FOOD SPOILAGE
AND FOOD PRESERVATION
Intrinsic Factors Affecting Microbial Growth

• pH
• Moisture Content
• Water activity
• Oxidation-reduction potential
• Physical structure of the food
• Available nutrients
• Presence of antimicrobial agents
Extrinsic factors

• Temperature
• Relative humidity
• Carbon dioxide or oxygen
• Types and numbers of Microorganisms in the food
Water Activity ($A_w$)?

- How available is water to microbes?
- Water is the most critical factor for life
- Reducing $A_w$ - inhibit microbial growth by drying or by additions of solutes (sugars, spices, or salts)
- Freeze-drying – the withdrawal of water from frozen food under vacuum
- Increasing solutes – Sugars for fruits and salts for meat and fish
Thermal Process

- Most bacteria are killed at 82-93°C, but spores are not.
- 121°C wet heat for 15 min is required to ensure sterility
- High acid foods require less heat
- Pasteurization eliminates only disease-causing microorganisms in milk
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Pasteurization

• Kills pathogens and substantially reduces number of spoilage microorganisms

• Different pasteurization procedures heat for different lengths of time (HTST, LTLT, UHT)

• Shorter heating times result in improved flavor
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**Canning**

- Foods heated in special containers (retorts) to 115°C for 25 – 100 min

- Kills spoilage microbes, but not necessarily all microbes in food
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Spoilage of Canned Foods

• Spoilage prior to canning
• Undercooking
• Contaminated water into damaged cans during cooling process
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**Cold Temperature**

- Food should not be refrozen after thawing
- Frozen food (-10°C) usually does not have any free water (reduce Aw)
- Freezing may kill some but not all microorganisms
- Growth at temperature below -10°C has been observed
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**Low Temperature**

- Refrigeration at 5°C retards but does not stop microbial growth
- Psychrophiles will continue to grow slowly
- Microorganisms can still cause spoilage with extended spoilage
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**Drying**

- Dehydrating food also dehydrates the microorganisms
- Microorganisms contain approx. 80% of moisture
- Freeze-drying (lyophilization) is the most efficient method
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Sugar or Salt

• One of the oldest preservation methods
• Addition of either to a food item increases the affinity of the food for water
• Decreases Aw in the food
• Removes water from the microorganisms through osmosis
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**Pretreatment of Drying**

- Sulfur dip – sodium metabisulfite. 5 min
- Ascorbic acid – 1 teaspoon of acid mixed with 2 cups of water. 5 min
- Fruit juice dip – orange, lemon, pineapple
- Syrup dip – sugar, light corn syrup, water (1:1:2). Dip for 30 min. rinse with cold water and drain
- Heat blanching – use boiling water for 3-5 min
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**Acidification**

- Organic acids may be naturally produced by fermentation in foods.
- GRAS (Generally Recognized As Safe) organic acids can be added artificially.
- As pH decreases, heat required for sterilization can be reduced.
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Smoke

• Contains formaldehyde and other preservatives
• Heat during smoking also helps reduce microbial populations and dries the food
• Maybe toxic to human
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Atmosphere

• Exclude air for control of aerobic microorganisms

• Provide air for control of anaerobic microorganisms

• Add carbon dioxide and nitrogen

• Application of Modified Atmosphere or Controlled Atmosphere packaging
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**Atmosphere**

- Most of fruits and vegetable give off ethylene gas
- Ethylene accelerate ripening process
- For extension of shelf-life it should be removed
Principles of Food Preservations
# Principles of Food Preservations

## Commonly Used Preservatives

<table>
<thead>
<tr>
<th>Compound</th>
<th>Food</th>
<th>Level (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sulfite</strong></td>
<td>Fruit juices, dried Fruits and vegetables</td>
<td>0.005 - 0.2</td>
</tr>
<tr>
<td><strong>Nitrite</strong></td>
<td>Meats</td>
<td>0.01 - 0.02</td>
</tr>
<tr>
<td><strong>Sorbate</strong></td>
<td>Cheese, juice, wine, pickle, jam &amp; jelly</td>
<td>0.05 - 0.2</td>
</tr>
<tr>
<td><strong>Benzoate</strong></td>
<td>Pickle, juice, jam &amp; jelly</td>
<td>0.03 - 0.2</td>
</tr>
<tr>
<td><strong>Citric acid</strong></td>
<td>Fruit juice, jam &amp; jelly</td>
<td>No limit</td>
</tr>
</tbody>
</table>