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Programme : M.Sc., Biochemistry

Course Title : VALUE ADDITION IN FOOD

Couse Code :BC003VAC

UNIT-I

Food science and technology

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VALUE ADDITION IN FOOD

FOOD PRESERVATION

- What is food preservation?

Retaining food over a period of time without being contaminated by pathogenic organisms or chemicals and without losing its colour, texture, flavour and nutritious value.

Advantages

- Increases the shelf life of food
- Retain the quality of food - colour, Texture, flavour & nutrition value
- Increases food supply
- Adds variety to the food
- Decreases wastage of food

Classification of food preservation methods

Physical methods	Chemical methods	Biological methods
• Pasteurization • Refrigeration • Freezing • Canning/bottling • Drying/dehydration • Irradiation	• Salting • Sugaring • Marinating • Natural/artificial additives	• Fermentation (cheese, wine, vinegar, beer, etc.)

Physico-chemical methods:
Smoking

Pasteurization

- Pasteurization involves *heating food* to a temperature that kills disease causing microorganism and substantially reduces the levels of spoilage organisms.
- Pasteurization is not intended to kill all micro-organisms in the food. Instead pasteurization aims to reduce the number of viable pathogens so they are unlikely to cause disease (assuming the pasteurized product is stored as indicated and consumed before its expiration date).
- Heat also destroy enzymes that make milk spoil, so pasteurized milk drinkable for longer time.

Refrigeration and Freezing

- By keeping food at low temperature: Refrigeration and Freezing are probably the most popular forms in food preservation today.
- In refrigeration, the bacterial action on the food is slowed down; it takes a week or two to spoil.
- In freezing, bacterial action on the food is stopped. Bacteria are completely inactive if frozen.1Cool W

Canning

- Canning is a method of preserving food in which the food contents are processed and sealed in an airtight container.
- Canning provides a typical shelf life ranging from one to five years, although under specific circumstances a freeze-dried canned product, such as canned, dried lentils, can last as long as 30 years in an edible state.

Drying

- Drying is the process of dehydrating foods until there is not enough moisture to support microbial activity.
- It can be used with moist foods
- Several different techniques, relatively easy to do and require no special equipment.
- Types of drying:
  - sun drying
  - tray or tunnel drying
  - drum drying

Salting

- Coating food in salt or placing it in a salt solution (brine) reduces the moisture content of the food, i.e. reduces the availability of water.
- With little moisture, micro-organism growth is retarded.
- However, the taste of the food may change considerably.

Two types of salting:

1. dry salting
2. brine solution

Fermentation

- Fermenting is the process of encouraging the growth of "good bugs" to inhibit the "bad bugs" that can spoil food.
- It can be used with many types of foods
- Produce a wide range of products such as wine (from grapes), sauerkraut (cabbage), cured sausage (meat), and yogurt (milk) produced without any special equipment.

Smoking

- Smoking is a complementary process to curing that improves flavor and appearance, and can also act as a drying agent.
- Smoked meats are less likely to turn rancid or grow mold than unsmoked meats.

Use of non-thermal technology in food processing

- Why Non thermal?

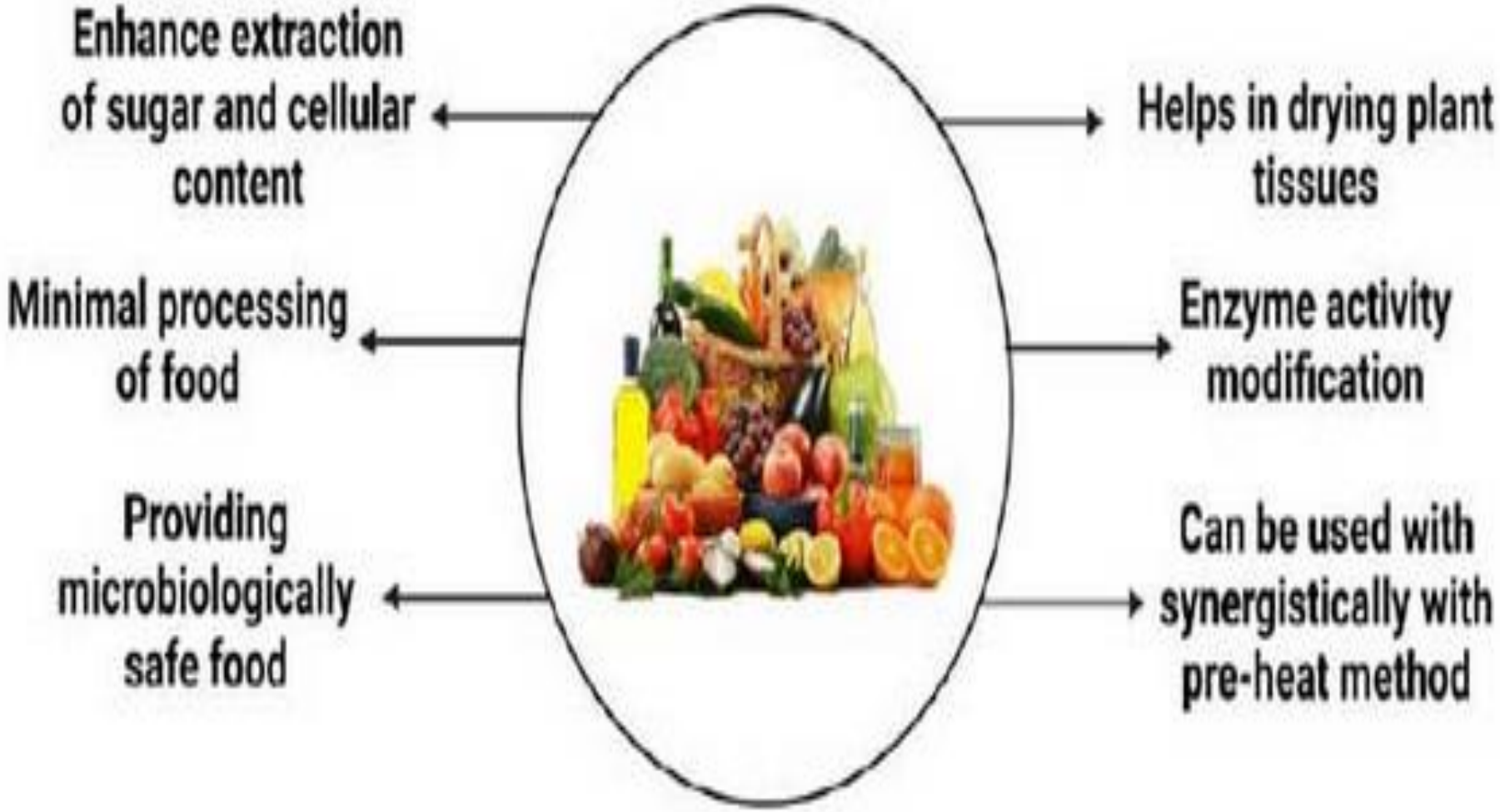
  ✓ The main problem with the thermal processing of food is loss of volatile compounds, nutrients, and flavour.

  ✓ To overcome these problems non thermal methods came into food industries to increase the production rate and profit.

  ✓ The non thermal processing is used for all foods for its better quality, acceptance, and for its shelf life.

  ✓ The new processing techniques are mostly employed to the liquid packed foods when compared to solid foods.

Advantages of non thermal techniques



Types of non thermal techniques

- Pulsed electric field (PEF) processing
- High pressure processing (HPP)
- Ultraviolet (UV) treatment
- Ultrasonication
- Cold plasma

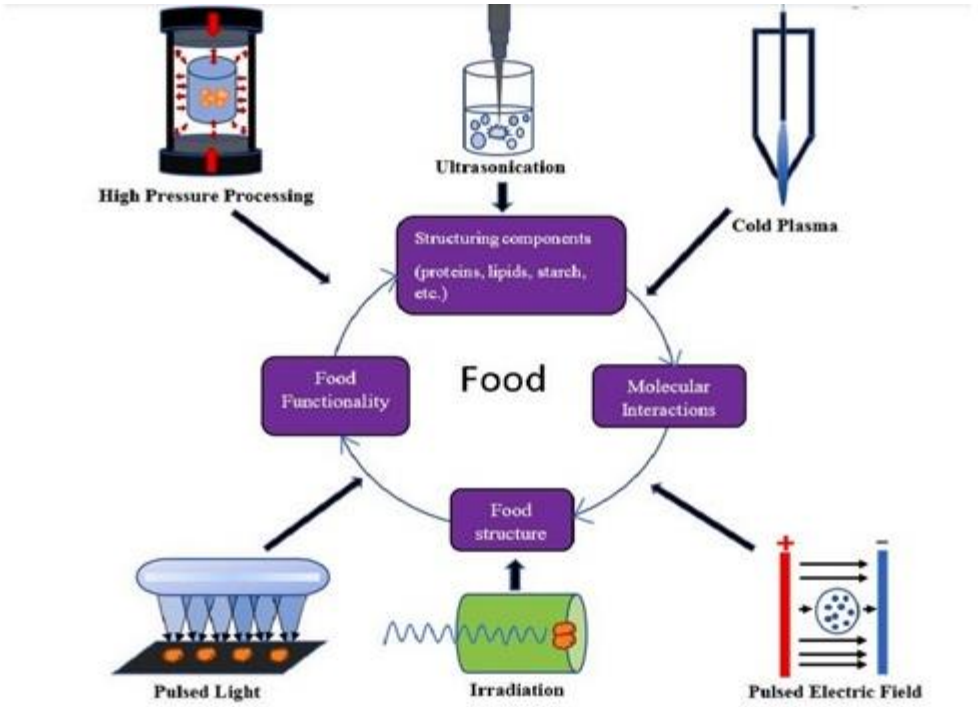


Fig 1: *The impact of different Non-Thermal Processing Technologies on foods.*

Pulsed electric field

- Pulsed electric field (PEF) used short electric pulses to preserve the food.
- Pulsed electric field (PEF) treatment is an innovative and promising method for non-thermal processing of food stuff.
- It is one of the most appealing technology due to short treatment time(typically below 1 second).
- reduced heating effect.
- energy lost during heating food is minimized.
- for fresh-like characteristics of food, along with high sensorial quality and nutrient content.
- It is suitable for preserving liquid and semi-liquid foods removing micro-organisms and producing functional constituents.
- Examples:- milk, fruit juices, soup, egg etc.

Working

- PEF technology is based on a pulsing power delivered to the product placed between a set of electrodes confining the treatment gap of the PEF chamber.
- The equipment consists of a high voltage pulse generator and a treatment chamber with a suitable fluid handling system and necessary monitoring and controlling devices.
- Food product is placed in the treatment chamber, either in a static or continuous design, where two electrodes are connected together with a nonconductive material to avoid electrical flow from one to the other.
- Generated high voltage electrical pulses are applied to the electrodes, which then conduct the high intensity electrical pulse to the product placed between the two electrodes.
- The food product experiences a force per unit charge, the so-called electric field, which is responsible for the irreversible cell membrane breakdown in microorganisms.

- This leads to dielectric breakdown of the microbial cell membranes and to interaction with the charged molecules of food.
- Hence, PEF technology has been suggested for the pasteurization of foods such as juices, milk, yogurt, soups, and liquid eggs.

High-Pressure Processing (HPP):

- **HPP involves subjecting food** products to high hydrostatic pressure, which disrupts cellular structures of microorganisms while preserving the native characteristics of the food matrix.
- Research indicates that HPP can effectively retain the color pigments in fruit and vegetable juices by minimizing enzymatic degradation and oxidative reactions, thereby maintaining vibrant colors and nutritional integrity.

Ultraviolet (UV) light treatment:

- **UV light treatment is gaining** traction as a non-thermal technology for food preservation and quality enhancement.
- UV-C irradiation, in particular, has been shown to inhibit microbial growth and extend shelf life while preserving the color attributes of food products.
- Furthermore, UV treatment can stimulate the accumulation of certain color pigments in plants, leading to enhanced coloration and antioxidant activity.

Alternate thermal technology for food processing

- Microwaving :
  - Microwave ovens are rarely used for processing large quantities of food.
  - They are mainly of interest when the products such as frozen foods are used.
  - Microwave ovens use electromagnetic radiation to excite water molecules in food.
  - The actual waves penetrate only about 10 inches from the source of the radiation. Within the food, the waves only penetrate 3-4 to 1 inch on all sides. As a result, the actual ovens must be limited in size.
  - Heat is produced within the food by the friction of water molecules, which spreads to the centre of the food by conduction.

Alternate thermal technology for food processing

- Irradiation:
  - Irradiation is the controversial process of applying low doses of gamma
  - Irradiation is generally used for
    - prevent sprouting in potatoes and onions
    - control insect infestation of wheat flour and
    - reduce the microbial load of ground spices.

INFRARED BIOLOGICAL TECHNOLOGIES – ANTIMICROBIAL ENZYMES AND BACTERIOCINS IN FOOD PROCESSING

ENZYME

- **Enzymes are biocatalysts synthesized by living cells. They are proteins that speed up the rate of a chemical reaction.**
- **An enzyme converts a specific set of reactants (substrates) into specific products.**

Purposes Of Using Enzymes In Foods:

- Specially enzymes are used in:
- Food modification
- Improving nutrition quality
- Bioavaibality
- Extraction
- Size reduction
- Filtration
- Fragmentation
- Of various foods to each in enhancing the –
- Color ,Texture , Appearance

Sources of food enzymes:

- **Plants**: Amylase, ß amylase, ß glucanase, papain, chymopapain, lipoxygenase.
- **Animals**: trypsin, chymotrypsin, pepsin, catalase, amylase, pancreatic lipase.
- **Microorganisms**: a amylase, ß amylase, glucose isomerase, cellulase, invertase, microbial lipase, catalase, lactase.

Enzymes used in food processing:

- **Baking industry:**
- Bakery products are common food products through all the world and
- Appearance
- Freshness
- Taste
- Flavour
- Color
- Are few of quality criteria which the consumers expect from the bakery products.

- A amylases: produce dextrins which are further broken down to sugar
- B amylase: improves yeast fermentatioon, bread volume
- Protease: used to reduce gluten elasticity in biscuits and wafer production.

- **Hemicellulase: improve dough properties and bread quality, decrease stickiness of bread.**
- **Llipoxygenase :used to whitening the bread.**

Dairy products

- Milk is the chief ingredient in production of dairy products such as yogurt, buttermilk, cheese, buttercream, soured cream. They are prepared through fermentation process.
- **ENZYMES**:
- **Proteases, lipases and lactases** are used to develop flavour compounds.
- Rennin is used as a coagulant of milk to produce cheese.

Brewing industry

- Many enzymes are used to produce wine, beer, soy sauce through fermentation process.
- Cellulase, hemicellulase, amylase,glucanase, lipase, decarboxylase etc enzymes are used in this industry.

Meat industry

- **Protease enzymes such as papain, bromelain and ficin are used to tenderize meat.**
- **These enzymes softens muscle.**

Beverage industry

- **In Fruit Juice Industry:**

- **Enzymes are widely used in clarification of juices and wines.**
- **During the production of fruit juice enzymes decreases the processinng capacity and enhance flavor, color and texture of juices.**
- **Pectinase and amylase increase juice production, juice volume and color extraction.**

- In wine production, pectinase is used to prevent haze forming and to get clear solution. Pectinase enzymes are used during:
- Ripening
- Harvesting
- Fermentation and
- clarification

Coffee Industry

- The skin and fibrous pulp are removed and then enzymes are mixed with pulped beans.
- In this process microbial enzymes such as **cellulase, hemicellulase,** pectinase are used.

Tea Industry

- **Cellulase, glucanase, pectinase** are used to break down the cell wall of tea leaf.
- The enzymes provide excellent fermentation during processing.
- They help to remove biopolymers from liquor and enhance the appearance of made tea.

BACTERIOCINS IN FOOD PROCESSING

Introduction

- **Bacteriocins are a kind of ribosomal synthesized antimicrobial peptides produced by bacteria, which can kill or inhibit bacterial strains closely-related or non-related to produced bacteria, but will not harm the bacteria themselves by specific immunity proteins.**
- **Antimicrobial peptides (AMPs) or proteins produced by bacteria are categorized as bacteriocins.**

Structure

- The structure of this toxin usually resembles the shape of a protein or peptide. It consists of amino acid chains of different size.
- Pore formation
- Nuclease activity
- Peptidoglycanase activity
- Due to the great variety of their chemical structures, bacteriocins affect different essential functions of the living cell.

Uses In Food Processing

- **Bacteriocins can also be used in controlling the antimicrobial resistance in certain food-borne pathogens.**
- **They are the future antimicrobial proteins for the food preservation and therapeutics in a cost-effective manner.**

Advantage

- Safer preservatives than chemicals.
- More accurate efficacy.
- Good acceptance from consumers.
- To overcome various drawbacks such as toxicity of chemicals and nutritional alteration of food.

Disadvantages

- **Generally bacteriocins are not useful as food preservatives because they are expensive to make, are broken down in food products.**
- **They harm some proteins in food, and they target too narrow a range of microbes.**