

# 'Ensuring Food Safety and Quality Through Advanced Technology'

Interactive session on: 'Innovative Food Products in India – Regulators Role'

For better understanding of the Policy, Regulation, Safety Measures and recently introduced Acts

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# Introduction

- ▶ Food is a vital component of our daily needs and wherever or however it is prepared it has to be standardized to obtain consistent quality, it should be safe for consumption, acceptable from the sensory view point and nutritious.
- ▶ When food is prepared on a large scale, packed and distributed it has to have the requisite shelf life under the prescribed conditions of storage.
- ▶ Large scale manufacture of foods further calls for many kinds of engineering inputs to be given to facilitate the manufacturing process.
- ▶ Innovative efforts in improving existing products or developing new products are essential for sustainability.
- ▶ The food industry has to therefore address issues of quality, safety, acceptability, nutritional value, shelf- life, process and product development.

# Food Safety

**Food safety** is a scientific discipline describing handling, preparation and storage of food in ways that prevent food-borne illness.

**Food safety** means assurance that food is acceptable for human consumption according to its intended use (**FSSAI**)

## Key global food safety concerns include:

- ▶ Spread of microbiological hazards
- ▶ Chemical food contaminants
- ▶ Assessment of new food technologies (such as genetically modified foods)
- ▶ Strong food safety systems to ensure a safe global food-chain

# What compromises food safety?

- ▶ Lack of GMP
- ▶ Inadequate processing/ preservation
- ▶ Inferior raw material quality
- ▶ Malpractices like adulteration, dilution
- ▶ Post processing contamination
- ▶ Lack of robust packaging
- ▶ Improper storage and distribution

# Food Quality

- ▶ **Food quality** is defined by the quality characteristics of food that makes the food acceptable to consumers.
- ▶ **Food quality** includes chemical, physical, microbial, nutritional and sensory quality of foods.
- ▶ Some quality attributes are visible while others are not.

# What affects Food Quality?

- ▶ Quality of raw materials used
  - ▶ Method of preparation/ processing
  - ▶ Conditions prevailing during processing
  - ▶ Conditions prevailing during storage and distribution
  - ▶ Use of additives/ ingredients
  - ▶ Package integrity
- ❖ Food quality and food safety are interdependent

# Challenges to be overcome in large scale manufacture and distribution of foods in India

**Indigenous machinery development / Mechanization for traditional foods**

**Indigenous process development**

**Availability/ procurement of good/ consistent quality raw materials**

**Standardization of product quality**

**Developing raw material specifications**

**Development of analytical methods**

**Preservation for extended shelf life through processing**

**Packaging development**

**Marketing**

**Process and product improvement, innovation**

**Nutritional improvements (traditional Indian sweets and savories)**

**Development of product specifications**

**Application of new and advanced technologies**

## Need for adopting emerging/ advanced technologies

- ▶ Reduce post harvest losses
- ▶ Value addition
- ▶ Local/ global competition and survival
- ▶ Continued growth
- ▶ Socio-economic and lifestyle changes
- ▶ Changing consumer needs
- ▶ Changing market trends



# How adapting to emerging/ advanced technologies will help

- ▶ Improved food quality
- ▶ Better food safety
- ▶ New product/ process development
- ▶ Holistic utilization of raw materials and minimizing waste
- ▶ Energy savings
- ▶ Development of new ingredients
- ▶ More convenience to consumers
- ▶ Greater variance in foods
- ▶ Meeting specific dietary needs
- ▶ Promoting good health

# Food Preservation Processes

## Food Preservation Processes

### Thermal processing

- Aseptic proc.
- Baking/ frying
- Ohmic heating
- Microwave
- Infrared
- Drying/Dehydration
- Retorting
- Extrusion
- Chilling & freezing
- Freeze drying
- Canning

### Non Thermal well established technologies

- Chemical Preservation
- MAP
- Vacuum Pkg
- Active Pkg
- Biopreservation

### Non Thermal emerging technologies

- High Hydrostatic processing
- Pulsed Electric field (PEF)
- Ultrasound
- Pulsed Light(PL)
- Irradiation
- Electron beam
- Oscillating magnetic field
- Ozone
- Gas & Cold Plasma

### Combined Technology

- Hurdle Technology

# ASEPTIC PROCESSING AND PACKAGING

- ▶ Aseptic processing is the process by which a sterile (aseptic) product is packaged in a sterile container in a way that maintains sterility.
- ▶ Sterility is achieved with a flash-heating process (91 to 146 °C)), which retains more nutrients and uses less energy than conventional sterilization.
- ▶ Allows processed food to keep for long periods of time without preservatives.
- ▶ The aseptic packages are typically a mix of paper (70%), polyethylene (LDPE) (24%), and aluminum (6%), with a polyethylene inside layer.

Food categories subjected to Aseptic processing globally	Indian Scenario	Remarks
Fruit juices, Dairy products, Soups, nutritional drinks, Soy milk, nut beverages etc.	Very widely adopted in India with good market presence	<ul style="list-style-type: none"> <li>• A technology with promise for more food products</li> <li>• Recycling issue of the packaging</li> <li>• High initial investment</li> </ul>

# DRYING

- ▶ Drying or dehydration is a method of food preservation that inhibits the growth of bacteria, yeasts, and mold through the removal of water. One of the oldest methods of food preservation, it was traditionally carried out by the sun.
- ▶ Bed dryers, Drum dryers, Freeze dryer, Shelf dryer, Spray dryers, Tray dryers are examples of commercial food dehydrators
- ▶ Dehydration is an important method of food preservation for developing countries.
- ▶ Freeze drying preserves food quality to a great extent



Food categories subjected to drying globally	Indian Scenario	Remarks
Meat products, Sea food, Fruits & Vegetables and dairy products etc.	Adopted for various fruits & vegetable, spices, sea food and in traditional foods	<ul style="list-style-type: none"> <li>- Freeze drying required to be explored more</li> <li>- Well established technology, basket required to be increased with new products</li> </ul>

# RETORT PACKAGING AND PROCESSING

- ▶ A retort pouch is a type of composite food packaging made from a laminate of flexible plastic and metal foil.
- ▶ It allows the sterile packaging of a wide variety of foods including RTE meals and is used as an alternative to traditional industrial canning methods.
- ▶ Quick heat penetration, energy saving and better product quality, light weight

Food categories subjected to retort processing globally	Indian Scenario	Remarks
RTE meals/ meal components, Fruit pulps/ concentrates, Sea foods etc.	Adopted for variety of Indian preparations including curried preparations	• Has scope to improve in terms of more product applications

# EXTRUSION PROCESSING

- ▶ Extrusion is the process in which a food is compressed and worked to form a semi-solid mass. This mass is then forced through a restricted opening, or die, to create a desired texture or shape. Food may also be cooked while being extruded.
- ▶ The purpose of this application is simply to provide a greater variety of textured foods to consumers.

Types of Extruded products	Examples
Directly expanded	Breakfast cereals, corn Curls
Unexpanded	Pasta
Half product	Potato Pellets
Co Extruded	Fruit Based Cereals, jelly filled cores
Modified	Starch and Fat Mimics
Texturized	Meat Analog
Candy	Licorice , Chewing Gums

# FREEZING

- ▶ Freezing is one of the oldest and most widely used methods of food preservation, which allows preservation of taste, texture, and nutritional value in foods better than any other method.
- ▶ Beneficial effects of low temperatures at which microorganisms cannot grow, chemical reactions are reduced, and cellular metabolic reactions are delayed.
- ▶ The rate of ice crystal formation has a big impact on the quality of frozen foods.

Food categories subjected to Freezing globally	Indian Scenario	Remarks
Meat Products, Fruits & Vegetables and dairy product	Fruits & vegetables, meat products and dairy products	<ul style="list-style-type: none"><li>- Lack of cold chain</li><li>- High initial investment</li><li>- High energy costs</li><li>- Growing scope for frozen foods in India</li></ul>

# MODIFIED ATMOSPHERE PACKAGING (MAP)

- ▶ MAP is a technique used for prolonging the shelf-life of fresh or minimally processed foods.
- ▶ In this technique the air surrounding the food in the package is changed to another composition and the initial fresh state of the product may be prolonged.
- ▶ The atmosphere in a MA package consists of  $N_2$ ,  $O_2$ ,  $CO_2$ . It is the altered ratio of these gases that prolongs shelf life.
- ▶ Each food product has its own ideal gas mixture to ensure the longest shelf life possible.

Food categories subjected to MAP globally	Indian Scenario	Remarks
Snack products, fruits & vegetable, baked goods, Seafood, pasta, Poultry, meat products etc.	Limited commercialization by use of vacuum packaging and gas flushing	<ul style="list-style-type: none"> <li>• High barrier packaging required</li> <li>• More effective with low temp storage</li> <li>• <math>CO_2</math> resistant microbes pose hazard ( yeast, LAB, anaerobes etc.)</li> </ul>



# MICROWAVEABLE PACKAGING (MWP)

- ▶ A package which can be used for cooking/ heating a product in a microwave oven
- ▶ Microwave transparent : Paper , glass and all plastics
- ▶ Microwave reflectors : Al foil
- ▶ Susceptors: metalized polyester

Food categories subjected to MWP globally	Indian Scenario	Remarks
RTE meals, Seafood , Meat, pizza , snack products etc.	No significant commercialization so far except as in microwavable popcorn, noodles	• Greater penetration of microwave oven in Indian households will contribute to progress in this field

# ACTIVE PACKAGING

- ▶ Active packaging usually means having active functions beyond the inert passive containment and protection of the product.
- ▶ It is food packaging that interacts chemically or biologically with its contents or head space to extend shelf-life of food product
- ▶ Oxygen scavengers and ethylene scavengers, carbon dioxide scavengers and emitters , moisture regulators, antioxidant release and antimicrobial agents

Food categories subjected to active packaging globally	Indian Scenario	Remarks
Meat products, bakery products, Sea food, Fruit juices, ketchup etc.	No commercialization so far	<ul style="list-style-type: none"> <li>• has to be combined with other preservation approaches</li> <li>• Unpredictable performance</li> <li>• Holds promise as a low energy alternative</li> </ul>

# INTELLIGENT PACKAGING

- ▶ Intelligent and smart packaging usually involve the ability to sense or measure an attribute of the product, the inner atmosphere of the package, or the shipping environment. This information can be communicated to users.
- ▶ One of the main purposes is to indicate whether the quality of the product has decreased before the product deteriorates.
- ▶ **Sensors** : Gas Sensors, Biosensors
- ▶ **Indicators**: Time-temperature, Freshness, Integrity indicators
- ▶ **Tracking services** : RFID



Time-Temperature indicator as a smart package

Food categories subjected to Intelligent packaging globally	Indian Scenario	Remarks
Fruit & Vegetables, Meat, Fruit beverages, cheese etc.	No commercialization so far	<ul style="list-style-type: none"> <li>- Promising technology</li> <li>- Assures food quality and ensures food safety</li> </ul>

# BIOPRESERVATION

- ▶ Bio preservation is defined as extension of shelf life and food safety by the use of natural or controlled microbiota and /or antimicrobial compounds.
- ▶ Examples include organic acids, phenolic compounds, active constituents of essential oils, antimicrobials from lactic acid bacteria like nisin.
- ▶ This method of preservation is being explored because it can help replace the use of chemical preservatives
- ▶ Not much commercialization is reported as the performance of these preservatives maybe somewhat unpredictable
- ▶ Probably would be more effective along with use of other preservation approaches
- ▶ It's a natural option which may find greater favour with consumers

# HIGH PRESSURE PROCESSING (HPP)

- ▶ Food is subjected to elevated hydrostatic pressures (approx 6,000 atmospheres), with or without the addition of heat, to achieve microbial inactivation or to alter the food attributes in order to achieve consumer-desired qualities.
- ▶ HPP retains food quality, maintains natural freshness, and extends microbiological shelf life.

Food categories subjected to HPP globally	Indian Scenario	Remarks
Meat , Sea food, fruit juices, RTE meals, spreads and fillings	No commercialization so far	<ul style="list-style-type: none"> <li>• Expensive technology</li> <li>• Such an awareness has not come in India</li> <li>• Good potential amongst non thermal methods</li> </ul>

# ULTRASONICATION

- Ultrasonication is the application of ultrasound, it refers to anything above the frequencies of audible sound, and normally includes anything over 20,000 Hz.

APPLICATION	BENEFITS OF ULTRASONICATION
Extraction	Increased extraction efficiency, yield in solvent, aqueous or supercritical systems
Emulsification/ Homogenization	Cost effective emulsion formation
Crystallization	Formation of smaller crystal formation during freezing
Filtration/screening	Increased flux rates, reduced fouling
Defoaming	Increased production throughput, reduction or elimination of antifoam chemicals
Enzyme & microbial inactivation	Enzyme inactivation adjunct at lower temperatures for improved quality attributes
Heat Transfer	Acceleration of heating, cooling and drying of products at low temp
Viscosity Alteration	Non-chemical modification for improved processing traits, reduced additives.

# EDIBLE COATINGS AND FILMS

- ▶ Edible coatings/ films help in extending post harvest life of fruits & vegetables by reducing respiration rate and transpiration rate and delaying ripening
- ▶ Properties : Moisture barrier, Gas barrier, Restrict exchanging volatile compounds , Physical protection, Carrier for functional ingredients
- ▶ Edible coatings: **Lipid based coatings**( e. g. paraffin, waxes), **Polysaccharide based coatings**(e. g. starches, cellulose, chitosan), **Protein based coatings** (e. g. zein, gluten), **combination coatings**

Food categories subjected to edible coatings/ films globally	Indian Scenario	Remarks
Fruits and vegetables , cheese, meat, cut fruits, seafood etc	Limited application in wax coating of fruits	<ul style="list-style-type: none"> <li>• Low cost technology</li> <li>• Low capital and energy required</li> <li>• Has promise in extending PH shelf life of fruits and vegetables</li> </ul>

# HURDLE TECHNOLOGY (HT)

- ▶ It is an intelligent combination of hurdles which secures microbial safety and stability as well as organoleptic and nutritional quality and economic viability of food products.
- ▶ Hurdle technology usually works by combining more than one approach. These approaches can be thought of as "hurdles" the pathogen has to overcome if it is to remain active in the food.
- ▶ The right combination of hurdles can ensure all pathogens are eliminated or rendered harmless in the final product.

Food categories subjected to HT globally	Indian Scenario	Remarks
Meat products, dairy products etc.	Pickles, pasteurized processed dairy products etc.	<ul style="list-style-type: none"> <li>- Improved food quality</li> <li>- Energy savings</li> <li>- Sometimes unpredictable performance</li> <li>-- Reduction in preservatives</li> </ul>



# Use Of Enzymes In Food Processing

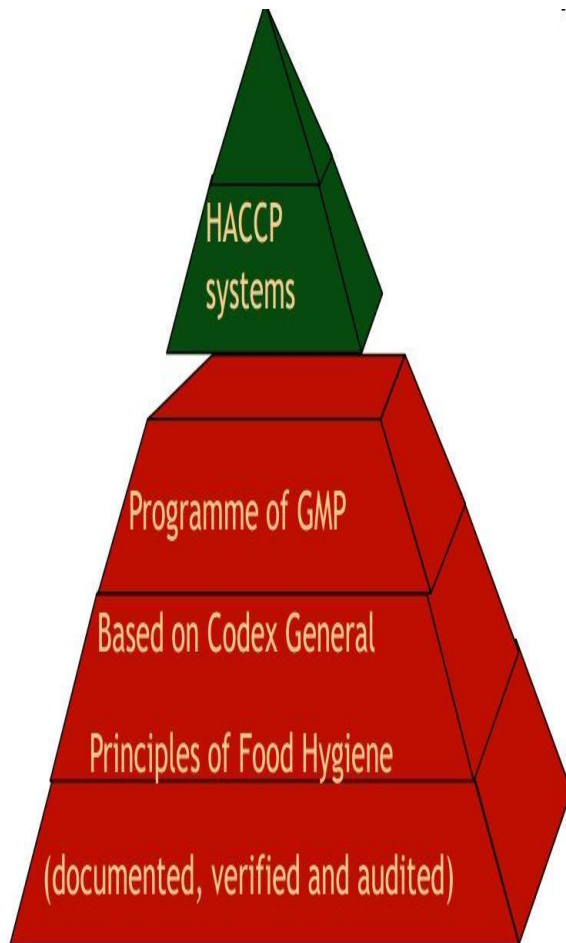
- ▶ Enzymes are naturally occurring biocatalysts that can be added to foods as processing aids or in product development for improved food quality
- ▶ Enzymes both free and immobilized, find varied applications in many areas of food processing.
- ▶ Microbial sources of enzymes are usually preferred.

Industry	Application	Enzymes
<b>Fruit juice/Wine</b>	Juice extraction Clarification, Starch hydrolysis	Pectinase, Cellulase Hemicellulase, Amylase
<b>Baking</b>	Dough conditioner Bread volume Crumb structure and colour Crust colour, Antistaling	$\alpha$ -amylase amyloglucosidase Protease lipoxygenase
<b>Dairy</b>	Cheese mft , Cheese ripening Lactose hydrolysis	Rennin , Lipase , Protease, Lactase
<b>Starch</b>	Glucose syrup/ HFCS	$\alpha$ -amylase, $\beta$ -amylase Pullulanase, Glucose isomerase
<b>Others</b>	Fat modification Oxygen removal Confectionery	Lipase Glucose oxidase Invertase

# New product development

- ▶ Convenience foods
- ▶ Minimally processed foods
- ▶ Exotic products
- ▶ Health foods
- ▶ Functional foods
- ▶ Foods for medical conditions
- ▶ Dietetic/ therapeutic foods
- ▶ Foods for special categories such as sports, geriatrics, pediatrics, maternal nutrition etc
- ▶ Creation of new ingredients

# GMP and HACCP



A system of food safety management that is

- ▶ Science-based and systematic
- ▶ Preventive
- ▶ Applicable throughout the food chain
- ▶ Before a food enterprise can apply HACCP, they must have programme of effective GMP in place
- ▶ In India compliance with GMP can be improved
- ▶ Many food quality and safety related issues can be resolved through GMPs

# Summary

- ▶ **Food quality and safety is of prime importance both to the food manufacturer as well as the consumer**
- ▶ **An interplay of several factors will affect food quality, safety and acceptability**
- ▶ **Increased awareness of these factors will lead to better preservation of foods**
- ▶ **Indian Food Industry today faces many challenges in this direction**
- ▶ **Need to adapt/ survive in an ever widening global food market should drive the industry to adopt advanced and emerging food processing technologies.**

# Summary

- ▶ **Adopting new technologies may incur added expenditure but will give tangible and intangible results in the form of improved food quality and safety**
- ▶ **Although initial inertia towards change will be sensed but once overcome it will contribute to long term improvement in food business both locally and globally.**
- ▶ **Many upcoming technologies are available yielding good quality, safe and shelf stable products**
- ▶ **New product development will contribute greatly to sustainability of food business**
- ▶ **Improvement in implementation of GMPs would greatly benefit the food business in terms of improved food quality and safety**

# Thank You

- ▶ Organizers- World Trade Centre, Mumbai  
All India Association of Industries
- ▶ Distinguished panelists
- ▶ Enthusiastic participants