

# Methods of Limiting Microbial Proliferation in Foods



# What is Food Preservation

**Food preservation may be defined as the process of treating and handling food in such a way to stop, control, or greatly slow down spoilage/pathogenic microorganisms and minimize the possibility of foodborne illness while maintaining the optimum nutritional value, texture, and flavor.**

# Principle of Preservation

1.

- Eliminate pathogens (organisms that cause disease) or reduce spoilage organisms in food

2.

- Destroy undesirable enzymes (microbial and food) that would otherwise adversely affect acceptance quality of food

3.

- Extend shelf-life and palatability of food

# Heat Treatment Methods

## Pasteurization:

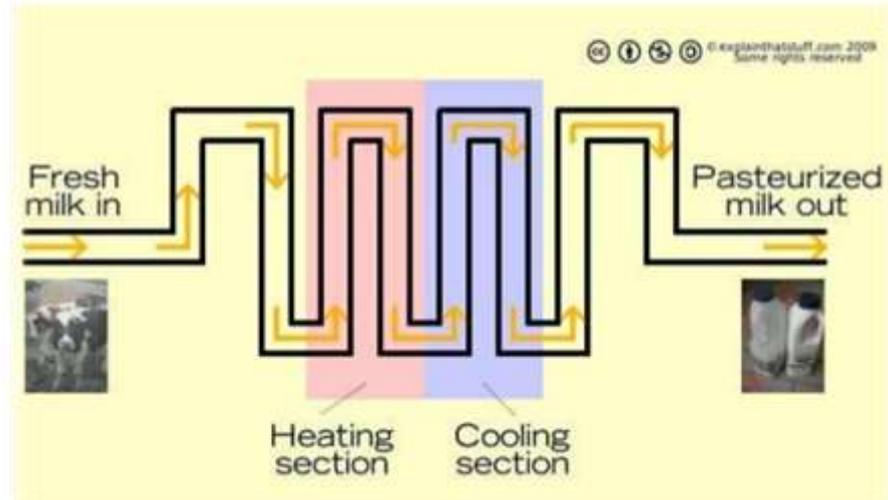
1. Mild heat treatment (below 100 C) used for milk, liquid egg, fruit juices, and beer.
2. Pasteurization destroy pathogens, reduce bacterial count, inactivate enzymes (phosphatase and lipase) and extend shelf-life.
3. Pasteurized product is not sterile, heat resistant survives and able to grow and multiply in the food after a while.

Products	Pasteurization temp and time
Market milk	72C for 15 sec/63C for 30 min
Dried fruits	65.6-85C for 30-90 min
Ice-cream mix	82.2C for 16-20 sec

## **Blanching:**

- 1. Used mainly for vegetables and some fruits prior to freezing.**
- 2. Aim of blanching: Inactivate enzymes that cause deterioration of food during frozen storage; Removes undesirable odours/ flavours; Softens fibrous material; Reduces microorganisms present on the surface.**
- 3. Method: Dipping vegetable in boiling water for 1–3 mins. E.g., peas require only 1–1.5 mins in water at 100 C.**

# Pasteurization of Milk



# Canning:

1. Hermetically sealing food in a container, and then inhibiting pathogenic and spoilage organisms with the application of severe heat.
2. Food is placed inside a cylinder or body of a can, the lid is sealed in place, and the can is then heated in a large commercial pressure cooker known as a retort (116–121 C).
3. Extended shelf-life (more than 6 months-up to 2 years).



# Process of Canning

- Preparation of food
- Filling of cans
- Exhausting
- Sealing
- Thermal processing
- Cooling
- Storage



# Drying Methods

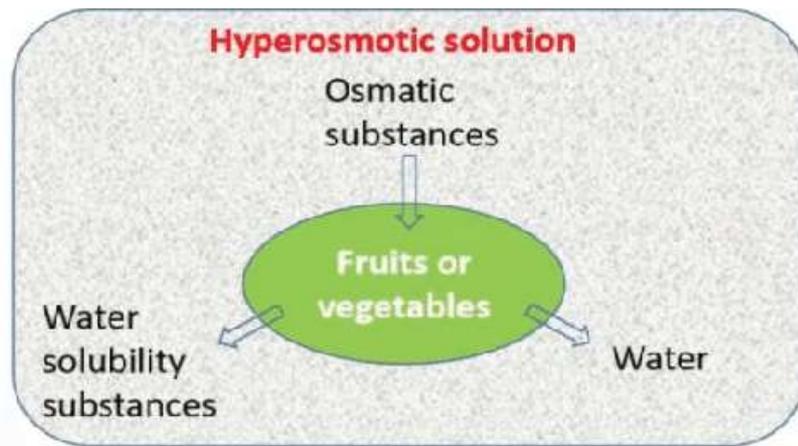
## Natural Dehydration (Sun-drying/Dry, hot air):

1. Low-cost and slow method in which water is removed by the heat of the sun.
2. Used to dry grains and some fruits (raisins), vegetables, fish, meat and milk especially in warmer countries.
3. Process is slow, susceptible to contaminants, humidity (below 60%) and air flow is difficult to achieve for proper drying.



# Osmotic dehydration:

1. Phenomenon of water removal by immersion of foods, mostly fruits and vegetables in a hypertonic aqueous solution (sucrose, glucose, fructose, sorbitol, corn syrup and sodium chloride).
2. Energy efficient method and suitable to increase the shelf-life of fruits and vegetables. Eg., dehydrated fruit based powder.



## Disadvantage:

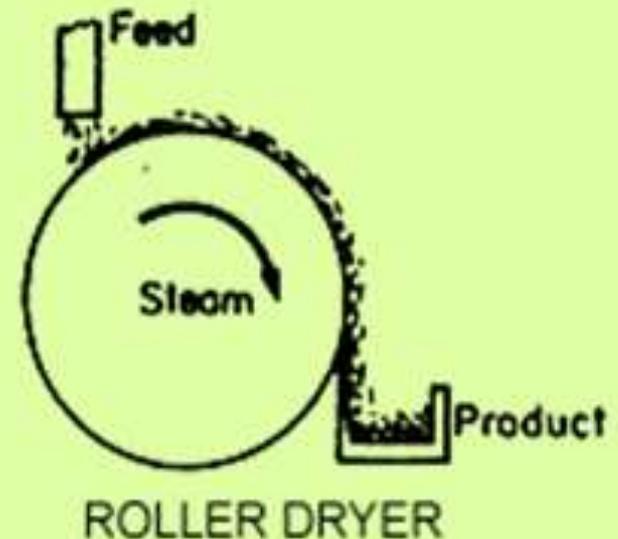
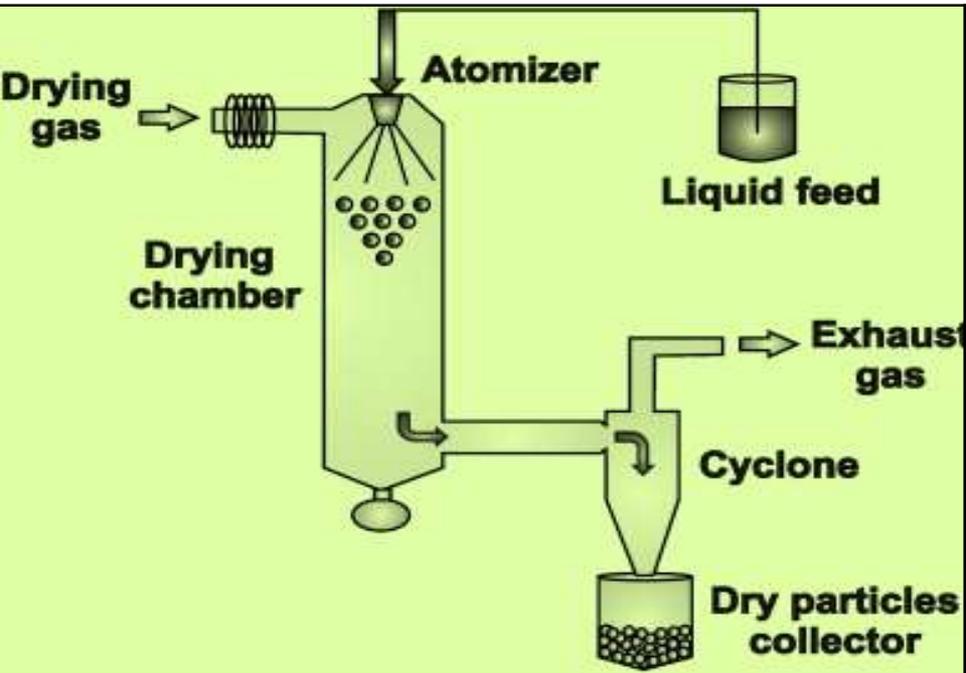
- Nutritional compounds loss
- Difficulty in osmotic solution management :
  - dilution of the concentrated solution
  - pollution by solids components

## Advantage

- Reduce drying time
- Reduce energy consumption
- Improve product's quality

## Mechanical drying:

1. Achieved in a few seconds to a few hours.
2. Roller drying (liquid is dried by applying a thin layer on the surface of a roller drum heated from inside), Spray drying (liquid is sprayed in small droplets, which then come in contact with hot air that dries the droplets instantly).
3. Fruits, fruit juices, milk, coffee, tea



## Freeze drying:

1. Freezing food at low temperature, and then exposing the frozen food directly from the solid phase to the vapour phase under reduced surrounding pressure. Water molecules are removed from the food by sublimation (solid state to vapour state) without affecting its shape or size.
2. Freeze-dried vegetables, fruits, meat and fish products.



# Irradiation Methods

## Radurization

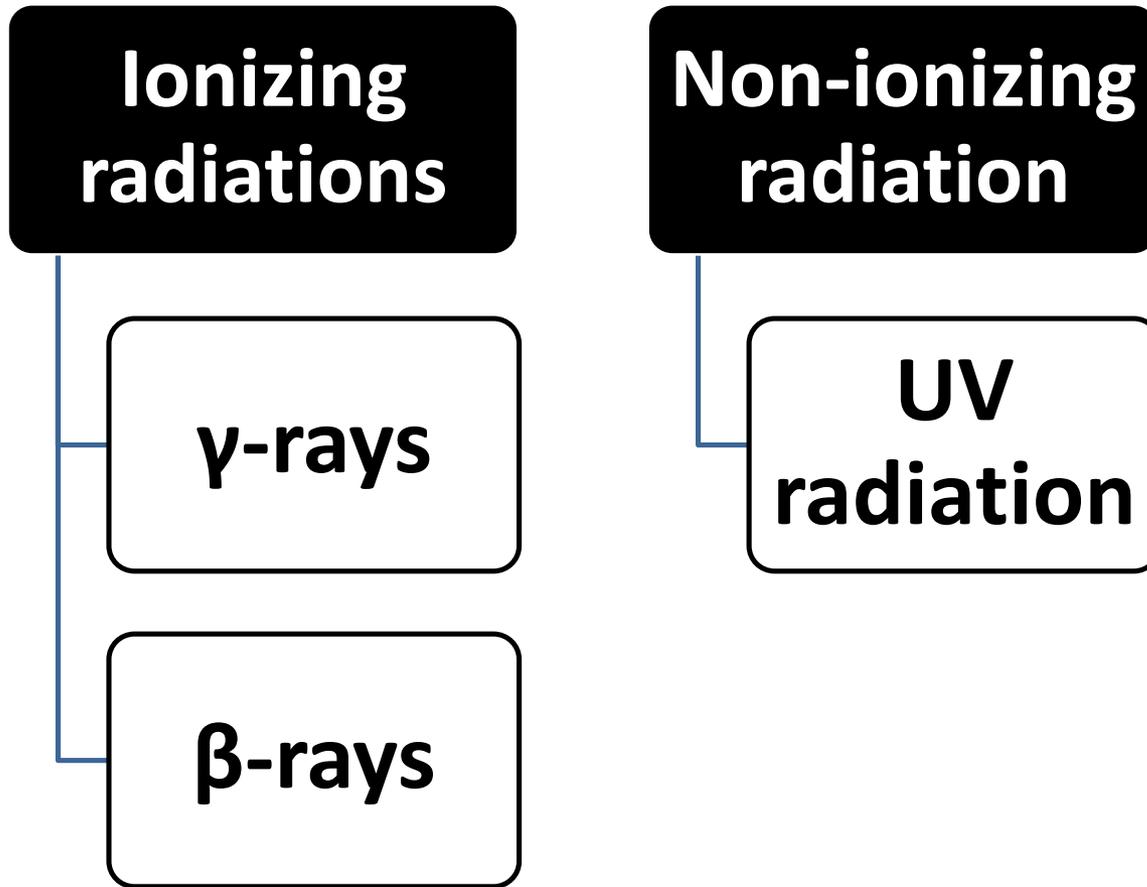
1. Destroy spoilage bacteria in high pH–high- $a_w$  foods, especially Gram-negative psychrotrophs in meat and fish and yeasts and molds in low pH–low  $a_w$  foods.
2. Treatment is generally milder (1 kGy).

## Radication:

1. Destroys vegetative foodborne pathogens.
2. Dose level is 2.5 kGy-5.0 kGy.
3. Irradiated products should be stored under 4C to prevent germination and outgrowth of spores of *C. botulinum*.

## Radappertization:

1. High dose (30 kGy) to destroy *C. botulinum* spores. Not recommended for use in food due to unacceptable sensory changes.



## **Applications of Ionizing Radiations**



**WHO recommended irradiation of food up to a certain dose level (10 kGy).**

# Use of Chemicals

**Non-toxic**

**Readily soluble**

**Don't impart off-  
flavors**

**Exhibit antimicrobial  
properties**

**Economical**

**Characteristics of Chemical Compounds**

Different chemical preservatives are used, which involves

1. Traditional chemical food preservatives

- ❖ Sugar
- ❖ Salt

2. Acidulants

- ❖ Benzoic acid
- ❖ Sorbic acid
- ❖ Lactic acid

3. Gaseous chemical food preservatives/ leavening agents

- ❖ Sulphur dioxide and sulphites



Preservative	Example	How it works
Salt	Salted fish	Draws the water out of the cells of microorganisms and retards the growth of microorganisms
Sugar	Jam	
Vinegar		Provides an acidic condition that inhibits the growth of microorganisms
Sodium nitrate or sodium nitrite	Burger, sausage, luncheon meat	Slow down the growth of microorganism
Benzoic acid or sodium benzoate	Sauce	
Sulphur dioxide	Fruit juice	



## Low Temperature Methods

### Ice-chilling:

1. Used in retail stores where the foods are kept over ice (between 0 and 1C).
2. Fresh fish, seafood, meats, cut fruits, vegetable salads (in bags), ready-to-eat salads salad dressing and some ethnic foods (tofu) are stored by this method.
3. Melting of ice, duration of storage, and cross-contamination can cause microbiological problems.



## Refrigeration:

1. 4-5 C is considered a desirable temperature.
2. Raw and processed foods of plant and animal origin, as well as many prepared and ready-to-eat foods, can be preserved by refrigeration with storage life of 60 d or more.
3. Any fluctuation in temperature can greatly accelerate their growth.



## Freezing:

1. The minimum temperature used in home freezers is  $-20\text{ C}$ . Dry ice ( $-78\text{ C}$ ) and liquid nitrogen ( $-196\text{ C}$ ) are used for rapid freezing (instant freezing).
2. Peas, meat, fish, shrimp, processed products are preserved by freezing.
3. Crystal growth limit freezer life of certain foods, because ice crystals grow in size and cause cell damage by disrupting membranes, cell walls, and internal structures.

