleaning agents.
- Materials should be durable, non-toxic, and suitable for high-temperature applications if necessary.

Minimize Ledges and Dead Spaces:

- Design equipment to minimize ledges, dead spaces, and hollow areas where food particles and contaminants can accumulate.
- Ensure all areas are easily visible and accessible for inspection and cleaning.

Specific Design Considerations

Seals and Gaskets:

- Select seals and gaskets made from food-grade materials that are resistant to cleaning chemicals and do not pose a risk of contamination.
- Ensure seals are designed to be easily accessible and replaceable to maintain integrity over time.

Hygienic Connections:

- Use hygienic fittings and connections (e.g., sanitary fittings, tri-clamp connections) that prevent leaks and minimize the risk of microbial ingress during operation and cleaning.

Drainage and Water Management:

- Ensure equipment is designed with adequate drainage systems to prevent pooling of water and facilitate complete drainage after cleaning.
- Slope surfaces appropriately to prevent stagnant water and minimize the risk of microbial growth.

Integration with Cleaning Systems:

- Integrate equipment with cleaning-in-place (CIP) systems where possible to automate cleaning processes and ensure consistent sanitation of internal surfaces.

Validation and Verification

Cleaning Validation:

- Conduct validation studies to ensure cleaning procedures effectively remove contaminants, allergens, and microbial residues from equipment surfaces.
- Use techniques such as swab testing, ATP (Adenosine Triphosphate) testing, and visual inspection to verify cleanliness.

Microbiological Monitoring:

- Implement regular microbiological monitoring and environmental sampling of equipment surfaces to verify hygiene standards are maintained.

- Set action limits for microbial counts to ensure equipment cleanliness meets acceptable levels.

Training and Documentation

Training Programs:

- Provide training to personnel on hygienic design principles, proper cleaning procedures, and the importance of equipment hygiene in food safety.
- Ensure operators are trained to recognize equipment wear, damage, or contamination risks.

Documentation and Records:

- Maintain detailed records of equipment specifications, maintenance schedules, cleaning procedures, and validation results.
- Document any modifications or repairs made to equipment to ensure traceability and compliance with food safety standards.

Regulatory Compliance and Audits

Compliance with Standards:

- Ensure equipment design and maintenance practices comply with relevant food safety regulations, industry standards, and guidelines.
- Prepare for and participate in audits conducted by regulatory authorities or certification bodies to demonstrate compliance with hygienic design principles.

Continuous Improvement

Feedback and Adaptation:

- Encourage feedback from operators and maintenance personnel on equipment performance and hygiene challenges.
- Implement corrective actions and continuous improvement initiatives based on feedback, audit findings, and emerging best practices in hygienic design.

Food Contaminants (Microbial, Chemical, Physical)

Microbial Contaminants in Food

- Microbial contaminants in food pose significant risks to public health, potentially causing foodborne illnesses and outbreaks.

Definition:

- Microbial contaminants in food refer to microorganisms such as bacteria, viruses, fungi, and parasites that can contaminate food during production, processing, handling, or storage.

Sources:

- Contamination can originate from raw materials, water, soil, air, equipment, and personnel involved in food production and distribution.

Types of Microbial Contaminants

Bacteria:

Pathogenic Bacteria:

- Examples include Salmonella, Escherichia coli (E. coli), Listeria monocytogenes, Campylobacter spp., and Staphylococcus aureus.

Spoilage Bacteria:

- Cause food spoilage but may not necessarily cause illness.
- Examples include Pseudomonas, Bacillus, and Clostridium species.

Viruses:

- Small infectious agents that require a host to replicate.
- Examples include Norovirus, Hepatitis A virus, and Rotavirus.
- Often associated with human fecal contamination.

Fungi:

- Includes molds and yeast. Some molds produce mycotoxins, which can be toxic if ingested in sufficient quantities.
- Examples include Aspergillus, Penicillium, and Fusarium species.

Parasites:

- Organisms that live on or inside a host organism. Parasites in food are typically protozoa and helminths (worms).
- Examples include Cryptosporidium, Giardia, and Trichinella.

Factors Affecting Microbial Growth in Food

Temperature:

- Temperature abuse (e.g., improper storage temperatures) can promote microbial growth.

pH:

- pH levels can influence microbial growth. Some microorganisms thrive in acidic conditions (e.g., molds), while others prefer neutral or alkaline environments.

Water Activity (aw):

- The availability of water in food affects microbial growth.
- Lower water activity inhibits microbial growth, while higher levels promote it.

Nutrient Availability:

- Microorganisms require nutrients (e.g., proteins, carbohydrates) for growth.
- Food components can support microbial proliferation if conditions are favourable.

Health Risks Associated with Microbial Contaminants

Foodborne Illnesses:

- Consumption of contaminated food can lead to foodborne illnesses (food poisoning) characterized by symptoms such as diarrhea, vomiting, abdominal pain, fever, and in severe cases, organ failure or death.

Allergenic Reactions:

- Some microbial contaminants may produce allergens that can trigger allergic reactions in susceptible individuals.

Toxicity:

- Certain microorganisms produce toxins (e.g., bacterial toxins, mycotoxins) that can cause foodborne intoxications, affecting the nervous system, kidneys, or liver.

Control Measures for Microbial Contaminants

Good Manufacturing Practices (GMPs):

- Implement hygiene practices, employee training, and sanitation protocols to prevent microbial contamination during food handling, processing, and packaging.

Hazard Analysis Critical Control Points (HACCP):

- Identify critical control points (CCPs) in food production where measures can be applied to prevent, eliminate, or reduce microbial hazards to acceptable levels.

Sanitation and Hygiene Practices:

- Maintain clean and sanitized food processing environments, equipment, and utensils to prevent cross-contamination and microbial growth.

Temperature Control:

- Monitor and control temperatures during food storage, processing, and transportation to inhibit microbial growth and ensure food safety.

Water Quality Management:

- Ensure water used in food production meets microbiological safety standards to prevent microbial contamination.

Food Packaging and Preservation:

- Use packaging materials and methods that maintain food quality and inhibit microbial growth (e.g., modified atmosphere packaging, vacuum packaging).

Microbiological Testing and Monitoring:

- Conduct regular microbiological testing of raw materials, finished products, and food contact surfaces to detect and control microbial contaminants.

Effects of Food poisoning

- Headache, Muscle pain,
- Nausea, Fatigue,
- Chills or fever,
- Stomach or abdominal pain,
- vomiting, diarrhea.

The foods that are commonly involved in these food poisoning incidents include

- Meat and poultry and their products,
- Seafood and seafood products,
- Egg and egg products,
- Milk and dairy products,
- Fruits and vegetables and their products,
- Low-acid canned foods and water.

Example:

Biological Hazard	Commonly Found in
Salmonella	Eggs, poultry, meat, unpasteurized milk or juice, cheese, fruits and vegetables, spices, and nuts
Norovirus	Produce, shellfish, ready-to-eat foods
Campylobacter	Raw and undercooked poultry, unpasteurized milk, contaminated water
E. coli	Undercooked ground beef, unpasteurized milk or juice, raw milk cheeses, raw fruits and vegetables, contaminated water
Listeria	Ready-to-eat deli meats and hot dogs, unpasteurized milk or juice, raw milk, cheeses

Biological Hazard Prevention

- The best way to prevent biological hazards from affecting customers is to implement robust processing and storage strategies.
- Kill steps used prior to packaging is necessary, such as cooking thoroughly or pasteurization of milk and juices.
- Use of packaging technologies during processing like vacuum sealing hinders bacterial growth.
- Proper temperature management for storage can dramatically reduce microbe growth.
- Finally, effective sanitation practices throughout the distribution chain will reduce cross-contamination of food products.

Chemical Contaminants in Food

- Chemical contaminants in food can arise from various sources and pose significant risks to human health.

Definition:

- Chemical contaminants in food refer to substances that are not intentionally added but may be present as a result of environmental contamination, processing, packaging, or food handling practices.

Sources:

- Chemical contaminants can originate from pesticides, veterinary drugs, environmental pollutants, food additives, packaging materials, and unintentional contaminants such as heavy metals and toxins.

Types of Chemical Contaminants

Pesticides:

- Chemicals used in agriculture to protect crops from pests and diseases. Residues can remain on food if not properly managed.
- **Examples**: include organophosphates, carbamates, and glyphosate.

Veterinary Drugs:

- Pharmaceuticals used in animal husbandry to treat or prevent diseases. Residues can transfer to animal-derived foods such as meat, milk, and eggs.
- **Examples** include antibiotics and growth promoters.

Environmental Pollutants:

- Chemicals released into the environment through industrial activities, waste disposal, and air or water contamination.
- **Examples** include polychlorinated biphenyls (PCBs), dioxins, and heavy metals (e.g., lead, mercury).

Food Additives:

- Substances added intentionally to food to enhance flavour, appearance, texture, or shelf life.
- **Examples** include preservatives (e.g., sulfites), artificial sweeteners (e.g., aspartame), and flavour enhancers (e.g., monosodium glutamate).

Packaging Materials:

- Chemicals from packaging materials (e.g., plasticizers, antioxidants) can migrate into food, especially under conditions of heat, prolonged storage, or acidic foods.

Natural Toxins:

- Toxins produced by plants, fungi, or marine organisms that can contaminate food if not properly identified and controlled.
- **Examples** include mycotoxins (e.g., aflatoxins), marine biotoxins (e.g., ciguatoxin), and plant toxins (e.g., solanine in potatoes).

Health Risks Associated with Chemical Contaminants

Acute Toxicity:

- Immediate health effects from high-level exposure, such as nausea, vomiting, diarrhea, and in severe cases, organ damage or death
- **Example** include acute pesticide poisoning

Chronic Effects:

- Long-term health effects from repeated exposure to low levels of contaminants over time.
- **Examples** include cancer (carcinogens), reproductive disorders, neurological effects, and developmental abnormalities.

Allergic Reactions:

- Some food additives and preservatives can trigger allergic reactions or sensitivities in susceptible individuals.

Factors Influencing Chemical Contamination

Environmental Factors:

- Pollution from industrial activities, agricultural practices, and waste disposal can contaminate soil, water sources, and air, leading to chemical residues in food.

Processing and Handling:

- Improper use of chemicals (e.g., pesticides, cleaning agents) during food processing, handling, and storage can result in contamination.

Packaging Materials:

- Chemicals in packaging materials may leach into food, especially under conditions of heat or prolonged contact.

Globalization of Food Supply:

- Challenges related to monitoring and regulating chemical contaminants in a globalized food supply chain.

Control Measures for Chemical Contaminants

Good Agricultural Practices (GAP):

- Use of integrated pest management (IPM) practices to minimize pesticide use and adhere to withdrawal periods.
- Monitoring of environmental factors to minimize contamination risks in agricultural production.

Good Manufacturing Practices (GMP):

- Implementation of hygiene practices and cleaning protocols to prevent cross-contamination with chemicals during food processing and handling.

Monitoring and Testing:

- Regular monitoring and testing of raw materials, finished products, and environmental samples for chemical residues.
- Use of analytical techniques such as chromatography, spectroscopy, and immunoassays to detect and quantify contaminants.

Regulatory Compliance:

- Adherence to national and international regulations and standards (e.g., Codex Alimentarius, FDA, EU regulations) for maximum residue limits (MRLs) of pesticides and veterinary drugs in food.

Risk Assessment and Management:

- Conducting risk assessments to identify potential chemical hazards, assess exposure levels, and implement risk management strategies to mitigate risks to consumer health.

Consumer Education:

- Providing information to consumers on safe food handling practices, awareness of potential chemical contaminants, and understanding labeling information related to food additives and contaminants.

Health effects

- Disrupt body metabolism
- Cause cancer (Ex: Aflatoxins – liver cancer)
- Damage genes
- Alter organ functions

- Affect reproduction and development
- Affect developing brains in foetuses, infants and children (Ex: mercury)

Control measures of chemical hazards

- **Prior to receipt:** Specifications
- **Upon receipt:** inspection before acceptance
- **During processing:** use approved chemicals

Physical Contaminants in Food

- Physical contaminants in food refer to foreign objects or materials that inadvertently enter food products during production, processing, packaging, or distribution.

Definition:

- Physical contaminants are foreign objects or materials that can be unintentionally introduced into food products.
- They may include pieces of glass, metal, plastic, wood, stones, insects, hair, or any other extraneous matter.

Sources:

- Physical contaminants can originate from various stages of food production and handling, including raw materials, processing equipment, packaging materials, and the environment.

Types of Physical Contaminants

Metal Contaminants:

- Examples include fragments of machinery, wires, nuts, bolts, or staples that may break off from processing equipment or packaging materials.

Glass and Ceramics:

- Pieces of glass or ceramic materials from broken equipment, light bulbs, or packaging materials.

Plastic and Rubber:

- Fragments or particles of plastic or rubber materials from packaging, equipment seals, or utensils.

Wood and Fiber:

- Splinters, chips, or fibers from wooden pallets, crates, or processing equipment.

Insects and Animal Parts:

- Whole insects, insect parts, or animal hair that may inadvertently enter food during processing or packaging.

Health Risks Associated with Physical Contaminants

Physical Injury:

- Consumption of physical contaminants can cause injury to the mouth, throat, digestive tract, or other organs.

Choking Hazard:

- Particularly dangerous for young children or elderly individuals who may choke on small or sharp objects.

Foreign Body Sensation:

- Consumers may experience discomfort or aversion upon discovering foreign objects in food products.

Factors Influencing Physical Contamination

Processing Equipment:

- Poorly maintained or damaged equipment can shed fragments into food products during processing.

Packaging Materials:

- Breakage or damage to packaging materials (e.g., glass jars, plastic containers) can result in pieces entering food.

Human Handling:

- Accidental introduction of contaminants by personnel during food handling or packaging.

Environmental Contamination:

- Presence of natural contaminants such as stones, soil, or insects in raw agricultural products.

Control Measures for Physical Contaminants

Good Manufacturing Practices (GMP):

- Ensure equipment is properly maintained and inspected regularly to prevent breakage or fragmentation.
- Implement procedures to minimize the risk of physical contamination during processing, handling, and packaging.

Metal Detection and X-ray Inspection:

- Use metal detectors and X-ray systems to detect and remove metal fragments or other dense materials from food products before packaging.

Sieving and Filtration:

- Incorporate sieves, screens, or filters in processing lines to remove particles or contaminants of varying sizes.

Visual Inspection:

- Conduct visual inspections of raw materials, finished products, and packaging materials to identify and remove physical contaminants.

Packaging Integrity:

- Ensure packaging materials are intact and free from defects that could lead to contamination of food products.

Employee Training and Awareness:

- Train personnel on proper handling techniques, hygiene practices, and procedures to prevent physical contamination.
- Encourage reporting of potential contamination incidents to facilitate prompt corrective actions.

Some common physical hazards and sources

Material	Sources
Glass	Bottles, jars, light fixtures, utensils
Wood	Fields, pallets, boxes, buildings
Stones	Fields, buildings
Bullet / Needles	Animals shot in field, hypodermic needles used for infections
Jewellery	Pens / pencils, buttons, careless employee practices
Metal	Machinery, fields, wire, employees
Insects and other filth	Fields, plant post – process entry
Insulation	Building materials
Bone	Fields, improper plant processing
Plastic	Fields, plant packing materials, pallets, employees
Personal effects	Employees

Injury potential

- Cuts
- Bleedings
- Infections
- Choking
- Trauma
- Illness

Factors determining the risk level

- Target audience for the food
- Type of product
- Method of consumption
- Size
- Hardness
- Sharpness
- Shape
- Type
- Ease of discovery

Injury risk of physical hazards

Injury risk	Commodity	Size of physical hazard
High	Infant foods	Any size (including small particles < 2mm)
	Beverages	2 mm or larger in size in any one dimension
Moderate	All other foods (except infant food & beverage)	2 mm or larger in size in any one dimension
Low	All other foods (except infant foods)	2 mm in size in all dimensions

To find and remove

- Physical exclusion of hazards (Ex: screens, filters and sieves etc.,)
- Effective detection and elimination systems
- Proper equipment design, selection, calibration and maintenance
- Effective facility maintenance
- On-line visual inspection
- Detection methods include metal detectors, X-ray machines, optical systems, magnets
- Screening assessment of raw materials
- End – product screening
- Consumer feedback or complaint analysis

To prevent

- GMPs
- GAPs
- HACCP
- Identification of raw materials, ingredients, packings materials and process that are at high risk of contamination
- Proper maintenance of the buildings, facilities, grounds and processing plants and equipments etc.,
- Eliminate potential sources of physical hazards within the establishment
- Employee training program

Food Adulteration

Food Adulteration

Replacement:

- Complete or partial replacement of a food ingredient or valuable authentic constituent with less expensive substitute with the intention of circumventing on **"origin"** and false declaration of the **"process"**.

Addition:

- Addition of small amounts of non-authenticated substances to mask inferior quality ingredient.

Ex. Synthetic Food Colourant

Removal:

- Removal of authentic and valuable constituent without purchaser's knowledge

Definition

- Food adulteration includes mixing, substitution, concealing the quality, putting up decomposed food for sale, misbranding or giving false labels and addition of toxicants.

Food is declared adulterated if

- A substance is added which depreciates or injuriously affects it.
- Cheaper or inferior substances are substituted wholly or in part.
- Any valuable or necessary constituent has been wholly or in part abstracted.
- It is an imitation.
- It is coloured or otherwise treated, to improve its appearance or if it contains any added substance injurious to health.
- For whatever reasons its quality is below the Standard

Types of Food Adulteration

Intentional Adulteration:

- Deliberate addition of substances to food with the intention of deceiving consumers or gaining economic advantage.
- done for financial gain.
- Addition of Sand, marble chips, stones, mud, other filth, talc, chalk powder, water, mineral oil and harmful colour

Incidental Adulteration:

- Unintentional contamination due to poor handling, processing, storage, or transportation practices.
- Happen due to carelessness and lack in proper hygienic conditions of processing, storage, transportation and marketing
- Ex: Pesticide residues, droppings of rodents, larvae in foods

Metallic Adulteration

- Occurs due to Arsenic from pesticides, lead from water, effluent from chemical industries, tin from cans

METHODS OF FOOD ADULTERATION

Mixing:

- Mixing of clay, stones, pebbles, sand, marble chips, etc.

Substitution:

- Cheaper and inferior substances being replaced wholly or partially with good ones.

Concealing quality:

- Trying to hide the food standard. E.G. adding captions of qualitative food to low quality for selling.

Decomposed food:

- Mainly in fruits and vegetables. The decomposed ones are mixed with good ones

Misbranding/ False labels:

- Includes duplicate food stuffs, changing of manufacture and expiry dates.

Addition of toxicants:

- adding non-edible substances like argemone in mustard oil, low quality preservatives, colouring agents, etc.

Disadvantages for the consumer

- He is paying more for the food stuff of lower quality
- Some form of adulteration is injurious to health, even resulting in death.

Ex :

1. Addition of argemone oil to mustard oil causes epidemic dropsy
2. Adulteration of edible oil with trycresyn phosphate (TCP) results in paralysis and death.
   List of common milk adulterants and their harmful effects

Adulterant	Added for	damage
water	Increase the milk volume	Decreases the nutritive value and poses health hazard to infants
Benzoic acid & Salicylic acid	Increases shelf life for long distance transport	Linked to asthma & increases level of hyperactivity in children
Detergents	Increases foaming in milk & increases whiteness and thickness	Causes gastro intestinal & renal problems
Urea	Provides whiteness and increases the consistency of milk, improves solid not fat percentage(SNF)	Overburdens the kidney and may cause renal failure
Formalin	Increases the shelf life	Liver & kidney damage
Starch	Increases quantity and maintains SNF in synthetic	Causes diarrhea, may be fatal for diabetics

1. Milk and Dairy Products

Water:

- Dilution of milk with water to increase volume and reduce cost.

Starch:

- Addition of starch to thicken milk and improve consistency.

Urea:

- Used to increase the nitrogen content in milk, fooling protein tests.

Vegetable Oil:

- Addition of vegetable oil to mimic the fat content of milk.

Detergents:

- Added to enhance frothing and make diluted milk appear genuine.

Implications:

- Adulteration of milk can reduce its nutritional value, increase health risks (e.g., gastrointestinal problems), and affect taste and quality.

Health effect:

- Cancer or acute renal failure

Preventive Measures:

- Regular testing of milk for quality parameters (e.g., fat, SNF - Solid Not Fat, protein), strict enforcement of standards, and public awareness campaigns.

2. Spices

Artificial Colours:

- Addition of synthetic colours to enhance appearance and mask inferior quality.

Lead Chromate:

- Used in turmeric powder to enhance its yellow color.

Metanil Yellow:

- A toxic dye added to spices like chili powder for color enhancement.

Sawdust:

- Used as a filler in ground spices to increase bulk.

Implications:

- Consumption of adulterated spices can lead to toxicity, digestive issues, and long-term health problems due to ingestion of harmful chemicals.

Preventive Measures:

- Strict monitoring and testing for food colours, banning harmful dyes, promoting use of natural colours, and ensuring traceability in spice supply chains.

3. Grains and Pulses

Stones and Sand:

- Presence of stones, sand, or soil particles due to poor storage and handling practices.

Ergot:

- Fungal contamination in grains like wheat, producing toxic alkaloids.

Chalk Powder:

- Added to increase weight and bulk of grains or pulses.

Colouring Agents:

- Used to enhance appearance and mask defects in pulses.

Implications:

- Adulteration of grains and pulses can cause tooth damage, digestive problems, and health risks due to ingestion of contaminants or toxins.

Preventive Measures:

- Use of proper storage facilities, screening of grains for fungal contamination, regular quality checks, and enforcement of standards for purity and cleanliness.

4. Honey

Sugar Syrup:

- Dilution of honey with sugar syrup to increase volume and reduce cost.

Corn Syrup:

- Addition of corn syrup or other sweeteners to adulterate honey.

Artificial Flavours:

- Used to mask changes in taste due to dilution.

Implications:

- Adulterated honey loses its nutritional value and health benefits. It may also contain contaminants from the adulterants used.

Preventive Measures:

- Testing honey for authenticity (e.g., presence of pollen), ensuring traceability to source, and regulatory measures to prevent adulteration.

5. Olive Oil

Vegetable Oils:

- Addition of cheaper vegetable oils like sunflower or soybean oil.

Refined Oils:

- Dilution with refined oils to reduce production costs.

Colorants:

- Use of chlorophyll or beta-carotene to mimic the color of extra virgin olive oil.

Implications:

- Adulterated olive oil reduces its health benefits (e.g., antioxidants, monounsaturated fats) and may contain harmful compounds from other oils.

Preventive Measures:

- Authentication tests for olive oil purity (e.g., fatty acid profile, sensory evaluation), traceability in supply chains, and regulatory controls on labelling.

Detection Methods

Chemical Tests:

- Detection of specific substances through chemical reactions (e.g., starch in milk, synthetic dyes in spices).

Microscopic Examination:

- Identification of contaminants under a microscope (e.g., insect parts, mold spores).

Physical Tests:

- Examination for physical properties (e.g., density, viscosity, solubility) that may indicate adulteration.

Sensory Evaluation:

- Assessing taste, smell, color, and texture for abnormalities.

Instrumental Techniques:

- Advanced methods like chromatography, spectrometry, and DNA testing for precise identification of adulterants.

Food inter national	Adulterant	Detection
Milk	Water	Pure milk will stop or flow slowly Adulterated milk will flow immediately when dropped on vertical surface
Milk	Urea	5ml milk in test tube, add 2 drops of bromothymol blue solution. Blue color will indicate presence of urea in 10 mins
Mustard seeds	Argemone seeds	Argemone has rough surface ,white and mustard has yellow inside
Ice-cream	Washing Pd	Lemon juice ,bubbles are observed

Sugar	Chalk	Dissolve sugar in glass of water, Chalk settles down
Silver foil	Aluminium foil	Silver foil burns on ignition leaving white spherical ball ,alum inum is reduced to black grey ash
Honey	water	Cotton wick dipped in honey burns ,water will not burn and gives cracking sound.
Coffee	Chicory seeds , Tamarind seed powder	Sprinkle coffee pd on water ,it will float while chicory will set tle down in few sec
Tea	Colored leaves Iron fillings Used tea	Rub leaves on white paper, artificial color comes out. Use magnet it will stick Sprinkle tea on wet filter ,red spots will be seen.
Red chilly pd	Radamine Brick pd	2 gm in 5 ml acetone, red color will be seen. It settles faster in water than chilli pd
Turmeric pd	Metanil yellow	Few drops of HCL –appears violet
Dal	Metanil yellow	Luke warm water add pulses and drop of HCL,pink color ind icates presence of Metanil
Pure Ghee	Vanaspathi	1 tsp melted ghee to conc HCL and add pinch of cane sugar-shake well and keep for 5mins,crimson color in lower layer is seen
Black pep per	Papaya seeds	Float in alcohol, pepper will sink and papaya will float
Common salt	White pd stone	Spoon of salt in water ,chalk will give white color and other i mpurities will settle down

IIA –Incidental Intentional Adulteration	**Food involved**	**Bad effects**
Arsenic	Fruits , drinking water	Dizziness, chills, cramps ,
Barium	Food contaminated by rat poison	Muscular twitching
Cadmium	Fruit juice and soft drinks	Liver, kidney damage, multiple facture, cancer
Cobalt	Water , beer	Cardiac failure
Copper	Acid foods	Vomiting, diarrhoea
Lead	Processed food, water	Brain damage, blindness
Mercury	Fish	Brain damage, blindness
Pesticides	All types of food	Damage to liver ,kidney, brain and nerves leading to death.
Antibiotics	Meat	Hardening of arteries , heart disease

Common food adulteration
Argemone seeds: mixed with mustard seeds.

- Toxic in form of oil and seeds
- As it contains 2 alkaloids obtained from poppy plants.
- Closely resembles mustard seeds but surface is rough and uneven and has tail at one end.
- Found: Mumbai, Chennai, Bihar, West Bengal
- Disease: Beri Beri, gastro intestinal disturbance, fever, rashes, swelling feet and leg, enlargement of liver, blindness, cancer, cardiac arrest.

Lathyrus (Kesari dal)

- Added with other pulses like masoor, black Bengal gram, Chana dal, besan, as its staple food for low income people.
- **Found:** Madhya Pradesh, Bihar, Bengal, Uttar Pradesh.
- **Effect:** Paralysis, of lower limbs, stiffness in knee joints, pain in ankle and knee joints

Toxic Colouring

- Colour introduces variety and makes it look attractive and appetizing.
- Used; ice cream, dairy products, biscuits, pastries, jelly, custard,
- Non permitted color: lead chromate, red, yellow earth, dyes, peela rang (metanil), Rhodamine B (red)
- **Used:** dal, sweet meals like jalebies, laddoos, halwa, red chillies
- **Effect:** abnormalities of bones, eyes, skin, lungs, ovaries, mental retardation.

Common toxic colours

Metanil Yellow	Ice candy, Faluda
Orange II	Halwa
Rhodamine B	Red chillie pd and churan
Blue VRS	Sweets
Auramine	Sugar coated saunf/sopari
Malachite Green	Coconut

Preventive Measures

Regulatory Measures:

- Enactment and enforcement of laws and regulations governing food safety and quality.

Quality Control:

- Establishment of quality standards and regular inspections of food products and manufacturing facilities.

Public Awareness:

- Consumer education on recognizing and reporting food adulteration.

Supplier Control:

- Monitoring of suppliers and ensuring traceability in the supply chain.

Technology Adoption:

- Use of advanced technologies for adulterant detection and authentication.

PFA-Prevention of Food Adulteration-1954

- This act prohibits manufacture, sales and distributions of not only adulterated food but also food contaminated with microbes, toxicants and misbranded food.
- There are standards specified for pasteurized milk, milk powder, infant milk food etc.

Food shall be deemed to be adulterated

- Not up-to standard.
- Other subs which affects the quality of the substance.
- Inferior or cheap subs used as substitute
- Subs has been wholly or partly abstracted
- Product has been prepared, packed or kept under unsanitary condition
- Poisonous or other ingredient which renders its content injurious to health.
- Prohibited preservative added to the product.
- Quality or purity falls below the prescribed standard

Food Additives

- any substance which is not normally consumed as a food by itself and not normally used as a typical ingredient of the food whether or not it has nutritive value, the intentional addition of it to food for a technological (including organoleptic) purpose in the manufacture, processing, preparation, treatment, packaging, transport or holding of such food results; or may be reasonably expected to result (directly or indirectly) in it or its bye products

becoming a component or otherwise affecting the characteristics of such foods.

The term "food additives" does not include

- contaminants in food
  (pesticide residues, metallic contamination, mycotoxins etc.)
- substances added to food for maintaining or improving its nutritive value
  (vitamins, minerals, herbs, yeast, hops, starter cultures, malt extract etc.)

BROAD GROUPS

Based on Technological Function

- Stabilizers of physical characteristics
- Ex: Emulsifiers, Thickeners, Anti-caking agents

Inhibitors of chemical and biological alterations

- Antioxidants, Antimicrobials

Modifiers of organoleptic characters

- Colouring Agents, Flavour Enhancers, Sweeteners

CLASSIFICATION

basis of their functional use:

1. Colours
2. Preservatives
3. Acidity regulators
4. Antioxidants
5. Anticaking agents
6. Antifoaming agents
7. Artificial sweeteners
8. Enzymes
9. Emulsifiers
10. Emulsifying agents
11. Flavours
12. Flavours enhancers
13. Modified starches
14. Stabilizers
15. Thickening & gellying agents
16. Foaming agents
17. Raising agents
18. Humectants
19. Bulking agents
20. Colour retention agents
21. Firming agents etc.,

E - NUMBERS

E-Code No.	Ingredients
E-100 to 199	Colorants
E-200 to 299	Preservatives
E-300 to 399	Antioxidants
E-400 to 499	Emulsifiers and Stabilizers
E-500 to 599	Anticaking agents
E-600 to 699	Flavourings & Flavour enhancers
E-700 to 799	Antibiotics
E-900 to 999	Miscellaneous

E-Code No.	Ingredients
E-100 to 109	Yellow
E-110 to 119	Orange
E-120 to 129	Red
E-130 to 139	Blue and Violet
E-140 to 149	Green
E-150 to 159	Brown and Black
E-160 to 169	Gold and Others

- It is not consumed as food directly
- In general, it is not a part of food ingredient
- It may or may not have nutritional value
- It is added intentionally
- The additive and its dosage level must be safe for a consumption based on current toxicological evaluation
- Food additives are substances added to food during processing to achieve specific technological purposes.
- They enhance flavour, appearance, texture, and shelf life, or they act as preservatives, stabilizers, or colorants.
- Additives undergo rigorous safety evaluations before approval for use in food products.

Benefits of Food Additives

Improved Food Safety:

- Preservatives and antioxidants help prevent spoilage and maintain food safety during storage.

Enhanced Food Quality:

- Additives improve taste, texture, appearance, and consistency of food products.

Increased Shelf Life:

- Preservation additives extend the shelf life of perishable foods, reducing food waste.

Functional Roles of Food Additives

- Food additives serve several essential functions in food processing and preparation, contributing to safety, quality, taste, appearance, and shelf life of food products.
- Understanding these roles helps in appreciating their importance and safe application in the food industry.

1. **Preservatives**

Purpose:

- Extend shelf life by inhibiting microbial growth, oxidation, or enzymatic reactions.

Examples:

- Sodium benzoate, potassium sorbate, nitrites/nitrates (used in cured meats).

Application:

- Used in processed meats, dairy products, beverages, and canned foods.

Benefits:

- Prevent spoilage, maintain freshness, and enhance food safety.

2. **Antioxidants**

Purpose:

- Prevent oxidation and rancidity of fats and oils, preserving flavour and nutritional quality.

Examples:

- Vitamin E (tocopherol), BHA (butylated hydroxyanisole), BHT (butylated hydroxytoluene).

Application:

- Added to fats, oils, snacks, and processed foods.

Benefits:

- Extend shelf life, prevent rancidity, and maintain product quality.

3. **Colorants**

Purpose:

- Enhance or restore color lost during processing, improve visual appeal.

Examples:

- Natural colours (e.g., beetroot extract), synthetic dyes (e.g., FD&C Red No. 40).

Application:

- Used in beverages, confections, baked goods, and processed meats.

Benefits:

- Enhance product appearance, appeal to consumer preferences, and differentiate products.

4. **Flavour Enhancers**

Purpose:

- Improve taste or impart specific flavours to enhance food palatability

Examples:

- Monosodium glutamate (MSG), yeast extract, natural flavour enhancers (e.g., garlic powder).

Application:

- Found in soups, sauces, snacks, and processed foods.

Benefits:

- Enhance flavour profile, balance tastes, and improve overall sensory experience.

5. **Sweeteners**

Purpose:

- Provide sweetness without adding calories (low-calorie sweeteners) or as bulking agents.

Examples:

- Aspartame, saccharin, sucralose, stevia, sorbitol.

Application:

- Used in beverages, desserts, dairy products, and table top sweeteners.

Benefits:

- Reduce sugar content, control calorie intake, and cater to dietary preferences (e.g., diabetic-friendly).

6. **Emulsifiers**

Purpose:

- Improve texture and stability by promoting the mixing of oil and water phases.

Examples:

- Lecithin, mono- and diglycerides, polysorbates.

Application:

- Added to margarine, salad dressings, baked goods, and dairy products.

Benefits:

- Prevent ingredient separation, improve mouthfeel, and enhance product consistency.

7. **Thickeners and Stabilizers**

Purpose:

- Modify viscosity, improve texture, and prevent ingredient separation.

Examples:

- Xanthan gum, carrageenan, agar-agar, pectin.

Application:

- Used in dairy products, sauces, soups, and frozen desserts.

Benefits:

- Provide desired texture, enhance mouthfeel, and stabilize formulations during processing and storage.

8. **Acidity Regulators**

Purpose:

- Control acidity or alkalinity, enhance flavour, and improve preservation.

Examples:

- Citric acid, lactic acid, sodium citrate.

Application:

- Found in beverages, canned fruits, sauces, and processed meats.

Benefits:

- Adjust pH levels, enhance flavor balance, and extend shelf life by inhibiting microbial growth.

HEALTH EFFECTS

Immediate & Short Term Effect

- Headache
- Change in energy level
- Alterations in mental concentration, behaviour or immune response

Long term Effect

- Increase risk of cancer, cardiovascular disease and other degenerative conditions
- ✓ Digestive disorders – Diarrhoea, Stomach pain
- ✓ Nervous disorders – Hyperactivity, Insomnia and Irritability
- ✓ Respiratory problems – Asthma and Sinusitis
- ✓ Skin problems – Hives, Itching, Rashes and Swelling

Preservatives

- They prevent spoilage of food due to fungi, bacteria and other microorganisms.
- Ex: Sodium benzoate, Sodium nitrite.

Benzoate:

- Aggravates asthma and suspected to be a neurotoxin and carcinogen, may cause fetal abnormalities, Worsens hyperactivity

Nitrite:

- Carcinogen

Nitrate:

- Risk of miscarriages & fetal deaths

Colouring Agents

- Make the food look appealing.

Ex: Erythrosine, Allura red, Tartrazine.

Erythrosine (Red No.3):

- Cancer

Allura red:

- May worsen or induce asthma, rhinitis, utricaris (hives)

Tartrazine (yellow No. 5):

- Hyperactivity, Asthma, Skin rashes and Migraine

Flavour Enhancers

- They are added to food products to give or intensify flavour.

Ex: Monosodium glutamate
Side Effects:

- Headache, Weakness, Nausea, Altered heart rate, burning sensation in the forearms and back of the neck, tightness in the chest, Neonatal exposure is linked to stunted growth and obesity

Sweeteners

- Substances that impart sweetness to food but supply little or no energy to the body. Ex: Aspartame, Saccharin, Acesulfame K.

Side Effects:

- Behavioural problems, hyper activity, allergies and possibly carcinogenic

Antioxidant

- Added to food to slow the rate of oxidation and if used properly can extend the shelf life of food in which they have been used.

Ex: BHA, BHT.

Side Effects:

- Hyperactivity, Asthma, Angiodema, Rhinitis, Utricaria and may affect ESTROGEN levels.

Others

Caramel colouring
Commercial Use:

- Food colouring

Sources:

- Colas, baked goods, precooked meats, soy and Worcestershire sauces, chocolate-flavoured products, beer

Health Implications:

- Contains certain contaminants that cause cancer in lab animals

Olestra

Commercial Use:

- Fat substitute

Sources:

- Some brands of light potato chips

Health Implications:

- Causes diarrhoea and loose stools, abdominal cramps, flatulence, and other adverse effects; reduces the body's ability to absorb fat-soluble, cancer-preventing carotenoids (such as beta-carotene and lycopene) from fruits and vegetables.

Potassium bromate
Commercial Use:

- Flour improver

Sources:

- White flour, bread, and rolls

Health Implications:

- May cause cancer in animals (look for 'bromate-free' bread)

Trans fats
Commercial Use:

- Fat, oil, shortening

Sources:

- Stick margarine, vegetable shortening, crackers, fried restaurant foods, baked goods, icing, microwave popcorn

Health Implications:

- Promotes heart disease

Propyl gallate
Commercial Use:

- Antioxidant preservative

Sources:

- Vegetable oil, meat products, potato sticks, chicken soup base, chewing gum

Health Implications:

- May cause cancer in animals

Food Packaging & Labelling

- Food packaging and labelling play crucial roles in food safety, quality assurance, consumer information, and regulatory compliance.

Types of Food Packaging Materials

1.Plastics:

- Lightweight, versatile, and durable; used for various food products from beverages to pre-packaged meals.
- Types include PET (polyethylene terephthalate), HDPE (high-density polyethylene), LDPE (low-density polyethylene), and PP (polypropylene).

2.Glass:

- Non-reactive and impermeable; suitable for beverages, preserves, and condiments.

3.Metal:

- Aluminum and steel cans provide barrier protection; used for canned foods, beverages, and aerosol products.

4.Paper and Cardboard:

- Eco-friendly and versatile; used for dry food products, fast food packaging, and corrugated boxes.

5.Composites:

- Combines properties of different materials for enhanced barrier protection, strength, and flexibility.

Functions of Food Packaging

Barrier Protection:

- Prevents moisture, oxygen, light, and contaminants from affecting food quality.

Physical Protection:

- Cushions food from damage during handling and transportation.

Information:

- Provides essential product information, including ingredients, nutritional content, allergens, and storage instructions.

Tamper Resistance:

- Ensures food safety by indicating if packaging has been tampered with.

Convenience:

- Facilitates storage, handling, and portion control for consumers.

Food Labelling Requirements

1.Mandatory Labelling Information:

Product Name:

- Clear identification of the food product.

Ingredient List:

- Listed in descending order of predominance by weight.

Nutrition Facts:

- Serving size, calories, nutrients (e.g., fat, carbohydrates, protein), and % Daily Value (%DV).

Allergen Information:

- Presence of major food allergens (e.g., milk, eggs, peanuts) must be declared.

Net Weight:

- Quantity of food product in the package.

Manufacturer Information:

- Name and address of the manufacturer, packer, or distributor.

Date Marking:

- Use-by, best-before, or expiration date for food safety and quality.

Country of Origin:

- Required for imported foods.

Handling Instructions:

- Storage and preparation guidelines for safe consumption.

Consumer Education

Understanding Labels:

- Educating consumers about how to interpret food labels for informed choices regarding nutrition, allergens, and product quality.

Food Safety Awareness:

- Promoting awareness about safe handling, storage, and consumption practices based on labelling information.

Sanitation in Warehousing

- Sanitation in warehousing is critical to maintaining food safety, preventing contamination, and ensuring the quality of stored food products.
- Proper sanitation practices mitigate risks associated with pests, allergens, pathogens, and environmental contaminants.

Cleanliness and Hygiene

Cleaning Procedures:

- Develop and implement cleaning procedures tailored to the warehouse environment, including floors, walls, shelves, and equipment.

Sanitization:

- Use approved sanitizers effective against pathogens commonly found in food environments. Ensure adequate contact time and proper concentration.

Frequency:

- Establish a regular cleaning schedule based on risk assessment, traffic flow, and the nature of stored products.

High-Risk Areas:

- Pay special attention to high-risk areas such as loading docks, storage areas near doors, and areas prone to spills or leaks.

Pest Control

Integrated Pest Management (IPM):

- Implement IPM strategies to prevent pest infestations.

This includes:

Exclusion:

- Seal entry points and gaps to prevent pests from entering.

Sanitation:

- Keep the warehouse clean and free of food debris that can attract pests.

Monitoring:

- Regularly inspect for signs of pests and implement traps or monitoring devices as needed.

Treatment:

- Use pesticides judiciously and in accordance with regulations, focusing on targeted areas.

Temperature and Humidity Control

Climate Management:

- Maintain appropriate temperature and humidity levels suitable for the stored food products to prevent spoilage and microbial growth.

Monitoring:

- Use temperature and humidity monitoring devices to ensure conditions remain within safe ranges.
- Implement alarms for out-of-range conditions.

HVAC System:

- Regularly inspect and maintain HVAC systems to ensure proper air circulation and filtration.

Storage and Organization

FIFO (First In, First Out):

- Implement FIFO principles to rotate stock and use older products first, reducing the risk of spoilage and waste.

Proper Shelving:

- Use shelving that is easy to clean and maintain. Ensure adequate spacing between shelves for air circulation and cleaning access.

Product Segregation:

- Store raw materials, ingredients, and finished products separately to prevent cross-contamination.

Personal Hygiene and Training

Employee Practices:

- Train warehouse personnel on proper hygiene practices, including handwashing, wearing appropriate PPE (personal protective equipment), and avoiding behaviours that could introduce contaminants.

Visitor Policies:

- Implement policies for visitors to maintain hygiene standards and prevent contamination from external sources.

Waste Management

Proper Disposal:

- Dispose of waste promptly and according to regulations. Implement recycling programs where feasible for packaging materials.

Spill Response:

- Have protocols in place for cleaning up spills promptly to prevent contamination and slips.

Sanitation in Storage

- Sanitation practices in storage are crucial for maintaining food safety, preventing contamination, and ensuring the quality of stored food products.
- Proper sanitation helps mitigate risks associated with pests, pathogens, allergens, and environmental contaminants.

Cleanliness and Hygiene

Cleaning Procedures:

- Develop and implement cleaning procedures specifically tailored to storage areas, including floors, walls, racks, shelves, and equipment.

Sanitization:

- Use approved sanitizers effective against common pathogens found in food environments.
- Ensure proper concentration and contact time as per manufacturer's recommendations.

Frequency:

- Establish a regular cleaning schedule based on risk assessment, traffic flow, and the nature of stored products.
- High traffic areas and those near loading docks should be cleaned more frequently.

High-Risk Areas:

- Pay special attention to areas prone to spills, leaks, or condensation.
- These areas can harbour bacteria and mold if not properly maintained.

Pest Control

Integrated Pest Management (IPM):

- Implement IPM strategies to prevent pest infestations in storage areas.

Key practices include:

Exclusion:

- Seal entry points and gaps to prevent pests from entering the storage area.

Sanitation:

- Keep the storage area clean and free of food debris that can attract pests.

Monitoring:

- Regularly inspect for signs of pests using traps or monitoring devices.

Treatment:

- Use pesticides judiciously and according to regulations, focusing on targeted areas.

Temperature and Humidity Control

Climate Management:

- Maintain appropriate temperature and humidity levels suitable for the stored food products to prevent spoilage and microbial growth.

Monitoring:

- Use temperature and humidity monitoring devices to ensure conditions remain within safe ranges.
- Implement alarms for out-of-range conditions to prompt immediate corrective actions.

Ventilation:

- Ensure proper ventilation to minimize condensation and reduce the risk of mold growth.

Product Segregation and Organization

Segregation:

- Store raw materials, ingredients, and finished products separately to prevent cross-contamination.
- Use designated areas or dedicated shelving for each product category.

FIFO (First In, First Out):

- Implement FIFO principles to rotate stock and use older products first.
- This reduces the risk of spoilage and ensures product freshness.

Proper Shelving:

- Use shelving that is easy to clean and maintain.
- Ensure adequate spacing between shelves for proper airflow and cleaning access.

Packaging Materials

Quality Assurance:

- Inspect packaging materials for damage, leaks, or defects before use.
- Ensure they are suitable for food contact and storage conditions.

Storage Conditions:

- Store packaging materials in a clean and dry environment to prevent contamination before use.

Handling:

- Train personnel on proper handling procedures for packaging materials to maintain their integrity and hygiene.

Personal Hygiene and Training

Employee Practices:

- Train storage personnel on proper hygiene practices, including handwashing, wearing appropriate PPE (personal protective equipment), and avoiding behaviours that could introduce contaminants.

Visitor Policies:

- Implement policies for visitors to maintain hygiene standards and prevent contamination from external sources.

Waste Management

Disposal:

- Dispose of waste promptly and according to regulations. Separate food waste from other types of waste to prevent contamination and facilitate recycling where possible.

Spill Response:

- Have protocols in place for cleaning up spills promptly to prevent contamination and slips.

Sanitation in Shipping

- Sanitation practices in shipping are crucial for maintaining food safety, preventing contamination, and ensuring the quality of food products during transportation.
- Proper sanitation helps mitigate risks associated with pests, pathogens, allergens, and environmental contaminants

Cleanliness and Hygiene

Cleaning Procedures:

- Develop and implement cleaning procedures specifically tailored to shipping areas, including vehicles (trucks, containers, trailers), pallets, and loading docks.

Sanitization:

- Use approved sanitizers effective against common pathogens found in food environments.

- Ensure proper concentration and contact time as per manufacturer's recommendations.

Frequency:

- Establish a regular cleaning schedule based on the type of shipments, traffic flow, and the nature of transported products.
- High traffic areas and frequently used equipment should be cleaned more frequently.

High-Risk Areas:

- Pay special attention to areas prone to spills, leaks, or condensation in vehicles and loading docks.
- These areas can harbour bacteria and mold if not properly maintained.

Pest Control

Integrated Pest Management (IPM):

- Implement IPM strategies to prevent pest infestations during shipping.

Key practices include:

Exclusion:

- Seal entry points and gaps in vehicles and storage areas to prevent pests from entering.

Sanitation:

- Keep shipping vehicles and loading docks clean and free of food debris that can attract pests.

Monitoring:

- Regularly inspect for signs of pests using traps or monitoring devices during loading and unloading.

Treatment:

- Use pesticides judiciously and according to regulations, focusing on targeted areas where pests are detected.

Temperature and Humidity Control

Climate Management:

- Maintain appropriate temperature and humidity levels suitable for the transported food products to prevent spoilage and microbial growth.

Monitoring:

- Use temperature and humidity monitoring devices to ensure conditions remain within safe ranges throughout transportation.
- Implement alarms for out-of-range conditions to prompt immediate corrective actions.

Ventilation:

- Ensure proper ventilation in shipping vehicles to minimize condensation and reduce the risk of mold growth.

Product Handling and Loading

Proper Handling:

- Train personnel on proper handling procedures for food products to prevent contamination during loading and unloading.

Use of PPE:

- Ensure personnel handling food products wear appropriate personal protective equipment (PPE) such as gloves and aprons.

Inspection:

- Inspect shipping containers, pallets, and vehicles for cleanliness, damage, and signs of contamination before loading food products.

Packaging Materials

Quality Assurance:

- Inspect packaging materials for damage, leaks, or defects before use. Ensure they are suitable for food contact and transportation conditions.

Secure Packaging:

- Properly seal and secure packaging to prevent contamination during transit.

- Use appropriate packaging materials to protect against physical damage and maintain product integrity.

Sanitation in Receiving

- Sanitation practices in receiving are critical for maintaining food safety, preventing contamination, and ensuring the quality of incoming food products.
- Proper sanitation helps mitigate risks associated with pests, pathogens, allergens, and environmental contaminants.

Cleanliness and Hygiene

Receiving Area:

- Maintain a clean and well-organized receiving area to prevent dirt, dust, and debris accumulation. Regularly clean floors, walls, shelves, and equipment.

Sanitization:

- Use approved sanitizers effective against common pathogens found in food environments.
- Ensure proper concentration and contact time as per manufacturer's recommendations.

Frequency:

- Establish a regular cleaning schedule based on the traffic flow, volume of incoming shipments, and the nature of received products.

High-Risk Areas:

- Pay special attention to areas where food products are unloaded, inspected, and temporarily stored before transfer to storage areas.

Pest Control

Integrated Pest Management (IPM):

- Implement IPM strategies to prevent pest infestations in receiving areas.

Key practices include:

Exclusion:

- Seal entry points and gaps in doors, windows, and walls to prevent pests from entering the receiving area.

Sanitation:

- Keep the receiving area clean and free of food debris that can attract pests.

Monitoring:

- Regularly inspect for signs of pests using traps or monitoring devices.

Treatment:

- Use pesticides judiciously and according to regulations, focusing on targeted areas where pests are detected.

Temperature and Humidity Control

Climate Management:

- Maintain appropriate temperature and humidity levels suitable for the received food products to prevent spoilage and microbial growth.

Refrigeration:

- Ensure refrigerated and frozen products are promptly transferred to appropriate storage conditions to maintain product quality and safety.

Monitoring:

- Use temperature monitoring devices to verify the condition of incoming shipments. Reject products that do not meet temperature requirements.

Handling and Inspection

Proper Handling:

- Train personnel on proper handling procedures for incoming shipments to prevent contamination.
- Use appropriate PPE such as gloves and aprons.

Inspection:

- Inspect incoming shipments for damage, contamination, or signs of pest activity. Use well-lit inspection areas with magnification tools if necessary.

Rejection of Non-Conforming Products:

- Establish procedures for rejecting and disposing of products that do not meet quality or safety standards.

Sanitation in Containers

- Sanitation practices for containers are crucial for maintaining food safety, preventing contamination, and ensuring the quality of food products throughout the supply chain.
- Proper sanitation helps mitigate risks associated with pests, pathogens, allergens, and environmental contaminants.

Types of Containers

Reusable Containers:

- Containers that can be washed, sanitized, and reused multiple times.
- Examples include bins, crates, and totes used for transporting raw materials or finished products.

Single-Use Containers:

- Containers designed for one-time use and disposal, such as cardboard boxes, plastic bags, and packaging materials.

Cleaning and Sanitization Procedures

Cleaning Procedures:

- Develop and implement cleaning procedures specific to each type of container.
- Consider factors such as material compatibility, size, and usage frequency.

Sanitization:

- Use approved sanitizers effective against pathogens commonly found in food environments.
- Ensure proper concentration, contact time, and rinse thoroughly as per manufacturer's recommendations.

Frequency:

- Establish a regular cleaning and sanitization schedule based on the type of container, usage patterns, and contamination risks.

High-Risk Containers:

- Prioritize cleaning and sanitization of containers used for high-risk products or those prone to contamination.

Handling and Storage

Proper Handling:

- Train personnel on proper handling practices to minimize contamination during loading, unloading, and storage of containers.

Storage Conditions:

- Store clean containers in designated areas that are clean, dry, and protected from environmental contaminants.

Segregation:

- Separate clean containers from dirty or contaminated containers to prevent cross-contamination.

Quality Assurance

Inspection:

- Inspect containers before and after cleaning for damage, leaks, or signs of contamination. Replace or repair damaged containers promptly.

Material Compatibility:

- Ensure containers are made from food-grade materials that are suitable for the intended use and compatible with the stored products.

Pest Control

Integrated Pest Management (IPM):

- Implement IPM strategies to prevent pest infestations in container storage areas.
- Maintain cleanliness and promptly address any signs of pest activity.

Sanitation in Packaging Materials

- Sanitation practices for packaging materials are essential for maintaining food safety, preventing contamination, and ensuring the quality of packaged food products.
- Proper sanitation helps mitigate risks associated with pests, pathogens, allergens, and environmental contaminants.

Types of Packaging Materials

Primary Packaging:

- Directly in contact with the food product, such as cans, bottles, pouches, and trays.

Secondary Packaging:

- Used to group primary packages together, such as boxes, cartons, and wrappers.

Tertiary Packaging:

- Outer packaging for transport and storage, such as pallets, stretch wrap, and shipping containers.

Cleaning and Sanitization Procedures

Primary Packaging:

Prevention:

- Ensure packaging materials are sourced from reputable suppliers and are made from food-grade materials.

Inspection:

- Check primary packaging for cleanliness and integrity before use. Inspect for defects, leaks, or foreign particles.

Secondary and Tertiary Packaging:

Cleaning:

- Clean secondary and tertiary packaging materials regularly to remove dirt, dust, and contaminants.

Sanitization:

- Use approved sanitizers appropriate for the type of packaging material (e.g., cardboard, plastic, metal).
- Ensure proper concentration and contact time to effectively kill pathogens.

Drying:

- Allow packaging materials to dry completely before use to prevent moisture-related issues and microbial growth.

Handling and Storage

Handling Practices:

- Train personnel on proper handling techniques to prevent contamination of packaging materials.
- Use gloves and other appropriate PPE if necessary.

Storage Conditions:

- Store packaging materials in clean, dry, and well-ventilated areas to prevent mold growth and contamination.
- Keep them protected from pests and environmental contaminants.

Segregation:

- Separate unused or clean packaging materials from used or contaminated ones to avoid cross-contamination.

Quality Assurance

Quality Control:

- Establish quality control procedures to ensure packaging materials meet safety and quality standards.
- This includes inspecting materials for defects, damage, or signs of contamination.

Traceability:

- Maintain records of packaging material suppliers, batch numbers, and inspection results for traceability and recall purposes.

Pest Control

Integrated Pest Management (IPM):

- Implement pest control measures to prevent infestations in areas where packaging materials are stored or handled.
- Regularly inspect and monitor for signs of pests.

Control of Rats in Food Facilities

- Rats pose significant risks in food facilities due to their ability to spread diseases, contaminate food, and cause damage to property.
- Effective control measures are essential to mitigate these risks and maintain a safe environment.

Understanding Rat Behaviour and Biology

Species Identification:

- Identify common species of rats in your region (e.g., Norway rats, roof rats) to tailor control strategies effectively.

Life Cycle:

- Understand the reproductive cycle and habits of rats, including nesting, feeding, and movement patterns.

Preventive Measures

Exclusion:

- Seal entry points and gaps in buildings, walls, and floors to prevent rats from entering the facility.

Sanitation:

- Maintain cleanliness to eliminate food and water sources that attract rats. Proper waste management and removal are essential.

Landscaping:

- Keep outdoor areas tidy and free of debris that could provide shelter or nesting sites for rats.

Monitoring and Detection

Inspection:

- Regularly inspect the facility for signs of rat activity, such as droppings, gnaw marks, burrows, and tracks.

Monitoring Devices:

- Use traps (snap traps, glue boards) and monitoring stations strategically placed in areas with suspected or confirmed rat activity.

Mechanical and Physical Control

Trapping:

- Use snap traps or humane traps placed along rat runways or near nesting sites.
- Check traps regularly and dispose of captured rats promptly and hygienically.

Exclusion Devices:

- Install barriers such as mesh screens, door sweeps, and air curtains to prevent rats from entering buildings.

Chemical Control

Rodenticides:

- Use rodenticides cautiously and according to label instructions.
- Place baits in tamper-resistant bait stations in areas inaccessible to children, pets, and non-target animals.

Regulatory Compliance:

- Adhere to local regulations and guidelines regarding the use, handling, and disposal of rodenticides.

Cultural Controls

Employee Education:

- Train staff on rat awareness, sanitation practices, and reporting procedures for suspected rat sightings or signs.

Documentation:

- Keep records of pest control activities, including inspections, treatments, and corrective actions taken.

Continuous Monitoring and Evaluation

Regular Inspections:

- Conduct routine inspections to assess the effectiveness of control measures and identify any new or recurring rat activity.

Response Plans:

- Develop and implement response plans for addressing rat infestations promptly and effectively.

Control of Rodents

- Rodents, including rats and mice, are significant pests in food facilities due to their ability to contaminate food, spread diseases, and cause damage to property.
- Effective control measures are essential to mitigate these risks and maintain a safe and hygienic environment.

Understanding Rodent Behaviour and Biology

Species Identification:

- Identify common species of rodents in your region (e.g., Norway rats, roof rats, house mice) to tailor control strategies effectively.

Life Cycle:

- Understand the reproductive cycle, feeding habits, nesting behavior, and movement patterns of rodents to implement targeted control measures.

Preventive Measures

Exclusion:

- Seal entry points and gaps in buildings, walls, floors, and utility penetrations to prevent rodents from entering the facility.

Sanitation:

- Maintain cleanliness throughout the facility to eliminate food and water sources that attract rodents. Proper waste management and removal are critical.

Landscaping:

- Keep outdoor areas tidy and free of debris that could provide shelter or nesting sites for rodents.

Monitoring and Detection

Inspection:

- Conduct regular inspections of the facility for signs of rodent activity, such as droppings, gnaw marks, burrows, and tracks.

Monitoring Devices:

- Use traps (snap traps, glue boards) and monitoring stations strategically placed in areas with suspected or confirmed rodent activity.
- Check traps regularly and dispose of captured rodents promptly and hygienically.

Mechanical and Physical Control

Trapping:

- Utilize snap traps, multi-catch traps, or humane traps placed along rodent runways, near nesting sites, and in areas of high activity.
- Choose traps appropriate to the size and behaviour of the target species.

Exclusion Devices:

- Install barriers such as mesh screens, door sweeps, and air curtains to prevent rodents from entering buildings through doors, windows, and other openings.

Chemical Control

Rodenticides:

- Use rodenticides cautiously and according to label instructions.
- Place baits in tamper-resistant bait stations in areas inaccessible to children, pets, and non-target animals.
- Follow regulations and guidelines for storage, handling, and disposal of rodenticides.

Cultural Controls

Employee Education:

- Train staff on rodent awareness, sanitation practices, and protocols for reporting suspected rodent sightings or signs.

Documentation:

- Maintain detailed records of pest control activities, including inspections, treatments, and corrective actions taken.
- This documentation aids in monitoring effectiveness and compliance.

Continuous Monitoring and Evaluation

Regular Inspections:

- Conduct routine inspections to assess the effectiveness of control measures and identify any new or recurring rodent activity.

Response Plans:

- Develop and implement response plans for addressing rodent infestations promptly and effectively. Ensure corrective actions are documented and followed up.

Control of Mice

- Mice are common pests in food facilities and can pose significant risks to food safety, hygiene, and structural integrity.
- Implementing effective control measures is essential to prevent contamination, protect product quality, and ensure compliance with food safety regulations.

Understanding Mouse Behaviour and Biology

Species Identification:

- Identify common species of mice in your region (e.g., house mice) to tailor control strategies effectively.

Life Cycle:

- Understand the reproductive cycle, nesting habits, feeding behaviour, and movement patterns of mice to implement targeted control measures.

Preventive Measures

Exclusion:

- Seal entry points and gaps in buildings, walls, floors, doors, and utility penetrations to prevent mice from entering the facility.

Sanitation:

- Maintain cleanliness throughout the facility to eliminate food and water sources that attract mice.
- Proper waste management, including prompt removal of trash and spilled food, is crucial.

Storage Practices:

- Store food and ingredients in tightly sealed containers made of durable materials that mice cannot chew through.

Monitoring and Detection

Inspection:

- Conduct regular inspections of the facility for signs of mouse activity, such as droppings, gnaw marks, nesting materials, and tracks.

Monitoring Devices:

- Use traps (snap traps, glue boards) and monitoring stations strategically placed in areas with suspected or confirmed mouse activity.
- Check traps regularly and dispose of captured mice promptly and hygienically.

Mechanical and Physical Control

Trapping:

- Utilize snap traps, multi-catch traps, or humane traps placed along mouse pathways, near nesting sites, and in areas of high activity.
- Choose traps appropriate to the size and behaviour of the target species.

Exclusion Devices:

- Install barriers such as mesh screens, door sweeps, and air curtains to prevent mice from entering buildings through doors, windows, and other openings.

Chemical Control

Rodenticides:

- Use rodenticides cautiously and according to label instructions.
- Place baits in tamper-resistant bait stations in areas inaccessible to children, pets, and non-target animals.

- Follow regulations and guidelines for storage, handling, and disposal of rodenticides.

Cultural Controls

Employee Education:

- Train staff on mouse awareness, sanitation practices, and protocols for reporting suspected mouse sightings or signs.

Documentation:

- Maintain detailed records of pest control activities, including inspections, treatments, and corrective actions taken.
- This documentation aids in monitoring effectiveness and compliance.

Continuous Monitoring and Evaluation

Regular Inspections:

- Conduct routine inspections to assess the effectiveness of control measures and identify any new or recurring mouse activity.

Response Plans:

- Develop and implement response plans for addressing mouse infestations promptly and effectively. Ensure corrective actions are documented and followed up.

Control of Birds

- Birds can pose significant challenges in food facilities due to their potential to contaminate food, spread diseases, and damage structures.
- Effective control measures are essential to mitigate these risks and maintain a safe and hygienic environment.

Understanding Bird Behaviour and Biology

Species Identification:

- Identify common species of birds in your region (e.g., pigeons, sparrows) to understand their behaviour and nesting habits.

Behaviour:

- Understand bird roosting, feeding patterns, flight paths, and preferred nesting sites to implement targeted control measures.

Preventive Measures

Exclusion:

- Seal entry points and gaps in buildings, roofs, walls, and structures to prevent birds from entering and nesting.

Deterrents:

- Use physical deterrents such as bird spikes, netting, wire mesh, and electric shock tracks to discourage birds from landing and roosting on surfaces.

Sanitation:

- Maintain cleanliness to eliminate food and water sources that attract birds. Proper waste management, including securing trash bins and promptly cleaning spills, is essential.

Monitoring and Detection

Surveys:

- Conduct regular surveys and inspections to identify areas with high bird activity, nesting sites, and roosting locations.

Monitoring Devices:

- Use visual surveys, bird calls, and automated deterrent systems to monitor and detect bird presence.
- Install motion-activated devices to deter birds from entering specific areas.

Mechanical and Physical Control

Netting:

- Install bird netting over open areas, loading docks, and outdoor storage to create physical barriers and prevent birds from accessing these spaces.

Trapping:

- Use humane traps or live-capture devices designed for birds in cases where removal is necessary.
- Ensure traps are checked regularly and birds are handled humanely and in compliance with wildlife regulations.

Chemical Control

Repellents:

- Use bird repellents and avian distress signals as part of an integrated strategy to deter birds from nesting and roosting.
- Ensure repellents are safe for use in food environments and applied according to manufacturer instructions.

Pest Control Products:

- Use bird control products such as fogging or misting agents designed to deter birds without harming them or compromising food safety.

Cultural Controls

Employee Training:

- Educate staff on bird control measures, recognizing signs of bird activity, and reporting procedures for addressing issues promptly.

Record Keeping:

- Maintain detailed records of bird control activities, including inspections, treatments, and corrective actions taken.
- Documentation helps track effectiveness and compliance.

Control of Insects

- Insects are common pests in food facilities and can pose significant risks to food safety, hygiene, and product quality.
- Implementing effective control measures is essential to prevent contamination, protect stored products, and ensure compliance with food safety regulations.

Understanding Insect Behaviour and Biology

Species Identification:

- Identify common species of insects in your region (e.g., ants, cockroaches, beetles) to understand their behaviour, life cycle, and habitat preferences.

Life Cycle:

- Understand the reproductive cycle, feeding habits, and environmental conditions conducive to insect infestations.

Preventive Measures

Exclusion:

- Seal entry points and gaps in buildings, walls, floors, doors, windows, and utility penetrations to prevent insects from entering the facility.

Sanitation:

- Maintain cleanliness throughout the facility to eliminate food and water sources that attract insects.
- Proper waste management, including regular removal of trash and cleaning of spills, is crucial.

Storage Practices:

- Store food and ingredients in sealed containers made of durable materials that insects cannot penetrate.
- Regularly inspect stored products for signs of infestation.

Monitoring and Detection

Inspection:

- Conduct regular inspections of the facility for signs of insect activity, such as droppings, egg cases, cast skins, and damage to stored products.

Monitoring Devices:

- Use insect traps (sticky traps, pheromone traps) and monitoring stations strategically placed in areas with suspected or confirmed insect activity.
- Check traps regularly and document findings.

Mechanical and Physical Control

Exclusion Methods:

- Install screens on windows and doors, use air curtains, and repair or replace damaged seals to prevent insects from entering.

Trapping:

- Use insect traps and light traps to capture and monitor insect populations.
- Choose traps based on the type of insect and the specific environment.

Chemical Control

Insecticides:

- Use insecticides cautiously and according to label instructions.
- Apply insecticides in targeted areas where insects are active, avoiding direct contact with food, food-contact surfaces, and areas accessible to employees and customers.

Residual Treatments:

- Apply residual insecticides to surfaces and cracks where insects may harbour or travel.
- Follow proper application techniques and safety protocols.

Cultural Controls

Employee Training:

- Train staff on insect identification, prevention strategies, sanitation practices, and protocols for reporting and responding to insect sightings.

Documentation:

- Maintain detailed records of pest control activities, including inspections, treatments, and corrective actions taken.
- Documentation helps track effectiveness and compliance.

Control of Microbes

- Microbial contamination poses significant risks to food safety, quality, and consumer health.
- Implementing effective control measures is essential to prevent contamination, reduce the growth of harmful microorganisms, and ensure compliance with food safety regulations.

Understanding Microbial Behaviour and Biology

Types of Microorganisms:

- Identify common types of microbes in food environments, including bacteria, viruses, fungi (yeasts and molds), and protozoa.

Growth Conditions:

- Understand the environmental factors (temperature, pH, moisture) that influence microbial growth and proliferation.

Preventive Measures

Personal Hygiene:

- Promote good hygiene practices among employees, including handwashing, proper use of gloves, and wearing clean uniforms.

Sanitation:

- Maintain cleanliness throughout the facility, including equipment, surfaces, utensils, and food-contact areas.
- Use approved sanitizers and cleaning agents effective against microbes.

Cross-Contamination Prevention:

- Implement measures to prevent cross-contamination between raw and cooked foods, including separate storage, preparation areas, and utensils.

Temperature Control

Refrigeration and Freezing:

- Store perishable foods at appropriate temperatures to slow down microbial growth.
- Monitor and record temperatures regularly.

Cooking and Heating:

- Ensure foods are cooked to safe temperatures to kill harmful microorganisms.
- Use food thermometers to verify internal temperatures.

Water Management

Potable Water:

- Ensure a safe and reliable supply of potable water for food preparation, cleaning, and sanitation purposes.

Water Treatment:

- Implement water treatment processes (e.g., filtration, chlorination) to eliminate microbial contaminants in water used in food production.

Packaging and Storage

Aseptic Techniques:

- Use aseptic packaging and handling techniques to minimize microbial contamination during packaging and storage.

Storage Conditions:

- Store packaged foods in clean, dry, and well-ventilated areas to prevent microbial growth. Monitor humidity levels and airflow.

Chemical Control

Sanitizers and Disinfectants:

- Use approved sanitizers and disinfectants to clean surfaces, equipment, and utensils effectively.
- Follow manufacturer instructions for proper dilution and contact time.

Preservatives:

- Use food-grade preservatives to inhibit microbial growth in processed foods.
- Ensure compliance with regulatory limits and label requirements.

Cultural Controls

Employee Training:

- Educate staff on microbial contamination risks, hygiene practices, sanitation procedures, and the importance of following food safety protocols.

Documentation:

- Maintain detailed records of cleaning schedules, sanitation procedures, water quality tests, temperature logs, and any corrective actions taken.

Cleaning in Food Processing: Principles and Practices

- Cleaning is a critical process in food processing facilities to maintain hygiene, prevent contamination, and ensure food safety.

Definition:

- Cleaning is the process of removing visible dirt, debris, organic matter, and microbial contaminants from surfaces, equipment, utensils, and environments in food processing facilities.

Importance:

- Ensures food safety, prevents cross-contamination, maintains product quality, extends equipment lifespan, and complies with regulatory standards.

Importance of Cleaning

Food Safety:

- Prevents cross-contamination and reduces the risk of microbial growth on surfaces, equipment, and utensils that come into contact with food.

Public Health:

- Protects consumers from foodborne illnesses and ensures compliance with food safety regulations and standards.

Operational Efficiency:

- Maintains equipment functionality, extends lifespan, and enhances overall cleanliness and hygiene standards.

Cleaning Principles

Hygienic Design:

- Equipment and facility layout should facilitate thorough cleaning, minimizing areas where dirt and contaminants can accumulate (e.g., smooth surfaces, rounded corners).

Mechanical Action:

- Cleaning involves physical agitation (scrubbing, brushing) and the use of water or detergents to dislodge and remove contaminants from surfaces.

Chemical Action:

- Cleaning agents (detergents, sanitizers) break down and dissolve soil, grease, and microbial residues to facilitate their removal.

Time and Temperature:

- Adequate contact time and appropriate temperature enhance cleaning effectiveness (e.g., warm water increases detergent efficacy).

Rinsing:

- Proper rinsing with clean water removes loosened soil and residual cleaning agents from surfaces.

Types of Cleaning Agents

Detergents:

- Remove grease, dirt, and organic matter from surfaces.
- They are essential for effective cleaning before disinfection.

Sanitizers:

- Reduce microbial contamination on surfaces to safe levels, typically through chemical agents or heat.

Disinfectants:

- Kill or inactivate pathogenic microorganisms on surfaces, equipment, and utensils.
- They are stronger than sanitizers and are used on surfaces that require a higher level of microbial control.

Cleaning Process Steps

Preparation:

- Ensure equipment is powered off and disconnected from utilities.
- Remove food residues and loose debris manually before cleaning.

Cleaning Agents:

Detergents:

- Break down fats, proteins, and carbohydrates. Choose detergents suitable for specific soils and surfaces (e.g., alkaline detergents for proteins).

Sanitizers:

- Reduce microbial load after cleaning. Use sanitizers according to manufacturer instructions and regulatory requirements.

Application:

- Apply cleaning agents using spray systems, foaming equipment, or manual methods to cover all surfaces thoroughly.

Mechanical Action:

- Scrubbing, brushing, or using automated cleaning equipment (e.g., scrubbers, pressure washers) to agitate surfaces and dislodge contaminants.

Rinsing:

- Thoroughly rinse surfaces with clean water to remove loosened soil and residual cleaning agents.

Verification:

- Use visual inspection, ATP (Adenosine Triphosphate) testing, or swab sampling to verify cleanliness and effectiveness of cleaning.

Validation:

- Periodic validation ensures cleaning processes consistently achieve desired cleanliness levels.
- Conduct swab tests or microbial testing as part of validation.

Documentation:

- Maintain records of cleaning schedules, procedures, chemicals used, verification results, and any corrective actions taken.

Cleaning Methods

Manual Cleaning:

- Hand scrubbing, wiping, or soaking equipment and surfaces with cleaning agents.
- Suitable for small equipment or areas where precision and control are required.

Automated Cleaning:

- Use of automated systems (e.g., CIP - Cleaning in Place) for large equipment and piping systems.
- Enhances efficiency, reduces labour costs, and ensures uniform cleaning.

Foam Cleaning:

- Application of foam detergents that cling to vertical and irregular surfaces, increasing contact time and cleaning effectiveness.

Steam Cleaning:

- Utilizes high-temperature steam to sanitize and clean surfaces, particularly effective for equipment and areas sensitive to moisture.

Factors Affecting Cleaning Effectiveness

Surface Material:

- Different materials (e.g., stainless steel, plastic) require specific cleaning agents and methods to avoid damage and ensure thorough cleaning.

Soil Type:

- Consider the nature of soil (e.g., fats, proteins, carbohydrates) and select appropriate detergents and sanitizers for effective removal.

Water Quality:

- Ensure water used for cleaning is of suitable quality (e.g., hardness, pH) to optimize detergent performance and prevent scale build-up.

Time and Temperature:

- Adequate contact time and temperature during cleaning processes enhance effectiveness in removing contaminants.

Safety Considerations

Personal Protective Equipment (PPE):

- Use PPE such as gloves, goggles, and aprons to protect workers from chemical exposure and physical hazards during cleaning.

Chemical Handling:

- Follow manufacturer instructions for handling, dilution, and storage of cleaning chemicals to prevent accidents and ensure safety.

Equipment Safety:

- Ensure equipment is safely disassembled, locked out/tagged out (LOTO), and free from electrical hazards before cleaning.

Disinfection in Food Processing: Principles and Practices

- Disinfection is a crucial process in food processing facilities to eliminate pathogenic microorganisms and ensure food safety.

Definition:

- Disinfection is the process of reducing the number of viable microorganisms on surfaces, equipment, and environments to a level that is considered safe by public health standards.

Objectives:

- Prevents the transmission of pathogens, reduces microbial contamination, and ensures the safety and quality of food products.

Principles of Disinfection

Microbial Targets:

- Effective against a broad spectrum of microorganisms, including bacteria, viruses, fungi, and protozoa.

Mode of Action:

- Disinfectants work by disrupting cellular structures, enzymes, or metabolic processes of microorganisms, leading to their inactivation or death.

Factors Influencing Effectiveness:

- Contact time, concentration of disinfectant, temperature, pH, and organic matter present can impact disinfection efficacy.

Disinfection Methods

Chemical Disinfectants:

Quaternary Ammonium Compounds (Quats):

- Effective against bacteria and some viruses. Commonly used in food processing environments.

Chlorine Compounds:

- Chlorine bleach (sodium hypochlorite) is effective against a wide range of microorganisms but requires proper handling and dilution.

Iodine Compounds:

- Used in sanitizers and disinfectants, effective against bacteria, viruses, and fungi.

Alcohols:

- Ethanol and isopropanol are effective against bacteria and some viruses but may not be suitable for all surfaces.

Peroxygens (Hydrogen Peroxide):

- Broad-spectrum disinfectant effective against bacteria, viruses, and spores. Breaks down into water and oxygen.

Physical Methods:

Heat:

- Thermal disinfection using hot water or steam to kill microorganisms on surfaces or equipment.

UV Radiation:

- Ultraviolet light disrupts microbial DNA, effectively killing or inactivating bacteria, viruses, and molds.

Filtration:

- Physical removal of microorganisms through fine filters or membrane systems.

Application of Disinfection

Surface Disinfection:

- Cleaning followed by application of disinfectants on food contact surfaces, equipment, and utensils to ensure microbial control.
- Proper contact time and concentration as per manufacturer instructions.

Environmental Disinfection:

- Disinfection of floors, walls, drains, and air handling systems in food processing areas to prevent cross-contamination.

Water Disinfection:

- Treatment of water used in food processing to eliminate microbial contaminants (e.g., chlorine disinfection in water systems).

Personal Hygiene:

- Disinfection of hands, footwear, and protective clothing worn by personnel to prevent contamination of food processing areas.

Safety Considerations

Chemical Safety:

- Handle disinfectants according to safety data sheets (SDS), wear appropriate personal protective equipment (PPE), and follow dilution and disposal guidelines.

Compatibility:

- Ensure compatibility of disinfectants with surfaces, materials, and equipment to prevent damage or corrosion.

Residue Management:

- Rinse surfaces thoroughly after disinfection to remove residual chemicals that may pose health risks or affect food quality.

Emerging Trends and Technologies

Advanced Disinfection Technologies:

- Innovations in disinfection technology, such as electrochemical activation (ECA), ozone generators, and hydrogen peroxide vapour systems.

Data-Driven Approaches:

- Use of data analytics and digital tools to optimize disinfection protocols, monitor effectiveness, and identify areas for improvement.

ISO 22000

Definition

- ISO 22000 is the food safety management system that can be applicable to ant organization in the food chain.

Part 1: Importance of ISO 22000

Ensuring Food Safety

Preventing Foodborne Illnesses:

- Controls and reduces the risk of foodborne diseases.

Comprehensive Coverage:

- Addresses hazards at all stages of the food chain, from farm to fork.

Compliance with Regulatory Requirements

Legal Compliance:

- Helps organizations meet national and international food safety regulations.

Reducing Legal Risks:

- Minimizes the risk of legal actions due to non-compliance.

Market Access and Trade Facilitation

International Recognition:

- ISO 22000 is recognized globally, facilitating international trade.

Market Opportunities:

- Opens new market opportunities by meeting global food safety standards.

Consumer Confidence

Trust and Loyalty:

- Enhances consumer trust and loyalty by ensuring food safety.

Brand Reputation:

- Strengthens the organization's brand and reputation in the market.

Risk Management

Systematic Approach:

- Provides a structured approach to identifying and managing food safety risks.

Proactive Management:

- Focuses on preventing food safety issues rather than reacting to them.

Operational Efficiency

Streamlined Processes:

- Improves efficiency by standardizing food safety processes.

Cost Reduction:

- Reduces costs associated with food safety incidents and recalls.

Continuous Improvement

Ongoing Enhancements:

- Encourages continuous monitoring, review, and improvement of the FSMS.

Food Safety Culture:

- Promotes a culture of food safety and quality within the organization.

Supplier and Stakeholder Relationships

Improved Communication:

- Enhances communication and collaboration with suppliers and stakeholders.

Supply Chain Assurance:

- Ensures that food safety requirements are met throughout the supply chain.

Part 2: Implementation of ISO 22000

Obtain Management Commitment

Top Management Involvement:

- Secure commitment from top management.

Resource Allocation:

- Allocate necessary resources, including financial and human resources.

Conduct a Gap Analysis

Current State Assessment:

- Evaluate current food safety practices against ISO 22000 requirements.

Action Plan Development:

- Identify gaps and develop an action plan to address them.

Form a Project Team

Cross-Functional Team:

- Assemble a team with representatives from relevant departments.

Roles and Responsibilities:

- Define clear roles and responsibilities for team members.

Develop Prerequisite Programs (PRPs)

Basic Conditions:

- Establish basic conditions and activities necessary for a hygienic environment.

Examples:

- Cleaning and sanitation, pest control, employee hygiene, maintenance.

Implement HACCP Principles

Hazard Analysis:

- Identify potential food safety hazards.

Critical Control Points (CCPs):

- Determine points where control is essential to prevent hazards.

Critical Limits:

- Establish critical limits for each CCP.

Monitoring Procedures:

- Develop procedures to monitor CCPs.

Corrective Actions:

- Establish actions to be taken when deviations occur.

Verification:

- Implement procedures to verify the effectiveness of the HACCP plan.

Documentation:

- Maintain detailed documentation and records.

Develop a Communication Plan

Internal Communication:

- Ensure effective communication within the organization.

External Communication:

- Communicate with suppliers, customers, and regulatory authorities.

Document the FSMS

Documentation Requirements:

- Develop and maintain necessary documentation.

Control System:

- Implement a document control system to manage documents and records.

Provide Training and Awareness

Employee Training:

- Train employees on food safety practices and ISO 22000 requirements.

Awareness Programs:

- Raise awareness about the importance of food safety.

Implement the FSMS

Execution:

- Execute the developed plans and procedures.

Monitoring:

- Continuously monitor the implementation process.

Conduct Internal Audits

Regular Audits:

- Perform regular internal audits to evaluate the FSMS.

Non-Conformities:

- Identify non-conformities and develop corrective actions.

Review and Improve the FSMS

Management Review:

- Conduct periodic reviews by top management.

Continuous Improvement:

- Use audit results, feedback, and performance data to improve the FSMS.

Prepare for Certification Audit

Certification Body:

- Select an accredited certification body.

Certification Audit:

- Schedule and conduct the certification audit.

Address Non-Conformities:

- Address any non-conformities identified during the audit.

UNIT II

Food Quality

Definition

- Food quality represents the sum of all properties and attributes of a food item all acceptable to the customers
- Food quality refers to the characteristics of food that meet consumer expectations and regulatory requirements.
- It encompasses various attributes that contribute to the overall satisfaction, safety, and nutritional value of food products.

Various Quality Attributes of Food

- Appearance (include size, shape, colour, gloss and consistency)
- Colour
- Texture
- Flavour
- Nutritional content
- Ethical and sustainable production
- Adulterants
- Contaminates (physical, chemical, biological)

Appearance:

- Comprising colour, shape, size, gloss etc.,
- Based on optical properties and visual manifestation of size and shape

Flavour:

- Comprising taste (on tongue based)
- Odour (on nose based)
- Based on the response of receptor in the oral cavity to chemical stimuli

Texture:

- Sense of physical stimuli
- Contact between some part of body and food

Nutrition:

- Not a quality factor
- Not an acceptability factor as it not perceived by the sense
- Hidden characteristics
- Toxicity is also hidden

Sensory properties:

- Man accepts food on the basis of certain characteristics that he defines and perceives with his sense
- These attributes are described as in term of sensations

Appearance factors	Kinaesthetic factors
Colour	Texture
Size	Viscosity
Shape	consistency
Physical aspects	Finger feel
	Mouth feel
	Flavour factors or sensation
	Combining odour
	Taste

Appearance / colour

- Colour is most important than taste and odour
- Increase attractiveness of food
- Prime factor determines the flavour, texture and nutrition value
- Judgement of the ripening of the fruit is also influenced by colour
- The strength of coffee and tea is also judged by colour

Appearance of food

Selection of food	Sensory evaluation of food
Appearance of any food commodity can be judged by the eye	Kinaesthetic : texture and consistency
Appearance may be in the term of colour, size, shape uniformity and absence of deserts	

Texture:

- It is the overall assessment of the feeling by mouth and hand or it is sense of touch by hand and mouth
- Mouth feel: include lips, tough, teeth, tongue
- Texture can be described as a properties of a food, stuff felt by both by the eye and by the skin
- Muscle sense in mouth
- Embracing roughness
- Smoothness
- Graininess
- The texture or mouth feel of liquid foods especially those that behave as Newtonian fluid is closely related to their viscosity
- Mouth feel is a products physical and chemical interaction in the mouth
- It is a concept used in many areas related to the testing and evaluation of food stuffs such as wine tasting and rheology

Textures

Cohesiveness	Degree to which the sample deforms before reporting
Denseness	Compactness of cross section
Dryness	Degree of sample feels dry in mouth
Factorability	Crispiness, cushiness and brittleness
Graininess	Degree of which a sample contain small grainy particles
Gumminess	Energy required to disintegrate a semi solid food ready to swallow
Hardness	Force required to deforming the food
Heaviness	Weight of product when placed on tongue
Moisture absorption	Amount of saliva absorbed by product
Smoothness	Absence of any particles, lumps, bumps
Uniformity	Degree to which the sample is even
Viscosity	Force required to draw a liquid from spoon to tongue

Flavour

- It is a combination of taste smell / aroma and feeling
- In short combination of taste and aroma
- Most important sensory property

Flavour

Odour	Taste	Chemically feeling factors stimulate serve
Caused by volatile substance released from the food product	Salt, sweet sour, bitter caused by soluble substance in the mouth	Heating, cooling, spice

Taste

- It is due to sensation felt by tough
- Sweet
- Sour
- Salty
- Bitter
- They are non-volatile at room temp
- They interact only with taste receptors in taste buds

Odour

- Aroma substrate as volatile
- Smell / odour is important factor in flavour related to flavour acceptability
- Aroma may be
- Fragrant
- Acidic
- Burnt
- Pungent
- Enzymatic
- Spoilage

Nutritive value

- Hidden character
- Toxic component may present
- The ratio of weight of raw materials to the weight of pre-packaged finished product is known as shrinkage ratio
- Low shrinkage ratio is desirable

Instrumental, Chemical, and Microbial Quality Control in Food

- Quality control in the food industry involves various methods and techniques to ensure that food products meet safety, quality, and regulatory standards.
- Instrumental, chemical, and microbial analyses play crucial roles in assessing and monitoring different aspects of food quality.

Instrumental Quality Control

- Instrumental methods involve the use of specialized equipment and technologies to analyze physical, chemical, and sensory attributes of food products.
- These methods provide objective measurements and data that help in assessing quality parameters accurately.
- Instrumental control involves the use of advanced instruments and technologies to analyze, monitor, and ensure the quality, safety, and compliance of food products.
- These methods provide precise measurements of physical, chemical, and sensory properties, helping food manufacturers maintain consistency and meet regulatory standards.
- Evaluation of texture involves measuring the response of food when it is subjected to forces such as cutting, shearing, chewing compressing or stretching.

Types of Instrumental Methods:

Viscometer:

- Calculate the viscosity
- These instrumental are used to measure the texture of the liquid and semi liquid foods
- The resistance to flow is known as viscosity
- More important among salads, creams, tomato products, jellies, jams, mayonnaise, syrups, fruit pulp.

Types of viscometer

Stormier viscometer

- Measure viscosity of certain food
- Give an index of the resistance of the sample to flow
- The number of second used for the rotor to make 100 revolutions has been used to measure the consistency of some food sample.

Brookfield synchro electric viscometer

- Measuring the consistency of custards, pie fillings, tomato products, cream, salad decising, mayonnaise.

Efflux tube viscometer

- It measures the time necessary for a quantity of fluid to pass through an orifice or capillary under standard pressure Ex: tomato puree

Penetrometer

- Measure tenderness of some foods
- The device consists of plunger equipment with a needle or cone that is allowed to penetrate the sample by gravitational force for a selected period of time
- The larger the reading the longer the dist. the more tender is the product
- Gel and many baked products are particularly well saluted to tenderness measurement using the penetrometer

Barbender farinograph

- Measure the plasticity of wheat dough for preparation bread products

Measuring colour

- Colour is the first quality attributes a consumer perceives in food
- Change of colour is generally accompanied by flavour changes

Spectrophotometer

- In this tube with the liquid is placed in a slot and light of selected wavelength is passes through the tube.
- The light will be absorbed depending on the colour of liquid and intensity of the colour
- Two liquids of exactly the same colour and intensity will transmit equal fractions of light.
- If one liquid is a juice and other is the juice diluted with water
- Diluted sample will transmit a greater fraction
- Instrument can measure clarity, cloudiness

Measuring taste

E – tongue

- For taste analysis of liquid such as gels, syrups, solutions, emulsion or solids dissolved in liquid solution
- Chemical compounds responsible for taste are perceived by human taste receptors
- Analyzes taste attributes based on interactions between food components and sensor arrays.
- **Applications**: Discrimination of taste profiles in beverages, sauces, and seasonings to ensure flavour consistency.

Electronic nose

- The seven sensors of electronic instruments detect the same dissolved organic and inorganic compounds
- Like human receptors each sensor have a spectrum or reactants different from the other
- The info given by each sensor is complementary
- Similar or better than those of human receptors
- Mimics the human olfactory system to detect and analyze volatile compounds that contribute to aroma.
- **Applications**: Quality control of coffee, wine, and flavorings by assessing aroma profiles and detecting off-odors.

Flavour measurement

Electronic nose

- Electronic nose was developed in order to mimic human of faction that function as a non seperative mechanism ie., the odour / flavour are perceived as a global finger print

Electronic nose includes three major part

- Sample delivery system
- Detection system
- Computing system

Spectroscopy

UV-Vis Spectroscopy:

Principle:

- Measures the absorption of ultraviolet-visible light by molecules in the sample.

Applications:

- Quantification of vitamins, pigments, and additives like colorants and preservatives in food products.

Infrared Spectroscopy (FTIR):

Principle:

- Detects the absorption of infrared radiation by functional groups in molecules.

Applications:

- Identification of chemical structures, analysis of fats, oils, proteins, and carbohydrates in food samples.

Atomic Absorption Spectroscopy (AAS):

Principle:

- Measures the absorption of light by atomic vapor in the sample.

Applications:

- Analysis of heavy metals (e.g., lead, cadmium) in food products, ensuring compliance with safety regulations.

Chromatography

Gas Chromatography (GC):

Principle:

- Separates and analyzes volatile compounds in the sample based on their distribution between a stationary phase and a mobile phase.

Applications:

- Quantification of pesticides, flavors, and volatile organic compounds (VOCs) in food matrices.

High-Performance Liquid Chromatography (HPLC):

Principle:

- Separates and analyzes non-volatile compounds dissolved in a liquid solvent.

Applications:

- Quantification of vitamins, amino acids, sugars, and contaminants like mycotoxins and antibiotics in food samples.

Mass Spectrometry

Liquid Chromatography-Mass Spectrometry (LC-MS):

Principle:

- Combines chromatography and mass spectrometry to separate, identify, and quantify compounds in complex mixtures.

Applications:

- Detection of pesticides, contaminants, and food additives with high sensitivity and specificity.

Gas Chromatography-Mass Spectrometry (GC-MS):

Principle:

- Analyzes volatile compounds separated by GC, followed by mass spectrometric identification.

Applications:

- Identification of flavor compounds, environmental contaminants, and residues in food products.

Rheology

Texture Analysis:

Principle:

- Measures mechanical properties such as hardness, adhesiveness, and elasticity of food products.

Applications:

- Evaluation of texture in baked goods, meats, dairy products, and sauces to ensure consistency and consumer acceptance.

Chemical Control in Food Quality

- Chemical control refers to the systematic monitoring and management of chemical components, additives, contaminants, and nutritional attributes in food products.
- It involves analytical techniques and methods to ensure compliance with regulatory standards, safety, and quality requirements throughout the food supply chain.

1. **Types of Chemical Control**

Proximate Analysis

Definition:

- Determines the basic composition of food products, including moisture content, protein, fat, ash, and carbohydrates.

Methods:

Gravimetric Analysis:

- Measures moisture content by drying samples to constant weight.

Kjeldahl Method:

- Quantifies protein content based on nitrogen determination.

Soxhlet Extraction:

- Extracts fat content using solvent extraction.

Ash Analysis:

- Determines inorganic mineral content remaining after complete combustion.

Applications:

- Assess nutritional value, composition, and labeling accuracy of food products.

Nutritional Analysis

Vitamins and Minerals:

- Quantifies essential vitamins (e.g., A, C, D) and minerals (e.g., iron, calcium) in food products.

Amino Acids:

- Profiles amino acid composition, essential for protein quality assessment.

Fatty Acids:

- Analyzes types and quantities of fatty acids (saturated, unsaturated) in fats and oils.

Applications:

- Ensures adequacy of nutrient levels, supports dietary claims, and meets nutritional labeling requirements.

Additive Analysis

Preservatives:

- Detects and quantifies additives (e.g., benzoates, sorbates) used for microbial control and shelf-life extension.

Colorants:

- Identifies synthetic and natural color additives (e.g., FD&C colors, carotenoids) for color stability and consumer appeal

Flavor Enhancers:

- Measures additives (e.g., monosodium glutamate) to improve taste perception and flavor profile.

Applications:

- Verifies compliance with permissible limits, ensures safety, and prevents overuse or misuse of additives.

Contaminant Analysis

Pesticide Residues:

- Screens for residues of agricultural pesticides used in crop protection.

Heavy Metals:

- Detects toxic metals (e.g., lead, mercury, cadmium) that may contaminate food through environmental exposure.

Mycotoxins:

- Identifies toxic fungal metabolites (e.g., aflatoxins, ochratoxins) in grains and cereals susceptible to mold contamination.

Environmental Pollutants:

- Analyzes contaminants (e.g., PCBs, dioxins) that may enter the food chain through air, water, or soil.

Applications:

- Ensures compliance with safety regulations (e.g., Maximum Residue Limits) to prevent health risks and ensure consumer safety.

Authenticity Testing

Species Identification:

- Verifies the species origin of meat, fish, and seafood products to prevent mislabeling and fraud.

Geographical Indication:

- Certifies the origin and authenticity of specialty foods (e.g., wines, cheeses) based on regional production methods.

Organic Certification:

- Confirms adherence to organic farming practices and certification standards (e.g., USDA Organic, EU Organic).

Applications:

- Protects consumer rights, supports fair trade practices, and promotes product authenticity and integrity.

Analytical Techniques

Chromatography:

Gas Chromatography (GC):

- Separates and quantifies volatile compounds.

High-Performance Liquid Chromatography (HPLC):

- Analyzes non-volatile compounds with high sensitivity.

Spectroscopy:

UV-Vis Spectroscopy:

- Quantifies substances based on light absorption.

Atomic Absorption Spectroscopy (AAS):

- Determines metal concentrations by measuring light absorption.

Mass Spectrometry:

LC-MS (Liquid Chromatography-Mass Spectrometry):

- Identifies and quantifies compounds in complex mixtures.

GC-MS (Gas Chromatography-Mass Spectrometry):

- Analyzes volatile compounds and organic pollutants.

Other Techniques:

- Fourier Transform Infrared Spectroscopy (FTIR), Nuclear Magnetic Resonance (NMR), Electrophoresis, and Enzyme-linked Immunosorbent Assay (ELISA).

Microbial Control in Food Safety

- Microbial control refers to the strategies and practices employed to prevent, reduce, or eliminate microorganisms (bacteria, viruses, fungi, and parasites) that can contaminate food products and pose health risks to consumers.
- Effective microbial control measures are crucial for ensuring food safety, extending shelf life, and maintaining product quality throughout the food supply chain.

Microbial Hazards in Food

Types of Microorganisms:

Bacteria:

- Pathogenic bacteria such as Salmonella, Escherichia coli (E. coli), Listeria monocytogenes, and Campylobacter can cause foodborne illnesses.

Viruses:

- Foodborne viruses like norovirus and hepatitis A can spread through contaminated food and water.

Fungi:

- Mold species such as Aspergillus and Penicillium produce mycotoxins that can contaminate grains and nuts.

Parasites:

- Protozoa (e.g., Giardia, Cryptosporidium) and helminths (e.g., Taenia, Anisakis) can infect humans through raw or undercooked meat, seafood, and produce.

Sources of Contamination:

Raw Ingredients:

- Contaminated water, soil, and animal feces can introduce pathogens during agricultural production.

Processing Environment:

- Cross-contamination from equipment, surfaces, and personnel handling can spread microorganisms.

Improper Handling and Storage:

- Inadequate temperature control, improper storage conditions, and extended storage times can promote microbial growth.

Microbial Control Measures

Preventive Measures

Good Agricultural Practices (GAPs):

- Ensuring hygiene and sanitation during crop cultivation and harvesting to minimize microbial contamination.

Good Manufacturing Practices (GMPs):

- Establishing hygiene protocols, sanitation procedures, and employee training in food processing facilities.

Hazard Analysis and Critical Control Points (HACCP):

- Identifying critical control points (CCPs) where microbial hazards can be prevented, eliminated, or reduced to acceptable levels.

Sanitation Programs:

- Regular cleaning and disinfection of equipment, surfaces, and processing areas to eliminate microbial reservoirs.

Water and Air Quality Control:

- Monitoring and treating water sources and air quality to prevent microbial contamination during production.

Physical and Chemical Control Methods

Temperature Control:

- Heat treatments (e.g., pasteurization, sterilization) to kill pathogens and spoilage organisms.
- Refrigeration and freezing to inhibit microbial growth and extend shelf life.

Packaging and Storage Conditions:

- Use of barrier packaging materials and modified atmosphere packaging (MAP) to create inhospitable conditions for microbial growth.
- Controlled humidity levels and storage temperatures to prevent spoilage and microbial proliferation.

Food Additives:

- Use of preservatives (e.g., salt, sugar, acids), antioxidants, and antimicrobial agents to inhibit microbial growth and extend shelf life.

Microbial Testing and Analysis

Microbial Enumeration:

- Total Plate Count (TPC): Quantifies viable microorganisms present in a sample.
- Yeast and Mold Count: Measures fungal contamination levels, particularly in baked goods, dairy, and fruits.

Pathogen Detection:

- Specific tests (e.g., PCR, ELISA) to detect and quantify pathogenic bacteria (e.g., Salmonella, Listeria) and viruses in food samples.

Indicator Organisms:

- Presence of coliforms, E. coli, Enterobacteriaceae, and other indicators to assess hygiene and sanitation practices.

Challenge Testing:

- Simulates conditions (e.g., temperature, pH) to evaluate microbial growth potential and product stability over time.

Sensory evaluation of food and statistical analysis

Introduction

- People make food choices based on various factors such as cost, preference, previous experience, and what is healthy.
- Still, probably more crucially, they employ information collected through their senses: look, texture, taste, and smell.
- These sensory elements can increase a food product's appeal, demonstrate attractiveness and quality, or meet the tastes and desires of critical groups.
- **Food product sensory** analysis can give manufacturers information for product development, marketing, and other claims.

What is Food Sensory Evaluation?

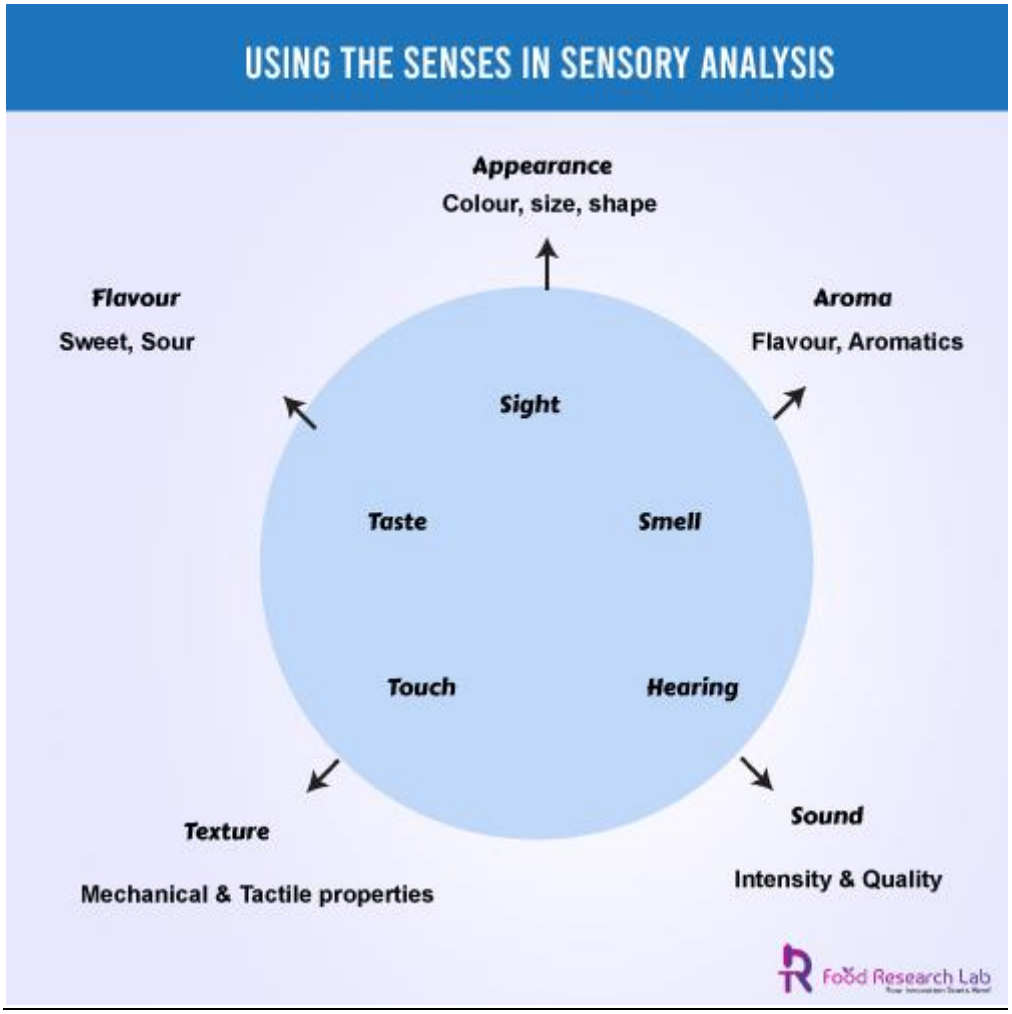
- Sensory assessment is a scientific field covering all techniques for eliciting, measuring, analysing, and interpreting human reactions to food characteristics perceived by the five senses: taste, smell, touch, sight, and hearing.
- Taste and smell are two senses that have piqued researchers' curiosity, particularly related to ingestive behaviour.

Why sensory evaluation is important in food industry?

Sensory assessment is a necessary method in the following five categories of problems:

- Development new product
- Cost – cutting measures
- Increase level of quality
- Product acceptability
- Quality assurance and control

- The sensory evaluation focuses on objective measurements of product sensory properties and subjective responses to physical products and interpretation of consumer response through product understanding.



- One can use sensory analysis for quality control, shelf-life determination, estimating product launch readiness, evaluating product success, flavour profiling, and finding the factors that drive customer preferences.
- You can use it to make critical decisions concerning raw materials, components, additives, storage and packing conditions, expiration or "best by" dates, and product optimization.

1. **Difference Tests**

- Difference testing compares food items to see if they differ in any way.
- The odour, taste, and texture are only a few of these characteristics.
- The three different types of tests, the triangle test, the duo-trio test, and the paired comparison test, are:

The Triangle Test

- Find one odd or find two identical samples
- It determines whether discernible sensory differences exist between two items.
- It is especially effective when production adjustments may have resulted in product alterations.
- The panellists taste the three samples and identify which one is unique.
- When there is significant taste carryover across samples and panellists are puzzled by three models to evaluate rather than two, a triangle test may not be the best option.
- Instructed to taste from left to right (A, B, C)

The Duo-Trio Test

- Which of the sample is the same as reference sample
- The probability of guessing the right answer is 50
- One reference sample (R)
- Two coded test samples (A, B)
- A is same as the reference sample (control product)
- B is the product to test.
- First reference taste than find A or B similar
- It can also be used to detect product variances caused by changes in ingredient suppliers, storage, packaging, and other factors.
- The **sensory Eater** indicates the sample that is identical to a specific reference sample.
- It is straightforward to comprehend.

Paired Comparison Tests

- Determine whether two products differ in specific attributes
- Two differently coded samples are presented to each panellist simultaneously
- Judge must give an answer - forced to answer

- Probability 1 /2
- A, B which one is more sweet?
- It determines which of two samples has more of a given attribute or which of two examples is favoured.
- It is regarded as an acceptability test in the latter application.
- It's one of the most used attribute difference tests, and it's simple to grasp for panellists.

2. **Descriptive Tests**

- A descriptive **food sensory analysis** provides a complete profile of a food product's sensory attributes and a qualitative assessment of the intensity of each feature.

Flavour Profile Test

- Character traits, attribute intensity, order of attribute appearance, aftertaste, and amplitude are the five primary components of the Flavor Profile approach (the overall impression of the analysable and non-analysable flavour components).
- Initially, the flavour profile was graded on a five-point scale: not present, threshold, minor, moderate, and vigorous.
- Over time, the scale has evolved to include more points (initially seven, now 14) to accommodate more intensity differentiation.

Texture Profile Test:

- The Texturometer – A New Instrument for Objective Texture Measurement presented five primary characteristics for evaluating food texture (hardness, cohesiveness, adhesiveness, viscosity, and elasticity) and three additional factors (brittleness, chewiness, and gumminess).

The Spectrum Descriptive Analysis

- incorporates the Flavor and Texture Profile Methodologies' rigorous training and organization and a more extensive panel group (up to 15 individuals), a

more refined scale (usually 150 points, subject to the product), and statistical methods to the descriptive data.

Quantitative Tests:

- Individual assessments are conducted with a panel of ten to twelve persons who are asked to quantify product qualities using a six-inch line scale with half-inch intensity indicators.

Free Choice Profiling

- In two fundamental ways, Free Choice Profiling differs from the previously mentioned methodologies.
- To begin with, each panel's participants are "untrained" customers.
- They are not chosen based on their ability or expertise in spotting tiny changes in product qualities, even if they are given instructions on the evaluation.
- Second, rather than an empirical rating, the participants primarily focus on offering "liking" or "acceptance" replies (among other qualifiers) as a way of measurement for each quality.

3. **Affective Testing**

- The test method is clear and straightforward, so the panel of consumers will know how to reply.

The Paired Preference Test

- It is a method of determining the preferences of two people.
- A preference test can be undertaken once a significant difference between the two wines has been resolved.
- This helps decide which wine mix to use or which yeast fermentation method to utilize.
- These types of test supply information about peoples likes and dislike of product.
- They are not intended evaluable specific characteristics.

Ranking Test:

- A preference ranking test may be completed if more than two samples are reviewed.
- A customer can usually rank three to five pieces in a reasonable amount of time.
- The consumer is asked to rate the samples in preference in this **sensory evaluation technique**, with "1" being the most desired.

The Hedonic Test

- The hedonic scale can be used to determine the degree to which one or more things are acceptable.
- This is a categorical scale with an odd number of categories (five to nine), ranging from "dislike highly" to "like extremely."
- There is a neutral middle (neither like nor dislike).
- Based on their responses, customers rank the product on a scale.
- Hedonic scale
- Scoring – certain score is given to each sample attributes in logical order on score sheet (mostly used in dairy industry)

Hedonic scale

S.No	9 point	5 point
1	Like extremely	High acceptable
2	Like very much	Very acceptable
3	Like moderately	Acceptable
4	Like slightly	Fair acceptable
5	Neither like nor dislike	Not acceptance
6	Dislike slightly	
7	Dislike moderately	
8	Dislike very much	
9	Dislike extremely	

- Prepare the food sample
- Ask each taster to taste each sample
- This is a 5 point scale or 9 point scale
- Taster may also wish to make remarks on appearance, colour, taste, texture
- Analyse the result

Water Quality and Utilities

Water Quality

- Water quality refer to the physical, chemical, biological and organoleptic (taste related) properties of water

Water quality important?

- The presence of certain contaminates in our water can lead to health issues, including gastrointestinal illness, reproductive problems and neurological problems

Water quality testing

Physical test

- Indicates properties detectable by the sense

Chemical test

- Determine the amount of mineral organic sub effect the water qualities

Bacteriological test

- Show the presence of bacteria or pollution

Physical test

- Colour, turbidity, total solids, dissolved solids, suspended solids, odour, taste are recorded

Colour

- May be caused by the presence of minerals such as iron, manganese, or by substance of vegetable origin such as algae and weeds

Turbidity

- Because of suspended solids, colloidal substance due to microorganism growth
- High turbidity make filtration expensive

Odour and taste

- Associated with the presence of living micro organism
- Decay organic matter including weeds, algae or industrial wastes contain ammonia, phenols can also cause off odour and taste
- The taste is imparted to fish
- While chlorination dilutes odour and taste cause by some contaminates

Chemical tests

- pH, hardness, presence of a selected group of chemical high toxic chemicals, BOD

pH

- pH is measured hydrogen ion concentration
- it is an indicator of relative acidity or alkalinity of water
- above 9.5 - high alkalinity
- below 3 – high acidity
- drinking water should have a pH between 6.5 and 8.5

BOD (biological oxygen demand)

- It denotes the amount of oxygen needed by micro organism
- For distillation of decomposable organic matter under aerobic condition

High BOD indicates

- Less oxygen to support life
- Organic pollution

Bacteriological test

- Generally check for indicator bacteria

Ex: coliform, Ecoli

- Testing for the presence or absence of disease causing bacteria
- These Bacteriological test are very expensive and conducted only if they are absolutely needed

Mineral test

- Determine if the mineral content of your water is high enough to effect health the aesthetic and cleaning, capacities of your water
- Mineral test may include calcium, magnesium, manganese, iron, copper, zinc

Water utility

- Utility water is for domestic and commercial application areas, which is not of drinking water quality.

UNIT III

Critical Quality control point in different stages of production including raw materials and processing materials.

Techniques for quality control

Following procedures are followed for quality control of processed products:

- Identify the critical points in the process flow sheet which contributes to major quality characteristics
- Sample each critical points and identity what is being sampled and to what extend it is critical
- Evaluate and relate quality at critical successive stages to costs and its application in field
- Relate costs to deviation from specified levels
- Evaluate data collect against standards and legal requirements
- Provide consistent system for the orderly continuous evaluation of quality from the selection of raw materials through different stages of processing
- Diagnosis problems and prediction before they occur
- Determine the extent of drifts and shifts in production and minimize or localize differencies
- Evolve a system to determine how well the quality control program is succeeding

Quality control during processing

The sequence of operation in quality control followed during processing are as under

1. Raw material control
2. Process control or the control of the manufacturing process
3. Production and processing inspection
4. Sensory evaluation
5. Packaging
6. Labelling and storage

1.Raw material control

- The quality of food material is judged in terms of its nutritional value, purity, wholesomeness and palatability.
- It any of these properties is not optimal, the food quality is affected
- Raw material examinations include test for getioness and composition, freedom from contaminant and conformity with official or factory standards

- The manufacturing of a desired food production depends upon the close collaboration between plant breeders, agronomists, horticulturists and food technologists
- All control tests are run on the sample and any adjustments a required are made in the processed product
- Approval for process is given only after all quality specification on the sample run have been not.

2.Process control

- During processing, afternoon should be given to processing procedure
- In order to get product of desired quality, all treatments standardises such as use of correct amount of ingredients, mixing, processing time and temperature etc., should be followed.
- The desired composition, consistency, colour and concentration are checked and ensured, where processing control are not properly employed. Ex: during dehydration.

3.Production, processing inspection

- Examination of the finished product is carried out to determine as to what extend the desired quality specifications have been achieved.
- Careful inspection is made of the external conditions of the can.
- A can where both ends are concave is said to flat and is said to be good while cans which have the problem of topper, springs or smell do not pass inspection.
- The dried product is regularly checked for its reconstitution value.
- Tests are also performed to check certain physical properties, such as crispiness, colour, viscosity and texture.
- Microbiological examinations are carried out to check whether proper hygiene procedures lower been followed.

4.Sensory evaluation

- After physical, chemical and biological examination have been performed on a finished product with a satisfactory result, the product is considered ready for distribution but only after sensory quality has been assessed.

5. Packaging

- The primary purpose of manufacture is to produce a food product to keep it in good condition and to preserve the flavour until reaches the consumer.
- Therefore, it is essential that a suitable packaging material is chosen for packing a finished product.
- Material used for packaging should not contaminate the product and must be effective in preventing the product from deterioration.

6. Labelling and storage

- After packaging. Labels are pasted on the finished product which are intended for sale.
- The information on the label shall include the name of product, ingredient used, date of manufacture, name and address of the manufacturer, sale price, net weight, volume etc.,
- A good and attractive label is and aid to successful marketing of the product.
- The product should be stored in cool and dry place.

Critical control points of inspection

- The critical control points of inspection followed during canning of foods in syrup are as under.

1.Raw material

- The important material used is fruit sugar and citric acid, water used in making syrup should be suitable for purpose of canning.
- Fruit: variety, maturity, extend of spoilage, handling and storage etc.,
- Sugar and citric acid with respect to physical and chemical characteristics

2.Tin containers

- Type of tin plate, weight of tin coating, side seam etc.,

3.Washing of fruits

- Quality of water

4.Preparation of fruit

- Efficiency of prepatory operator like peeling, sleeting, coring, trimming and freedom from damaged or diseased portion.
- Uniformity with respect to colour, texture and maturity.

5.Preparation of syrup

- Calculation of strength of covering syrup
- Control of weight, temperature and uniformity

6.Filling

- The coefficient of variation in weight of empty cans is generally about 4%

7.Exhausting

- Periodic checks should be made to ensure that the cans coming out of exhaust box

8.Container closure operation

- Protection, cleaning, maintains, measurement

9.Processing

- Recording of retorting operation

10.Cooling water

- Microbiological quality
- Chlorine content

11.Post process handling

- Warehousing temperature, humidity etc.,

12.Clean up and sanitation
13.Steam quality
14.Examination of finished product
15.Sanitation control (sampling, location)
16.General inspection

- Product preparation area

Food quality and quality control including the HACCP system

Food quality and control

- Quality control is the standard which maintain quality of products according to the customers acceptability.
- Physical, chemical, microbiological, nutritional and sensory parameters are used for maintenance of nutritious food.
- The quality factor depends on specific attributes such as sensory properties, based on flavour, aroma, taste, texture and quantitative properties namely percentage of sugar, protein, fiber etc.
- To ensure standardization of these procedures, food laws and regulation cover the related acts affecting the marketing, labelling, production, food additive used, enforcement of GMP, HACCP, federal laws and regulation etc.

Food quality

Quality parameters:

- In order to ensure the right quality of various food products, several parameters are evaluated by different methods.

1. Physiochemical and rheological parameters
2. Phytochemical parameters
3. Packaging materials

1.Physiochemical and rheological parameters

S. No	Parameters name	Evaluation method	Products
1	Admixture	Visual observation	Cereal, pulses
2	Crude fiber	Mix Chemical	Most of fruits and vegetables
3	Moisture	Hot air oven, vacuum oven	Most of food products, animal Beed
4	Optical rotation	Polari meter	Sugar, syrup, oil and fat

2.Phytochemical parameters

S. No	Parameters name	Evaluation method	Products
1	Anthocyanin	Chemical and spectrophotometer	Red colouration Fruit and Vegetables
2	Antioxidant activity	Chemical and spectrophotometer	Most of Fruit and Vegetables
3	Lycopene	Chemical and spectrophotometer	Coloured Fruit and Vegetables
4	Ascorbic acid	Chemical and titration method	Most of Fruit and Vegetables

3.Packaging material

S. No	Parameters name	Evaluation method	Products
1	Migration test	Chemical	Food grade plastics
2	Laquer	Physical chemical	Tin cans
3	Heavy metals	AAS (atomic absorption spectroscopy)	Coloured plastics

Benefits of food analysis

- Used to remove toxic substance from food
- Increases shelf life of foods during storage
- Adds extra nutrients such as vitamins

Drawbacks of food quality measure

- By heat treatment Vitamin C is destroyed
- Large mixing, grinding, chopping etc., introduce
- Number of contamination risk
- Decrease in nutrient density

Quality control

Methods of food quality control

The process improvement cycle comprising

1. PLAN (plan improvement)
2. DO (implement plan for improvement)
3. CHECK (analyse the collected data)
4. ACT (take action)

- Quality control process consist of raw materials in process, product and service, statistical quality control consist of following procedures

1. Finished product is measured
2. Sampling occurs for days or week
3. Lot is either accepted or rejected based on information from sample

HACCP

<u>12 steps of HACCP (principles)</u>

1. Assemble HACCP team
2. Describe product
3. Identity intended use
4. Construct flow diagram
5. Confirm flow diagram on site
6. List all potential hazard, conduct a hazard analysis, consider control measure
7. Determine critical control point (CCPs)
8. Establish critical limit for each CCP
9. Establish a monitoring system for each CCP
10. Establish corrective actions
11. Establish verification procedures
12. Establish documentation and record keeping

Step 1:HACCP Team

- Multi-disciplinary, inter – hierarchical, workable size, expertise needed, use of external experts and consultant
- Includes inputs from all discipline
- Can lead to more cohesive workforce

Terms of reference / scope

- Types of hazard categories included
- Which product / process
- Whole process or process module
- Start and end points

Step 2: Describe product

- A description of nature and characteristics of product
- It is important to understand the product, understand what makes it safe

For Ex:

- Product name and type
- Processing details (preservation methods: - heating, freezing)
- Composition: - Ex: ingredients / raw materials used
- Shelf life: - Ex: (use by or best before date)
- Allergen information

Step 3: Identify intended use

- A consideration of how the customer and / or consumer should / could use / abuse the product and who it is suitable for.
- It can be done as a part of product description
- Whether the product is targeted at a vulnerable group

Step 4: Construct flow diagram

- A step wise illustration of process under consideration
- It is important because to ensure all inputs / outputs and steps considered

Step 5: On site confirmation of process flow diagram

- Walk the process to confirm detail
- Ensure it is carried out by someone not involved in the design
- Check for seasonal variations
- Test it out at different times / shifts

Step 6: list all potential hazard, conduct hazard analysis, consider control measure (principle 1)

Hazard analysis

- Fundamental part of HACCP
- Identifies significant hazards and control
- The process of collecting and evaluating information on hazard and condition leading to their presence to decide which are significant for food safety and therefore should be addressed in HACCP (Codex 2001)

List all potential hazard:

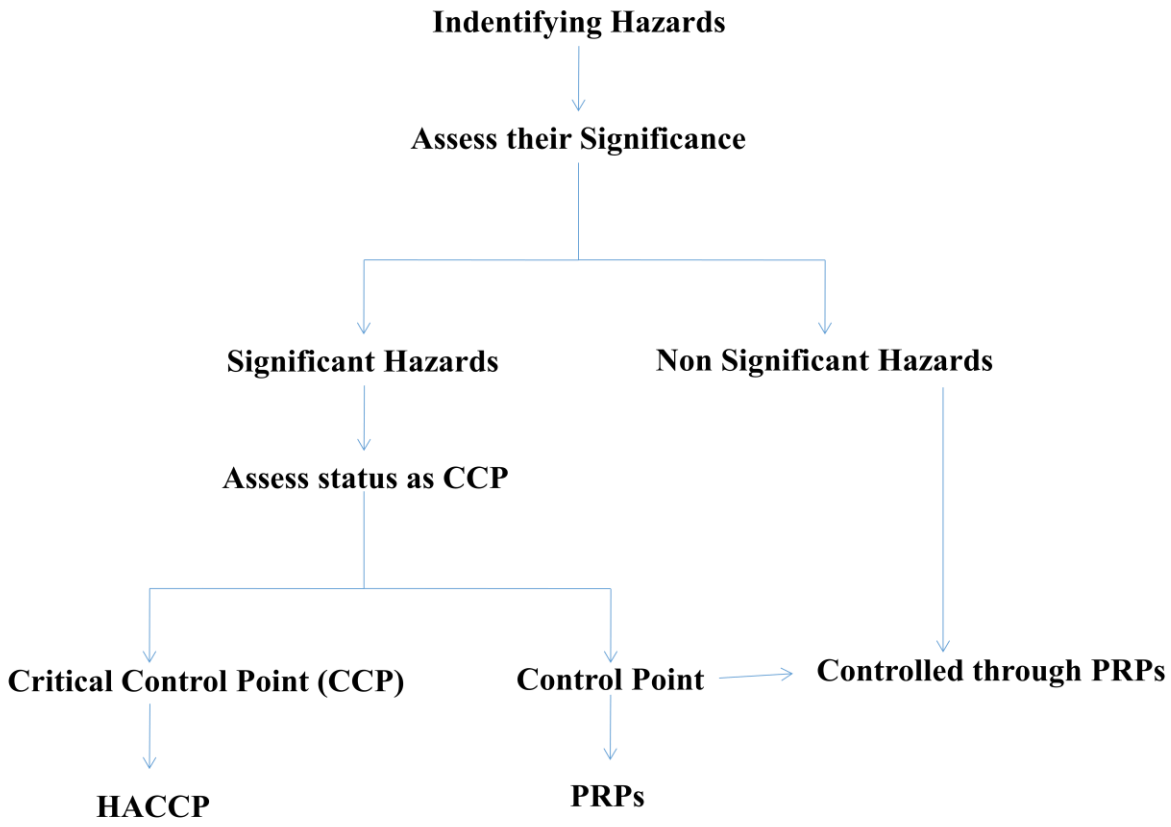
- List all potential hazard that could be expected to occur at each step
- Includes hazards in raw materials, introduced during the process which raw material or survive at a process step
- Hazard categories: - microbiological, chemical, physical and allergenic

Hazard:

- A biological, chemical, physical or allergenic agent in or condition of food with potential cause and adverse health effect
- Includes detail of three elements: - What the hazard is, flow its manifest itself, what is source / cause is?
- Microbiological hazards: - pathogenic bacteria, viruses, moulds
- Physical hazards: -in terms which are sharp and may cause injury
- Allergenic hazard: - symptoms ranges from rashes
- Chemical hazard: - pesticides, heavy metal, natural toxins etc.,

Conduct hazard analysis (asses significance / risk)

- Risk: - probability of an adverse health effect and the severity of hazard in food
- Like hood: - the like hood of hazard occurring
- Severity: - the seriousness of adverse health effect
- Significant hazard: - hazards must be prevented, eliminated or reduced in order to produce safe food



Identify control measures:

- Any action or activity that can be used to prevent of eliminate a food safety hazard or reduced it to an acceptable level (Codex 2001)

Step 7: Determine CCP (principle 2)

- Steps om the process that must be controlled in order to produce safe food
- A step at which control can be applied and is essential to prevent or eliminate a food safety hazard or reduce it to an acceptable level (codex 2001)
- Identified using a decision tree or judgement and experience of team

Step 8: Establish critical limit for each CCP

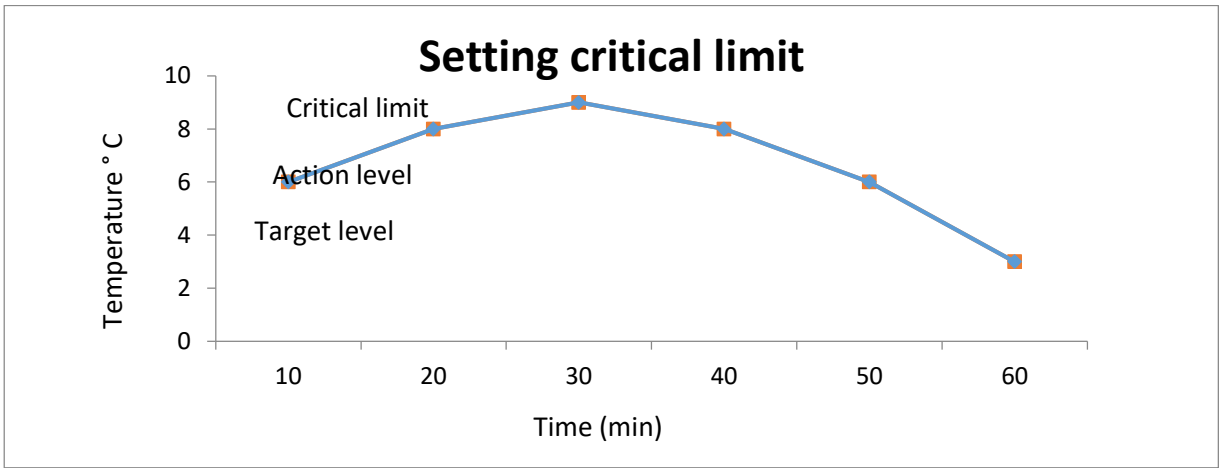
- Critical limit: a criterion which separates acceptability from unacceptability (Codex 2001)

Or

- Values which separate safe from unsafe product

Ex: cooking to core temperature > 75 ° C

Setting critical limit



- Three steps: target level, tolerance, unacceptable process deviation

Step 9: Establishing monitoring system

- To identify deviations and trigger corrective actions
- To identify towards loss of control
- Monitoring records provide evidence of production of safe food and will be used for verification
- Finding out if CCP is under control

Step 10: Establish corrective actions

- Any action to be taken when the result of monitoring at the CCP indicate a loss of control

Step 11: Verification, Validation and Review

- Verification: - To meet the legislative requirements

Step 12: HACCP documentation

- The evidential base for the HACCP plan
- To satisfy legal requirements

Food inspection and Food law

- Food inspection is at the heart of the enforcement system
- The approach of food inspection has shifted from being most reactive, based on food end product inspection to being preventive and risk based taking into account

Benefits of risk based food inspection

- Focuses on points of the food chain or processes that poses highest risk.
- Minimize cost to food operators
- Promotes preventive rather than reactive approach to food control
- Optimizes the efficiency of food control and use of inspection resources

FAO's work in food inspection

- FAO delivers a range of activities to support member countries introduce implement and strengthen risk based food inspection system and food safety and quality management system
- Technical assistance includes the provision of broad policy to help national authorities develop and improve the:
- Use of risk analysis framework for building, monitoring and inspection programme
- Specific sampling issues
- Management and harmonization of inspection programmes and services

Indian standards / regulations of food safety

- Food safety means an assurance that the food is acceptable by human consumption according to its intended use
- Standards: standards notified by food authority
- It provides confidence to consumes that the food they buy or ear will not harm them and they are protected from adulteration

Food laws and regulation

Objective

- These law ensure safety and stability of food for consumes
- To meet country sanitary and phytol sanitary and requirements.
- Food must have local laws and regulation to gain market access

Indian laws

- Prevention of food adulteration act
- Export act (quality and control of inspection)
- Milk and milk products order
- Vegetable oil product order
- Fruit product order
- Agricultural product act
- Edible oil packaging order

FSSAI (food safety and standard authority of India)

- FSSAI has been established under FSS act 2006
- It has been created to lay down science basis standards for food and to regulate this manufacture, storage, distribution, sale, imprints to ensure availability of safe and wholesome food for human consumption

Functions performed by FSSAI

- Laying down mechanisms and guidelines for accreditation of certification of food safety management system for food business
- Laying down procedure and guidelines for accreditation of laboratories
- Providing training programmes for person involved in food business
- Promote general awareness about food safety and standards
- Creating an information network across the country so that public consumers, panchayat receives rapid object information about food safety and issues of concern

BIS (Bureau of Indian standards)

- The national standards body of India, resolves to be leader in all matters concerning standardization quality and certification

Main activities

- Certification to product, hall marking of gold jewellery, quality management system, HACCP etc.,

AGMARK

- The directorate of marketing and inspection enforces the agriculture produce (grading and marketing) Act 1937.
- Under this act grade standard are prescribed for agriculture and allied.
- It acts as 3rd party guarantee to quality certified
- Produces available under agmark: - pulses, vegetable oils, wheat products etc.,

MFPO (meat food products order)

- The main objective is regulating production and sale of meat food products through licensing of manufacture, enforcing sanitary and hygiene conditions prescribed for meat food product, exercise street quality control for production in all stages of meat products, fish product meeting chilled pouty etc.,
- Meat and meat products are highly permissible in nature and can transmit disease from animals to human beings

- Processing of meat products is licensed under meat food products under (MFPO) 1973 which was being implemented by ministry of food processing industries

MMPO (milk and milk products order)

- The objective of the order is to maintain and intense the supply of liquid milk of desired quality in the interest of general public and also for regulating the processing, production and distribution of milk and milk products
- As per the provision of this order, a person / dairy plant handling 10,000 L of milk per day or 500 MT of milk solids need to be registered in registered authority of central government.

Fruit product order (FPO) 1955

- The objective is to manufacture fruits and vegetables products maintaining sanitary and hygiene practices in premises and including quality standards.
- It is mandatory for all manufactures of fruit and vegetables products including some non-fruit products like non fruit vinegar, syrup and sweetened aerated water to obtain licence under this order.

Prevention of food adulteration act 1954 (PFA)

- To make provision for prevention of food adulteration
- PFA acts covers food standards, general procedure for sampling, analysis of food, power on authorized officers, nature of penalties and other parameters related to food
- It deals with parameters relating to food additives, preservatives, colouring matter, packaging and labelling of food, prohibition and regulation of sales.

Risk analysis

- Defined for the purpose of the codex alimentarius commission as a process consisting three components

1.Risk assessment

- The scientific evaluation of known or potential adverse health effects resulting from human exposure to food borne hazards.
- A proper risk assessment can be described as being objective and unblased with absolute transparency

A proper risk assessment consists of following steps:
i)Hazard identification
ii)Hazard characterisation
iii) Exposure assessment
iv) Risk characterisation

i)Hazard identification

- The identification of biological, chemical and physical agents capable of causing adverse health effects and which may be present in particular food or groups of food.
- Potential biological hazards: bacterial, molds, yeasts, viruses etc.,
- Potential chemical hazards: toxic plant material, intentional / unintentional food additives, insecticides, pesticides, etc.,
- Potential physical hazards: glass, wood, stones, metal, bones, etc.,

ii) Hazard characterisation

- The qualitative and or quantitative evaluation of the nature of adverse health effects associated with biological, chemical and physical agents which may be present in food
- For chemical agents, a dose response assessment should be performed
- For biological or physical agents, a dose response assessment should be performed if the data are obtainable

Dose response assessment

- It involves describing the quantitative relationship between the amount of exposure to a chemical and extent of toxic injury or disease

iii) Exposure assessment

- The qualitative and or quantitative evaluation of the likely intake of biological, chemical and physical agents via food as well as exposures from other sources if relevant
- This step characterises the amount of hazard that is consumed by various members of exposure population
- An exposure assessment examines the exposure to hazard over a particular period of time in foods that are actually consumed

iv) Risk characterisation

- The qualitative and or quantitative estimation including attendant uncertainties of the probability of occurrence and severity of known or potential adverse health effects in a given population based on hazard identification, hazard characterisation and exposure assessment.
- A proper risk characterisation should take into account multiple degrees of uncertainty and variability

Principles of risk assessment

1. Identify hazards
2. Assess the risk
3. Control the risk
4. Record your findings
5. Review the controls

2. Risk management

- The process distinct from risk assessment of weighing policy alternatives, in consultation with all interested parties, considering risk assessment and other factors relevant for the health protection of consumes and for the promotion of fair trade practices and if needed, selecting appropriate prevention and control points

3. Risk communication

- The interactive exchange of information and opinions throughout the risk analysis process concerning hazards and risk, risk related assessors, risk managers, consumers, industry, the academic community and other interested parties including the explanation of risk assessment finding and basis of risk management.

Microbial Risk Assessment

Definition:

- Microbial risk assessment (MRA) is a systematic approach to evaluating the risks associated with microbial hazards in food, water, environmental samples, or other matrices.

Steps in Microbial Risk Assessment

Step 1: Hazard Identification

Identify Microbial Hazards:

- Determine which microorganisms pose a risk to human health.

Sources of Hazards:

- Foodborne pathogens (e.g., Salmonella, E. coli), waterborne pathogens (e.g., Cryptosporidium, Legionella), environmental pathogens.

Step 2: Hazard Characterization

Pathogen Properties:

- Assess characteristics of the identified microorganisms, such as virulence factors, survival capabilities, and growth requirements.

Dose-Response Assessment:

- Estimate the relationship between the dose of a microorganism and the probability of infection or illness in exposed individuals.

Step 3: Exposure Assessment

Evaluate Exposure Pathways:

- Identify routes of exposure to microbial hazards (e.g., ingestion, inhalation, dermal contact).

Quantify Exposure Levels:

- Estimate the magnitude, frequency, and duration of exposure to microorganisms through different pathways.

Factors Affecting Exposure:

- Consider food consumption patterns, water usage, hygiene practices, and environmental conditions.

Step 4: Risk Characterization

Integrate Hazard and Exposure Data:

- Combine hazard characterization and exposure assessment to estimate the level of risk.

Quantitative Risk Assessment:

- Use mathematical models to calculate the probability and severity of adverse health effects.

Qualitative Risk Assessment:

- Descriptive assessment based on expert judgment when quantitative data is limited.

3. Tools and Techniques in Microbial Risk Assessment

Microbiological Sampling and Testing:

- Collect and analyze samples to detect and quantify microbial contaminants.

Predictive Modelling:

- Use mathematical models (e.g., growth models, survival models) to predict microbial behavior under different conditions.

Epidemiological Studies:

- Use of epidemiological data to understand disease transmission and assess public health risks.

4. Risk Management and Decision-Making

Risk Management Strategies:

- Implement control measures to reduce or eliminate microbial hazards in food, water, or other matrices.

HACCP and Good Hygienic Practices:

- Implementing preventive measures such as HACCP (Hazard Analysis and Critical Control Points) and GHP (Good Hygienic Practices).

Regulatory Compliance:

- Ensure compliance with food safety regulations and standards related to microbial hazards.

Dose-Response Modelling

Definition:

- Dose-response modelling is a quantitative method used to characterize the relationship between the dose or exposure level of a substance and the biological response or effect observed in an organism or population.

Types of Dose-Response Models

Linear Models

Linear Non-Threshold Model:

- Assumes a linear relationship between dose and response without a threshold.
- Adverse effects increase linearly with increasing dose.

Linear Threshold Model:

- Assumes a linear relationship above a certain dose (threshold).
- Below the threshold, no adverse effects are expected.

Non-Linear Models

Sigmoidal (Emax) Models:

- Describe a sigmoidal curve where response increases with dose until reaching a maximum effect (Emax), beyond which increasing dose does not increase response further.

Non-Monotonic Models:

- Response may vary in a non-linear manner across different dose ranges, showing peaks or valleys.

Steps in Dose-Response Modelling

Step 1: Data Collection and Preparation

Exposure Data:

- Gather information on exposure levels, duration, frequency, and routes of exposure.

Response Data:

- Collect data on biological responses, health outcomes, or clinical endpoints observed in exposed individuals or populations.

Step 2: Model Selection

Model Assumptions:

- Choose an appropriate model based on the nature of the exposure-response relationship observed in the data.

Statistical Methods:

- Select regression techniques (e.g., linear regression, logistic regression), non-linear regression, or other modelling approaches (e.g., Bayesian modelling).

Step 3: Parameter Estimation and Model Fitting

Parameter Estimation:

- Estimate model parameters (e.g., slope, intercept, EC50) using statistical methods to fit the data.

Goodness-of-Fit:

- Evaluate the model's fit to the data using statistical measures such as R-squared, Akaike Information Criterion (AIC), or Bayesian Information Criterion (BIC).

Step 4: Model Validation and Uncertainty Analysis

Validation:

- Assess the predictive performance of the model using independent datasets or cross-validation techniques.

Uncertainty Analysis:

- Evaluate uncertainties in dose-response relationships, including variability in data, model assumptions, and extrapolation to different scenarios.

4. Factors Influencing Dose-Response Relationships

Individual Variability:

- Differences in susceptibility, genetics, age, sex, health status, and lifestyle factors affecting response to exposure.

Cumulative Exposure:

- Consideration of cumulative exposure effects over time and potential for chronic toxicity.

Route of Exposure:

- Different routes (e.g., oral, inhalation, dermal) may lead to different dose-response relationships.

5. Applications of Dose-Response Modeling

Toxicology:

- Assessing the toxicity of chemicals, environmental contaminants, food additives, and pharmaceuticals.

Pharmacology:

- Determining effective doses, therapeutic windows, and safety margins for pharmaceutical drugs.

Environmental Health:

- Evaluating risks from exposure to air pollutants, water contaminants, and occupational hazards.

Regulatory Decision-Making:

- Setting exposure limits, establishing safety guidelines, and informing risk management strategies.

6. Challenges in Dose-Response Modeling

Data Quality:

- Availability and reliability of exposure and response data, especially for low-dose effects and long-term exposures.

Model Complexity:

- Addressing complex interactions between multiple exposures, co-exposures, and confounding factors.

Extrapolation:

- Challenges in extrapolating from experimental or high-dose animal studies to predict effects at lower doses or in humans.

Regulatory Acceptance:

- Ensuring that models meet regulatory standards for risk assessment and decision-making.

Exposure-Response Modelling

Definition:

- Exposure-response modelling is a quantitative approach used to describe the relationship between the magnitude of exposure to a substance or agent and the biological response or health outcome observed in individuals or populations.

Types of Exposure-Response Models

Pharmacokinetic Models

Definition:

- Models that describe the absorption, distribution, metabolism, and excretion (ADME) of substances in the body over time.

Applications:

- Predicting the concentration of a substance in blood or tissues based on exposure dose and duration.

Pharmacodynamics Models

Definition:

- Models that describe the relationship between drug concentration (exposure) and the resulting pharmacological or toxicological effect (response).

Types:

- Emax models (sigmoidal dose-response curves), linear models, and other empirical models.

Steps in Exposure-Response Modelling

Step 1: Data Collection and Preparation

Exposure Data:

- Collect information on exposure levels, duration, frequency, and routes of exposure.

Response Data:

- Collect data on biological responses, health outcomes, or clinical endpoints of interest.

Step 2: Model Selection

Model Assumptions:

- Choose an appropriate model based on the characteristics of the exposure and response data.

Statistical Methods:

- Select regression techniques (e.g., linear regression, nonlinear regression) or other modelling approaches (e.g., Bayesian modelling, machine learning).

Step 3: Model Development and Validation

Parameter Estimation:

- Estimate model parameters (e.g., slope, intercept, EC50) using statistical methods to fit the data.

Model Validation:

- Evaluate the model's predictive performance using validation datasets or cross-validation techniques.

Step 4: Interpretation and Application

Exposure Assessment:

- Estimate exposure levels associated with a specified level of response or effect.

Risk Assessment:

- Evaluate the potential risks associated with different levels of exposure, considering uncertainties and variability.

Regulatory Decision-Making:

- Inform regulatory decisions on safe exposure limits, risk management strategies, and public health interventions.

Factors Influencing Exposure-Response Relationships

Individual Variability:

- Differences in susceptibility, genetics, age, sex, health status, and lifestyle factors.

Cumulative Exposure:

- Consideration of cumulative exposure effects over time.

Threshold Effects:

- Determination of thresholds below which no adverse effects are expected.

Applications of Exposure-Response Modelling

Environmental Health:

- Assessing risks from air pollutants, water contaminants, and occupational exposures.

Pharmacology:

- Determining effective doses and safety margins for pharmaceuticals and therapeutic agents.

Food Safety:

- Evaluating risks from dietary exposures to contaminants and additives.

Occupational Health:

- Assessing risks associated with workplace exposures to chemicals, dusts, and physical agents.

6. Challenges in Exposure-Response Modelling

Data Quality:

- Availability and reliability of exposure and response data.

Complexity:

- Addressing interactions between multiple exposures and confounding factors.

Extrapolation:

- Limitations in extrapolating from animal studies or high-dose exposures to predict effects at low doses.

Uncertainty:

- Dealing with uncertainties in data, model assumptions, and variability in human responses.

Risk Management

Definition:

- Risk management is the process of identifying, assessing, prioritizing, and mitigating risks followed by monitoring and controlling the impact of these risks on a project or organization.

Components:

Hazard Identification:

- Identify potential hazards in the food supply, such as pathogens, contaminants, allergens, and chemical residues.

Risk Assessment:

- Evaluate the likelihood and severity of adverse health effects from these hazards.

Risk Mitigation:

- Implement measures to reduce or eliminate risks, such as food safety standards, regulations, and industry best practices.

Monitoring and Compliance:

- Continuously assess and ensure compliance with established risk management measures.

Response and Crisis Management:

- Develop strategies for addressing emergencies, recalls, and outbreaks.

Risk Management Frameworks and Standard

ISO 31000:

- International standard providing principles and guidelines for risk management processes, emphasizing systematic, structured approaches.

COSO ERM:

- Framework developed by the Committee of Sponsoring Organizations of the Tread way Commission, focusing on enterprise risk management integrating risk with strategy and performance.

Project Management Institute (PMI):

- Guidelines for risk management in project management, emphasizing proactive risk identification and response planning.

Regulatory Authorities:

- Government agencies (e.g., FDA, USDA) and international organizations
- (e.g., WHO, FAO) play a vital role in regulating and managing food-related risks.

Implementation of Food Surveillance System to Monitor Food Safety

Definition:

- Food surveillance involves the systematic monitoring and assessment of food safety and quality throughout the food supply chain.

Components of a Food Surveillance System

Data Collection:

- Collect data from various sources, including inspections, sampling, and laboratory testing.

Data Analysis:

- Analyze data to identify trends, patterns, and potential risks.

Reporting and Monitoring:

- Communicate findings to relevant authorities, industry stakeholders, and the public.

Response and Enforcement:

- Take action to address non-compliance and food safety issues, which may include recalls or enforcement measures.

Continuous Improvement:

- Use surveillance data to enhance food safety regulations and practices.

Surveillance Methods:

- Surveillance includes methods such as regular inspections, random sampling, microbiological testing, chemical analysis, and consumer complaints tracking.

Global Collaboration:

- International cooperation is crucial for sharing surveillance data and addressing food safety issues that can cross borders.

Risk Communication:

Definition

- Risk communication is the exchange of information between experts, authorities, and the public about risks and risk management measures.

Key Elements of Effective Risk Communication:

Transparency:

- Open, honest, and accurate communication about risks.

Timeliness:

- Providing information promptly, especially during food safety crises.

Consistency:

- Maintaining a consistent message across all communication channels.

Audience-Centric:

- Tailoring messages to the needs and knowledge of the audience.

Feedback:

- Encouraging two-way communication and addressing concerns and questions.

Channels of Communication:

- Risk communication can occur through various channels, including public
- health websites, press releases, social media, and public service announcements.

Public Education:

- Educating the public about safe food handling practices and understanding food labels can empower consumers to make informed choices.

Crisis Communication:

- Rapid and effective communication during food safety emergencies is vital to inform the public and prevent panic.
- Effective risk management, food surveillance, and risk communication work together to ensure that food is safe and of high quality.
- These measures help protect public health, maintain consumer trust, and promote food safety at all levels of the food supply chain.

UNIT – IV

Indian and Global Regulations

Introduction to Food Regulations

- **Purpose**: Food regulations are established to ensure the safety, quality, and labelling of food products to protect public health and consumer interests.
- **Regulatory Authorities**: Regulatory bodies at national and international levels oversee compliance with food safety standards and regulations.

Indian Food Regulations

Food Safety and Standards Authority of India (FSSAI)

- **Role**: FSSAI is the apex regulatory authority in India responsible for formulating and enforcing food safety and standards.
- **Functions**:
    - Setting standards for food products, additives, contaminants, and labelling requirements.
    - Licensing and registration of food businesses to ensure compliance with food safety norms.
    - Monitoring and surveillance of food products through inspection, sampling, and testing.

Key Regulations

- **Food Safety and Standards Act, 2006**: Legislative framework for regulating food safety and standards in India.
- **Food Safety and Standards (Food Product Standards and Food Additives) Regulations, 2011**: Standards for various categories of food products, additives, and contaminants.
- **Food Safety and Standards (Packaging and Labelling) Regulations, 2011**: Requirements for packaging materials and labelling of food products.

Global Food Regulations

Codex Alimentarius Commission

- **International Standards**: Codex develops international food standards, guidelines, and codes of practice to facilitate international trade and ensure food safety.
- **Adoption**: Many countries base their national food regulations on Codex standards.

International Food Safety Standards

- **EU Regulations**: European Union regulations on food safety, labelling, and hygiene standards.
- **FDA Regulations**: Regulations by the U.S. Food and Drug Administration (FDA) covering food safety, additives, labelling, and imports.
- **WHO/FAO Guidelines**: Guidelines issued by the World Health Organization (WHO) and the Food and Agriculture Organization (FAO) on food safety and standards.

FAO in India

Introduction to FAO

Food and Agriculture Organization (FAO):

- A specialized agency of the United Nations that leads international efforts to defeat hunger, improve nutrition, and promote sustainable agriculture.

Mandate: To achieve food security for all and make sure that people have regular access to enough high-quality food to lead active, healthy lives.

- The Food and Agricultural Organization of the United Nations (FAO) in an international organisation that leads international effort to defeat hunger and improve nutrition and food security.
- The FAO coordinates the efforts of government and technical agencies in programs for developing agriculture, forestry, fisheries and land and water resources.

FAO what it is, what it does

- Information: FAO collects, analyses, interprets and disseminates information
- Advice: FAO provides independent advice on agricultural policy and planning
- Development assistance: FAO provides practical help to developing countries through technical assistance.

FAO's rule:

- One of the FAO's major role is "putting information in reach"
- FAO highlights information as one of the priority areas in achieving agriculture development and food security

FAO's mission statement

- Help eliminate hunger food insecurity and malnutrition
- Make agriculture, forestry and fisheries more productive and sustainable
- Reduce rural poverty

- Enable inclusive and efficient agricultural and food systems
- Increase the resilience of live hoods to threats and crises

Vision

- In contributing to a world face from hunger and malnutrition, the statistics division of FAO serves as the foremost
- Authoritative source of standards and methods as well as timely and reliable data on hunger, food and agriculture
- Develop, implement and promote international stastical standards, methods and tool in collecting
- Analysing and disseminating data

Other programmes

- Climate change issues in agriculture
- Agricultural development tools prepared and installed
- Integrated pest management (IPM)
- Special programme for food security (SPFS)

FAO in India

Programmes and projects

- The food and agricultural organisation of the united nations (FAO) has enjoyed valuable partnership with India since it began operation in 1948.
- It continues playing a catalyst role in India's progress in the area of crops, livestock's, fisheries, food security and management of natural resources
- The priorities set in the NITTS aayog's 7-year national Action agenda and the medium 3-year Action agendas as well as the union budget represent the key overarching framework for the agriculture sector.
- The main objective of govt. is to double farmer's income by solving the turn problems of maximising efficiency and ensuring equity in sustainable manner
- The 5 strategic objectives through their alignment into regional initiatives and regional priorities will govern FAO's support, in addition to the GOI's priorities and the priorities and outcomes laid out in the UNSDF.

Priority Area 1: Sustainable and improved agricultural productivity and increased farm incomes

- Under this priority area, FAO will facitate adaption of farmer's water school (FWS) in Uttar Pradesh on ground water management to surface irrigation practices to increase crop productivity and improve water use efficiency

Priority Area 2: Stronger food and nutrition security systems

- Under this priority area, FAO's technical assistance will focus on providing technical assistance that drive zero hungs initiatives of FAO

Priority Area 3: Effective natural resources management, community development and assistance in trans boundary cooperation to global public good

- Under this priority area, FAO will implement the GFF founded green agriculture project that will provide model for successful landscape approaches to address the interface of biodiversity conservation in and around key protected areas

Priority Area 4: Enhanced so well indusion improved skills and employment opportunity in the agriculture sector

Under this priority, FAO will focus on the building capacities and skill of the poor for gainful and sustainable livelihoods through employment generating agribuisters and enterprises clusters and other projects.

Technical Cooperation Programmes (TCPs):

Introduction to TCPs

- **Purpose**: Technical Cooperation Programmes (TCPs) are initiatives led by international organizations, such as the United Nations (UN) agencies or regional bodies, to provide technical assistance and support to member countries.
- **Objectives**:
    - Addressing specific developmental challenges or gaps in technical expertise.
    - Promoting sustainable development, capacity building, and institutional strengthening.
    - Facilitating knowledge exchange and sharing of best practices.

Key Components of TCPs

Needs Assessment

- **Identification**: Conducting assessments to identify priority areas and specific technical needs of the recipient country or region.
- **Consultation**: Consulting with stakeholders, including government officials, local communities, and experts, to determine the scope and focus of technical assistance.

Project Design and Implementation

- **Development of Proposals**: Formulating project proposals outlining objectives, activities, timelines, and expected outcomes.
- **Resource Mobilization**: Securing funding and technical resources from donor countries, international organizations, and other stakeholders to support project implementation.

- **Partnerships**: Collaborating with national governments, non-governmental organizations (NGOs), academic institutions, and private sector entities to implement projects effectively.

Capacity Building and Training

- **Training Workshops**: Organizing workshops, seminars, and training sessions to transfer technical knowledge and build the skills of local stakeholders.
- **Institutional Strengthening**: Supporting the development and enhancement of institutional capacities within government agencies and organizations.
- **Technology Transfer**: Facilitating the adoption and adaptation of technologies relevant to the project objectives.

Monitoring and Evaluation

- **Performance Monitoring**: Monitoring project progress, outputs, and outcomes to ensure alignment with planned activities and objectives.
- **Impact Assessment**: Evaluating the impact and effectiveness of TCPs in achieving developmental goals and addressing technical challenges.
- **Feedback Mechanisms**: Soliciting feedback from stakeholders to improve project implementation and inform future initiatives.

Examples of TCPs

Agriculture and Food Security

- **Enhancing Agricultural Productivity**: Introducing modern farming techniques, improving irrigation systems, and promoting sustainable agriculture practices.
- **Food Security Initiatives**: Implementing programs to enhance food security, reduce post-harvest losses, and improve access to nutritious food.

Health and Nutrition

- **Healthcare Systems Strengthening**: Supporting the development of healthcare infrastructure, training healthcare workers, and improving access to essential medicines.
- **Nutrition Programs**: Promoting nutrition education, maternal and child health initiatives, and addressing malnutrition.

Environmental Sustainability

- **Climate Change Adaptation**: Assisting countries in developing climate-resilient strategies, promoting renewable energy sources, and implementing environmental conservation measures.
- **Biodiversity Conservation**: Supporting efforts to protect ecosystems, preserve biodiversity, and promote sustainable natural resource management.

Bio security in food and agriculture

- Biosecurity is a key requirement for achieving the goals set out in the FAO strategic framework by promoting, developing and reinforcing policy and regulatory framework for food, agriculture, fisheries and forestry.
- Biosecurity has direct relevance to food safety, the conservation of the environment and sustainability of agriculture.
- Biosecurity encompasses all policy and regulatory framework to manage risks associated with food and agriculture including fisheries and forestry and constitutes 3 sectors namely food safety, plant life and health and animal life and health.
- These sector include food production in relation to food safety the introduction of plant pests, animal pest and disease and zoo noses the introduction and release of genetically modified organisms (GMO's) and their products and introduction and safe management of invasive alien species and genotypes.
- Growing industry in biosecurity is a result of major international development such as globalization of the world economy, the rapid increase in volume of communication, transport and trade, technological process and growing awareness of problems faced by biological diversity and environment
- Members require effective efficient improved and updated international frameworks and standards to support appropriate national action.
- Members also required national frameworks to regulate manage and control biosecurity in food and agriculture including forestry and fisheries thus permitting practical implementation increasing cost effectiveness and improving consistency across sectors.
- Recent developments related to biosecurity in food and agriculture include the tendency toward integration of and cooperation across sectors.
- Internationally this tendency is demonstrated in the WTO agreement on the application of sanitary and phytosanitary measures (SPS agreement) and convention on biological diversity (CBD) and its Cartagena protocol on biosafety.
- It is further addressed in FAO /WHO codex alimentarius, the international plant protection convention (IPPC) and the FAO code of conduct for responsible fisheries.
- The IPPC makes a key contribution to biosecurity by reducing the risk of introduction of plant pests that may effect agriculture and the environment.

World Health Organization (WHO)

- The World Health Organization is a specialized agency of the United Nations responsible for international public health.
- The WHO constitution states its main objective as the attainment by all peoples of the highest possible level of health
- Headquarter in Geneva, Switzerland. It has 6 regional offices and 150 field offices worldwide.
- The role in food safety is to proted the consumer against exposure to adverse effects from hazard in food.
- The organization has always recognised that access to adequate, nutritious and safe food is a right of each individual.
- WHO most important role is a normative fund, including international standard setting, health risk assessment and the development of risk analysis framework for the management of public health risk in food and water.
- The concept of risk analysis has been promoted by WHO as a framework for the development of public policy with regard to safety of food chain supply.

This consist of 3 components

1.Risk assessment

- A process of systematic and objective evaluation of all available information pertaining to food borne hazards.

2.Risk management

- The process of weighting policy alternatives in the light of the results of risk assessment and if required.
- Selecting and implementing appropriate control options including regulatory measures.

3.Risk communication

- The interactive exchange of information and options concerning risk and risk management among risk assesses, risk managers, consumers and other interested parties.
- WHO has a long history of providing advice on health risk assessment to the codex alimentarius commission and to member states. Reaction to the safety hazards in foods.
- WHO has a series of consultations to assess the safety of food produced by biotechnology and to assess the public health implications of emerging food borne pathogens.
- WHO provides training (Technical) in the application of risk analysis.
- The HACCP system and other food safety related skills
- In addition, WHO assist national government in the development and implementation of food legislations.

- To monitor food contamination and conduct surveillance of food borne disease
- WHO integrated approach to food safety incorporation activities in several department
- It works in conducted in coordination with other international organization. Mostly the food and agricultural organization (FAO) and recently also the world trade organization (WTO)

World Animal Health Organization (OIE)

- The world organization for Animal Health formerly the office international des Epizooties (OIE) recognized by the SPS agreement.
- Founded in 1924, the OIE has 6 main mission
- To ensure transparency in the global animal disease station
- To collect analyse and disseminate veterinary scientific information
- To provide expertise and encourage international solidarity in the control of animal disease
- Within its mandate under WTO SPS agreement to safeguard world trade by publishing health standards for international trade in animals and animal products
- To improve legal framework resources of national veterinary services.
- To provide a better guarantee of food of animal origin and to promote animal welfare through a science based approach

Ex: of OIE work in this area include the following

- International animal health code (for mammals, birds and bees)
- International aquatic animal health code (for fish, molluscs and crustaceans) and manual for aquatic animal disease
- Manual of standards for diagnostic tests and vaccines
- Animal health and human health are closely interlinked more than 60% of pathogens that cause disease in human originate from domestic or wild animals
- In addition, both animals and humans are affected by and effect the environment in which they exist.
- Zoonotic pathogens may be transmitted to human via food through direct content between animals and humans
- Although attempts have been made in some countries and regions to coordinated control system across the animal health food safety and human health sectors
- In view of recognised need for all important of better coordination of surveillance policies for animal health, food pathogens and food borne diseases

Food safety environment

Risk analysis

- The emergence of risk based approaches in elaboration of international standards has been highly influenced by the world trade organization (WTO)
- OIE focusses on standards from specified hazard of biological origin. In contrast, CAC has primary addressed biological hazards in food by developing general hygiene provisions.
- Risk analysis offers new opportunities to OIE and CAC in the elaboration of optimal sanitary measures either as international standards or as technical advice to national government.
- In the case of food safety improvement must be brought about in the face of ever changing patterns of primary production processing, technology and consumer behaviour.

Assessment and management of hazards and risks

- Consideration of all food borne hazards and their significance in terms of risk to human health in an essential food safety activity and core component of HACCP
- Most food borne hazards of animal origin will be either intrinsic to the line animal or introduce during handling and processing the product.

Production – to – consumption

- There should be an integrated approach to the design and implementation of regulatory system.
- Monitoring and surveillance of the form level, including consideration of data from non-regulatory sources and monitoring at other steps in the food chain including meat inspection.
- Monitoring and risk management of the use of veterinary drugs, including antimicrobial resistance
- Exchange of monitoring information with all interested parties
- Animal identification system of traceability of animal products
- Utilization of diagnostic tests
- Recognition of competence of food safety authorities in exporting countries
- Certification of official assurance
- Emergency response capability
- Potential effects on food safety of the transport of live animals
- Risk assessment + risk management

Food borne hazard to human risk

- Performance based inspection for process contents
- Establishing decision criteria for the outcome of risk reduction
- Risk based surveillance of live animals and monitoring of animal products throughout the food chain
- Effective information exchange of risk communication between all interested parties

Animal health hazards

- Hazards of animal health significance that can be detected in animal population must first be identified
- The risk assessed and properly managed, so as to optimise use of the available resource of vetnary services
- Veterinarians involved in food safety can make a significant contribution to achieving animal health goals through application of animal health measure.

International Plant Protection Convention (IPPC)

Introduction

- The international plant protection convention (IPPC) that came into being in 1951 at the 6th conference of the food and agriculture organization of united nations (FAO) in an international plant health agreement that aims to protect cultivated and wild plants by preventing the introduction and spread of pests.

IPPC Vision

- Protecting global plant resources from pests

IPPC Mission

- To secure cooperation among nations in protecting global plant resources from the spread and introduction of pests of plants, in order to preserve food security, biodiversity and to facilitate trade.

How the IPPC helps

By protecting plant resources from pests and diseases the IPPC helps to

1. Protect farmers from economically devastating pest outbreaks
2. Protect the environment from loss of species diversity
3. Protect ecosystem from loss of viability and function as a s result of pest invasion
4. Protect industries and consumers from the costs of pest control or eradication
5. Facilitate trade through standards that regulates that safe movements of plant and plant products.

6. Protect livelihood and food security by preventing the entry and spread of new pest of plants into a country.

- **CMP (The commission on phytosanitary measures)**

The secretariat:

- Facilitate the development and action of international standards
- Helps contracting parties resolve disputes
- Helps contracting parties build phytosanitary capacity to protect their wild and cultivated plants, their environment and their food security
- Organizes meetings plus other CPM activities

IPPC partners

- Convention members: To develop phytosanitary measures to manage plant pests
- Regional plant protection organization (RPPO's): To build phytosanitary capacity and address risk associated with movement within and between regions
- National plant protection organization
- NPPOS through government and local authorities to respond to plant health risk
- Technical experts in contracting party government to share information and expertise to strengthen phytosanitary capacity
- Exporters transporters to reduce the movement of pests

Producers:

- To put in place phytosanitary practices that protect livelihood, food supply societies and the environment.

Civil society:

- To build knowledge of phytosanitary capacity to protect biodiversity ecosystem vitality and conservation

Educators:

- To promote technical expertise in assessing and managing pest risk

Media:

- To build awareness of the impacts of plant pest

Donors:

- To find the creation of program that reduce plant pest risk and promote safe trade in plants and plant products.

UNIT – V

Codex Alimentarius Commission (CAC)

- The CAC is the body responsible for all matters regarding the implementation of the joint FAO / WHO food standard programmes.
- Membership of the commission is open to all member nation and associate members of FAO and WHO

Codex Alimentarius

- Latin word which means food code.
- It is intergovernmental body established in 1963 to set guidelines and standards to ensure fair trade practices and consumer protection in relation to the global food trade comprises 14 volumes.

Goals

The commissions main goals are

1. To protect the health of consumer
2. Ensure fair practices in international food trade

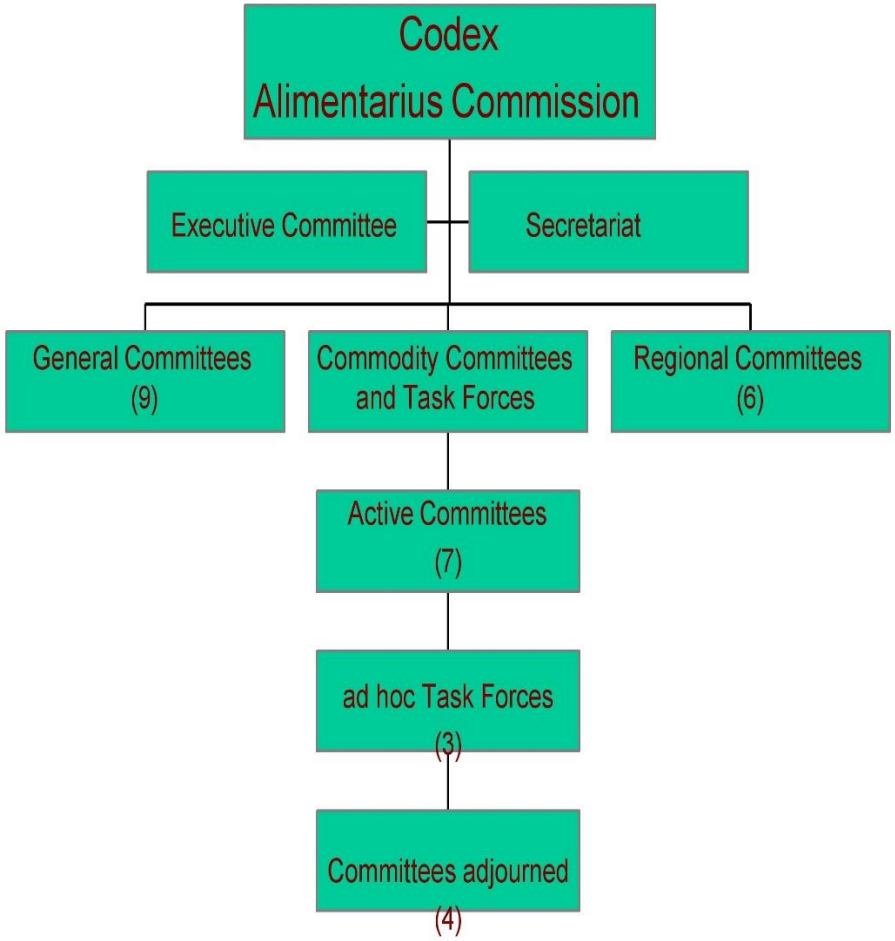
Objectives of CAC / function

- To protect health of the consumers
- To ensure fair practices in the food trade
- To coordinate all work regarding food standard
- To determine the priorities
- To publish the standards
- To initiate the preparation of standards

How is codex organised?

- Codex secretariat located at FAO HQ
- Executive committee meets annually
- Technical committees and task forces meet every 1 or 2 years
- Regional coordinating committees
- CAC sessions held every 2 years

Structure of the Codex Alimentarius Commission



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Horizontal codex standards

Horizontal standards

- Prepared in general subject committees
- Have across the board relevance to a number of commodities

Work of some codex horizontal committees is relevant to OTA question

- Food additives and contaminants (CCFAC)
- Food hygiene (CCFH)
- General principles (CCGP)
- Food import and export inspection and certification systems (CCFICS)
- Methods analyzing and sampling (CCMAS)

Vertical codex standards

- Vertical standards: Those related to particular commodity
- There are no vertical codex coffee standards, other international coffee standards exist (ISO, ICO)

Key features of codex process

- Science based participatory transparent
- Scientific advisory bodies to codex:

JECFA: joint FAO / WHO expert committee on food additives

JMPR: Joint FAO / WHO meeting on pesticide residues

JEMRA: joint FAO / WHO expert committee on microbiological risk assessment.

Effective participation in CAC

National codex structures

- ✓ National codex control points
- ✓ National codex committees

Regional codex coordinating committees

National codex structures

Codex contact point (CCP)

- ✓ The codex contact point acts as the liaison point with the food industry, consumers, traders and all other concerned to ensure that the government is provided with an appropriate balance of policy and technical advice upon which to base decisions relating to issues raised in the context of the codex work.

Functions of codex contact point

- Link between codex secretariat and member countries
- Coordination of codex activities within their own countries
- Reception and circulation of codex final texts and working documents of codex session
- Sending of comments on codex documents or proposals to the codex alimentarius commission, subsidiary bodies and or codex secretariat
- Close cooperation with national codex committee
- Liation with food industry, consumers, traders and other concerned parties
- Exchange of information and coordination of activities with other codex members
- Maintenance of a library of codex texts

National codex contact point (NCCP)

- NCCP India is the national codex contact point of India
- NCCP has been constituted by the FSSAI for keeping liation with codex alimentarius and to coordinate codex activities in India
- NCCP for India coordinates and promotes codex activities in India in association with the NCC and facilitates India's input to work of codex through an established consultation process.
- NCCP India is located at FSSAI, FDA Bhavan, New Delhi, India

Objectives of NCCP India

- To lay down the guidelines for preparation of national response or national view point to codex matters and participation in codex meeting
- To establish procedures for formulation of national view point / response
- To make the stakeholders understand codex working procedures so that they are capable and competent manner to the work of codex at the national level
- To propose new work on standards or code of practice or guidelines at the committee meetings
- To coordinate and promote codex activities in India in association with the national codex committee

National codex committee (NCC)

- The national codex committee has been constituted by the food safety and standards authority of India, chaired by chairperson, FSSAI to for keeping liaison with the CAC

Functions (NCC – India)

- To advise government on the implications of various food standardization, food quality and safety issues which have arisen and related to the work undertaken by the CAC so that national economic interest is taken into account or considered, when international standards are discussed.
- To provide important inputs to the government so as to assist in ensuring quality and safety of food to the consumers, while at the same time maximizing the opportunities for development of industry and expansion of international trade
- To appoint shadow committees on subject matters related to corresponding codex committees to assist in the study or consideration of technical matters
- To meet as and when necessary to formulate national position
- Act as consultative groups to the government

Regional codex committees

- Definition of problems and needs in the region
- Development of regional standards
- Coordinator of activities in the region
- Representation of specific interest of the region to the commission
- Promotion of acceptance of codex standards by the member countries

Role

- Coordinating committee for Africa, Asia, Europe, Latin America and the Caribbean, the near east, north America and the south west Pacific

Functions

- To advise the NCCP / NCC on the implications of various food standardization, food quality and safety issues which lower arisen and related to the work undertaken by the relevant subsidiary body or task force so that national economic interest is taken into account or considered when international standards are deliberated by the relevant committee
- To follow the codex agenda of the relevant subsidiary body and provide inputs to the government so as the assist in ensuring quality and safety of food to the consumers while at the same time safeguard national interest and maximize the opportunities for development of industry and expansion of international trade
- To advise on the composition of Indian delegation

- To coordinate with other shadow committee and concerned department for seeking comments and finalize India viewpoint on difference agenda items under consideration of the respective codex committees

Codex Alimentarius in India

Establishment:

- Codex Alimentarius Commission (CAC) was established in 1963 by the Food and Agriculture Organization (FAO) and the World Health Organization (WHO) to develop international food standards, guidelines, and codes of practice.

Objectives:

- The primary goal of Codex is to protect consumer health and ensure fair practices in food trade globally through science-based standards.

Role

Adoption and Implementation:

- India adopts Codex standards as benchmarks for food safety and quality.

Regulatory Framework:

- Codex standards are integrated into India's food safety regulations managed by the Food Safety and Standards Authority of India (FSSAI).

Implementation Mechanisms

National Codex Committee:

- India has a National Codex Committee (NCC) responsible for coordinating Codex-related activities.

Advisory Role:

- NCC provides advice and recommendations to FSSAI on the adoption of Codex standards and their incorporation into national regulations.

Importance

Consumer Protection:

- Codex standards ensure that food products in India meet international safety and quality benchmarks, protecting consumer health.

Facilitating Trade:

- Harmonized food safety standards facilitate the export of Indian food products by ensuring compliance with international requirements.

Role of Codex Contact Points

Definition:

- Codex Contact Points (CCPs) are designated by member countries to facilitate communication and coordination with the Codex Alimentarius Commission (CAC).

Purpose:

- CCPs serve as the primary liaison between national governments and the Codex Secretariat, promoting effective participation in Codex activities and ensuring compliance with Codex standards.

Functions and Responsibilities

Information Dissemination:

- CCPs disseminate information on Codex standards, guidelines, and activities to relevant stakeholders within their countries, including government agencies, industry, and consumers.

Coordination:

- CCPs coordinate national positions and contributions to Codex meetings, ensuring that the country's interests and concerns are adequately represented.

Technical Support:

- Provide technical support and advice to national stakeholders on the interpretation and implementation of Codex standards.

Capacity Building:

- Conduct training and awareness programs to build capacity within national food safety systems and improve understanding of Codex standards.

National Codex Committee (NCC)

Role within NCC:

- CCPs are often part of or closely collaborate with the National Codex Committee (NCC), which oversees Codex-related activities at the national level.

Advisory Role:

- CCPs provide advice and recommendations to the NCC and regulatory authorities on Codex standards adoption and incorporation into national regulations.

Collaboration with Codex Alimentarius Commission

Representation:

- CCPs represent their countries at Codex meetings and participate in the development of international food standards, guidelines, and codes of practice.

Feedback Mechanism:

- Gather input and feedback from national stakeholders to inform discussions and decision-making processes at Codex meetings.

Importance and Impact

Facilitating International Trade:

- CCPs ensure that national food safety measures align with Codex standards, facilitating the export and import of safe food products.

Consumer Protection:

- Promote the adoption of science-based Codex standards to protect consumer health and ensure food safety.

Harmonization:

- CCPs contribute to the harmonization of food safety regulations globally by promoting the adoption of consistent Codex standards across member countries.

Terms of Reference (ToR)

Definition:

- Terms of Reference (ToR) outline the objectives, scope, and responsibilities of a project, committee, or task force.

Purpose:

- To provide clarity and direction, ensuring all stakeholders understand their roles, expectations, and deliverables.

Components of ToR

Background

- Provides context, including the rationale for initiating the project or committee.

Objectives

- Clearly states the goals and outcomes to be achieved.

Scope

- Defines the boundaries and limits of the project or committee's authority and activities.

Roles and Responsibilities

- Outlines the specific duties and obligations of each stakeholder or committee member.

Duration and Timeline

- Specifies the timeframe for completion and milestones.

Resources and Budget

- Identifies the resources (financial, human, and technical) allocated to the project or committee.

Reporting and Communication

- Establishes communication protocols and reporting mechanisms.

Types of ToR

Project ToR:

- Defines the scope, objectives, and responsibilities of a specific project team or task.

Committee ToR:

- Outlines the mandate, structure, and functioning of a committee or working group.

Task Force ToR:

- Defines the purpose and activities of a temporary group assembled to address specific issues or tasks.

Development and Approval Process

Drafting:

- Developed collaboratively by stakeholders, ensuring input from relevant parties.

Consultation:

- Circulated for feedback and revisions before finalization.

Approval:

- Endorsed by relevant authorities or management before implementation.

Importance and Benefits

Clarity and Direction

- Ensures all stakeholders have a clear understanding of their roles and responsibilities.

Alignment

- Aligns project or committee activities with organizational goals and priorities.

Accountability

- Provides a framework for accountability and monitoring progress.

Efficiency

- Helps in efficient resource allocation and decision-making.

Examples of ToR Application

Project Management:

- Defines project scope, objectives, and team responsibilities.

Committees and Task Forces:

- Guides committee members on their roles and the scope of their mandate.

Consultancy Engagements:

- Defines expectations and deliverables for external consultants.

Research Initiatives:

- Outlines the scope and objectives of research studies or academic projects.

Terms of Reference (ToR) for National Codex Committee (NCC) of India:

Introduction

Purpose:

- Define the scope, objectives, roles, and responsibilities of the National Codex Committee (NCC) of India.

Authority:

- Established under the mandate of the Food Safety and Standards Authority of India (FSSAI) to coordinate and oversee Codex-related activities within India.

Background

Rationale:

- Provide context on why the NCC was established, emphasizing the importance of aligning Indian food safety regulations with international standards set by the Codex Alimentarius Commission.

Legal Basis:

- Reference to relevant laws, regulations, or directives empowering the NCC to fulfill its mandate.

Objectives

- Ensuring adoption and implementation of Codex standards in India.
- Facilitating participation in Codex meetings and contributing to international food safety standards.
- Harmonizing national food safety regulations with Codex standards to promote trade.

Scope

- Reviewing and endorsing Codex standards and guidelines for adoption in India.
- Providing technical guidance to stakeholders on Codex standards interpretation and implementation.
- Coordinating stakeholder consultations and feedback on Codex-related matters.

Structure and Composition

Membership:

- Government ministries and departments related to food safety and agriculture.
- Regulatory bodies (e.g., FSSAI) and industry associations.
- Academic and research institutions, consumer organizations, and relevant stakeholders

Roles and Responsibilities:

- Attending meetings, contributing expertise, and representing their respective sectors.
- Participating in working groups or subcommittees focused on specific Codex standards or issues.

Functions and Activities

Coordination:

- Facilitate coordination among stakeholders to ensure a unified national approach to Codex-related activities.

Review and Endorsement:

- Review Codex standards and guidelines proposed for adoption in India, providing recommendations and endorsements as appropriate.

Capacity Building:

- Organize training programs, workshops, and awareness campaigns to build capacity among stakeholders on Codex standards.

Communication:

- Act as the primary liaison between India and the Codex Secretariat, ensuring timely dissemination of information and updates.

Reporting and Accountability

Reporting Mechanism:

- Establish reporting protocols and frequency, detailing how progress, challenges, and recommendations are communicated to relevant authorities.

Accountability:

- Define mechanisms for monitoring and evaluating the effectiveness of NCC activities in achieving its objectives.

Duration and Review

Duration:

- Specify the term of reference for the NCC, including provisions for review and renewal.

Review Mechanism:

- Outline procedures for periodic review of the ToR to ensure relevance and alignment with evolving Codex and national priorities.

Shadow committee

- For every codex committee a parallel shadow committee has been constituted to work on subject matters corresponding to codex committees to assist the NCC in the study or consideration of technical matters
- Officers in the rank of joint secretary or above in the concerned department / ministry / food authority who handle the subject at the policy level and also serve as the members of the NCC may be nominated as the chairpersons of these shadow committees
- Specialized experts in the relevant field may be nominated as members of these shadow committee.

Constitution of shadow committee

- Composition of individual codex shadow committee varies and depends upon the expertise in each field
- Each shadow committee is constituted by various stakeholders as follows:
- Representatives from difference ministries viz.,
- ✓ Ministry of health and family welfare
- ✓ Ministry of women and child development
- ✓ Ministry of agriculture
- ✓ Ministry of food and processing and department of animal husbanded and dairy fisheries concerned with food safety, food production and trade in food
- Representatives from scientific organizations such as public universities and research institutions
- Representatives from industry associations. Experts / scientists from concerned areas

Various shadow committees

- ✓ There are 16 shadow committees

1.The committees under the charge of FSSAI

- ✓ Codex alimentarius commission
- ✓ Regional coordinating committee
- ✓ General principles
- ✓ Food labelling
- ✓ Methods of analysis and sampling
- ✓ Food hygiene
- ✓ Food additives
- ✓ Contaminates in food

- ✓ Fat and oil
- ✓ Processed fruit and vegetables
- ✓ Sugars

2.The committees under the charge of other ministries

- ✓ Food import and export inspection and certification systems: ministry of commerce
- ✓ Pesticides residues: ministry of agriculture (department of plant protection)
- ✓ Residues of veterinary drugs in food: ministry of agriculture (LH)
- ✓ Fresh fruit and vegetable: ministry of agriculture
- ✓ Nutrition and foods for special dietary uses: ministry of women and child development

When are shadow committee meetings conducted?

- ✓ Usually 3 months prior to respective main codex meetings depending upon the availability of agenda items under consideration

How do stakeholders contribute to shadow committee meetings?

- ✓ The stakeholders after going through the various agenda items for a particular meeting can submit their meaningful comments to finalize the national position.
- ✓ The comments shall all be specific and may be followed by scientific justification or rationale behind the opinion

DEPARTMENT OF

CHEMISTRY

ALL THE BEST