Food preservation

MIC 204

UNIT 4

Principles of food preservation

1. Prevention or delay of microbial decomposition

2. Prevention or delay the self decomposition of the food

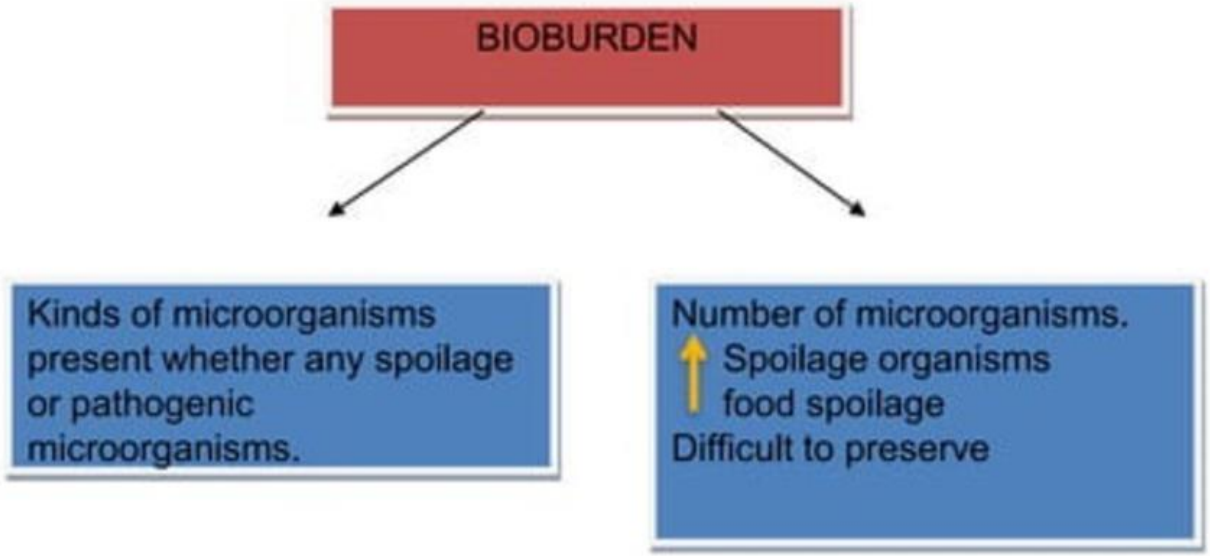
3. Prevent the damage cause by insects, animals, mechanical etc.

Applications of microbial growth curve to food preservation

- Microbial decomposition of foods will be prevented if all spoilage organisms are killed and recontamination is prevented by:
  - Predict microbial growth of food spoilage. Eg: Salmonaella
  - Control at any course. Eg: growth rate, lag time, generation time
- Hindering the growth of microorganisms by merely stopping the multiplication does not necessarily prevent decomposition because there is possibility that viable organisms or their enzymes may continue to be active.

Methods of food preservation

- Asepsis- keeping out microorganisms
- Removal of microorganisms
- Maintenance of anaerobic condition
- Use of high temperature
- Drying and smoking
- Use of chemical preservatives
- Irradiation



Aim: to measure the total number of viable microbes (total microbial count) on a food prior to its final sterilization before use.

Maintenance of anaerobic conditions

- Anaerobic conditions can be achieved by a complete fill, replacement of air by $C0_2$ or N_2 and others.

- Spores are resistant to heat and may survive in canned food but they unable to germinate in the absence of oxygen.

Use of high temperatures

Temperature and time used in heat processing will depend on:

(a) The effect of heat on the food

(b) Other preservative methods employed

Heat Treatment ↑	Microorganisms ↓

Classification of heat treatments used on foods:

(a) Pasteurization (below 100°C)

(b) Heat at 100°C

(c) Heat > 100°C

a. Pasteurization

- Heat treatments that kills most but not all microorganisms.

- Example: milk 63ºC, 30 mins
  72ºC, 15 mins
  Juice 77ºC, 30 mins
  88ºC, 30 secs

- The pasteurized products are cooled promptly after the heat treatment.

Pasteurization is important when:

(a) Heat treatment will not harm the quality of product

(b) Main spoilage microbes are not very heat resistant e.g. yeast in fruit juices

(c) Kill pathogens

(d) Any surviving organisms will be treated with other preservative methods

(e) Competing organisms are to be killed, allowing a desired fermentation

Preservative methods used to supplement pasteurization:

(a) Refrigeration.

(b) Keeping out microorganisms by packaging.

(c) Maintenance of anaerobic conditions.

(d) Addition of high concentration of sugar.

(e) Presence of chemical preservatives

b) Heating at about 100°C

- Sufficient to kill all microbes but not spores,
- Many acid foods are successfully preserved at100°C.
- Methods

©Boiled ©Immersion ©Baking ©Simmering © Roasting

© Frying © Blanching © Exposure to flowing steam

c) Heating above 100°C

- Obtained by means of steam under pressure

Steam pressure if ↑ Temp. ↑

121°C. 1 atm.

- Commercial sterility: include heating foods at high temperature for a short time e.g. ultra heat treatment.
- All commercially sterile foods should be stored in cool, dry, place to prevent any viable thermophilic spores from germinating and cause, spoilage to the foods.
- Ultra Heat Treatment: Treatment of milk by heating at 150°C by steam injection followed by 'flash evaporation' of the condensed steam.

Objective of heating foods:

(a) To destroy pathogens and spoilage microorganisms

(b) To destroy toxin present in foods

(c) To destroy the vegetative cells and spores of yeast, bacteria and moulds

(d) To destroy undesirable enzymes this can affect the quality of foods.

(e) To control the growth of surviving microorganisms

(f) To retain the acceptance and nutritional quality of foods

(g) To reduce competition

Canning process

- Preservation of foods in sealed containers followed by application of heat treatment.

- Canning (also known as hermetically sealed containers) is done in tin cans, glass containers, aluminum and plastic pouches.


Growing
Harvesting
Transporting
Reject
Good
Grading
Cold Storage
Washing
Peeling
Coring/Halving/Slicing
Blanching
Juice
or
Syrup
Added
Filling
Sealing
Cooking
Cooling
Storage
Labelling
safvca
Despatch

Spoilage of canned food can be divided into 3 types:

(a) Microbial spoilage

(b) Chemical spoilage

(c) Enzymatic spoilage

- In general, microbial spoilage can occur due to under processing and/or leakage after processing.

Types of spoilage in canned food depends on the type of microorganisms involved:

1. Thermophilic bacteria and spores

These bacteria can cause 3 types of spoilage especially when cans are kept at > 43°C.

(a) "Flat-sour" spoilage

(b) Thermophilic Anaerobe Spoilage

(c) Sulphide stinker spoilage

2. **Mesophilic bacteria**

(a) Bacillus spp.

(b) Clostridium spp.
e.g.: *C. sporogenes.*

3. Non-spore forming bacteria

E.g. *Streptococcus*, *micrococcus* etc. which will produce acid and gas.

4. Moulds and Yeasts

- can be killed by mild heat.

Use of low temperature

- Low temperature reduces the activity of microorganisms by reducing the chemical reaction and action of enzymes.

  -low temp will prevent growth of m/o allowing only small metabolic activity.

- Hence, less microbial growth and spoilage' is delayed / prevented.

A. Chilling temperature

- Temperature of 6°C can prevent the growth of food poisoning microorganisms except the *Clostridium botulinum* type E and retard the growth of spoilage microorganisms.
- Chilling temperature is the main method for temporary preservation of food.
- Psychrotroph are microorganisms which can grow at low temp. e.g. *Flavobacterium* spp. & *Pseud. alcaligenes* but they have a low growth rate.

B. Freezing temperature

- Cause reduction in number of viable microorganism but does not sterilize the food.
- The percentage of microorganisms killed during freezing and storage varies depending on:

(a) Substrate (kind of food)

(b) Type of freezing

Advantages of fast freezing

(a) Smaller ice crystal form - less mechanical destruction to food

(b) Short period of solidification - sudden death to microorganisms and quick inactivation of the enzymes.

(c) Food quality after thawing is better

Drying and smoking

A. Drying

- Methods which lower the water content of food to a point where the activities of enzymes and food spoilage and food poisoning microorganisms are destroyed / inhibited.

- The lower the water activity of food, the greater is the inhibition.

- If Aw is between 0.75 - 0.70, the spoilage is delayed. If Aw is 0.65, the spoilage is most unlikely to occur up to 2 years.

- Molds and yeasts are more important in spoilage dried foods since bacteria require higher water content for growth.

e. g. *Streptomyces rouxii* Aw 0.65
Aspergillus glaucus Aw 0.60

Types of drying:

a. Sun drying
b. Spray drying
c. Free drying
d. Smoking

Treatment before drying (to reduce number of microorganisms):

a. Washing
b. Dipping food in alkaline solution
c. Treatment with S02 (1000-3000 ppm)
d. Blanching/ scalding

Effects of drying upon foods.

Desiccated foods are subjected to certain chemical changes which can cause undesirable product:

(a) Dried food that contains fat and oxygen can cause oxidative rancidity to occur.

(b) Dried food which contains reducing sugar can undergo a color change called Maillard reaction. Carbonyl groups of reducing sugar react with amino groups of protein and amino acids followed by a series of complicated reaction. The browning is undesirable because of the unnatural color and bitter taste imparted to the food.

(c) Loss of vitamin C

(d) Discoloration

(e) Toughness

- Methods of minimizing the chemical changes in dried food:

(a) Keep moisture content as low as possible
(b) Reduce the level of reducing sugar as low as possible
(c) Reduce serial blanching in the same water
(d) Use S02 to retain vitamin C and avoid browning

B. Smoking

- Heating foods using smoke from various types of wood to preserve foods.
- The smoke produces heat which kills some microorganisms on the surface
- Heat also reduces the Aw.
- It also has an antimicrobial compounds e.g. formaldehyde which can inhibit the growth of some microorganisms.
- The presence of aromatic compounds will also give a distinctive flavor and around to the food.
- This will make the foods taste better and more tender e.g. smoked fish.
- Woodsmoke is more effective against vegetative cells than against bacterial spores.

Chemical preservatives

- Food additives / preservatives:

"A substance or a mixture of substance which are specifically added to prevent deterioration or decomposition of a food"

- Deterioration may be caused by:

(a) Microorganisms
(b) Food enzymes
(c) Chemical reactions

- Chemical preservatives are used mainly to inhibit the growth and activity of microorganisms by:

(a) Interfering with their cell membranes
(b) Their enzymes activity
(c) Their genetic mechanisms

Other preservative methods

(a) Filtration

- Although fruit juices can be preserved by chemical preservatives, now we can get product with no preservatives added.

- Fruit juices are subjected to filters with steam sterilize methods for 10-20 minutes. The sterile products are filled aseptically in sterile bottles or cartons.

(b) Radiation

- Gamma ray is the cheapest form of radiation for food preservation.
- X-rays essentially has the same character like gamma rays but produced differently.

Factors affecting radiation:

Types and species of microbes
-Spores are generally radioresistant

Number of microbes
-The more cell present, the less effective a given dose of radiation

Composition of medium
-Cells in protein medium are more resistant
-Protein exerts protective effect against radiation

Presence or absence of oxygen
-Resistance is reportedly increase when oxygen is absent

Physical state of food
-Dried cells are more resistant than moist cells

Age of cells
-Cells in lag phase are more resistant than in other phase

(c) Antibiotics

- Antibiotics such as aureomycin, terramysin and chloromycetin were found to be effective in lengthen the storage time of raw food especially meats, fish and poultry at chilling temperature.

- Niasin has been used to suppress anaerobes in cheese and cheese products.

- Natamycin has been tested in orange juice, fresh fruits, sausage and cheese.

Some problems in the use of antibiotics:

(a) Effect of antibiotic on microorganisms vary with the species.

(b) Organisms ' may be adapted to increasing concentrations of an antibiotic so that resistant strains finally develop

(c) Other organism which is not a significant food spoiler but has acquired resistant will eventually important in food spoilage

(d) Effect of antibiotic to consumer.