PRINCIPLES OF FOOD PRESERVATION

Food preservation involves various methods and principles aimed at preventing food spoilage and extending its shelf life. Here are the main principles of food preservation:

Temperature Control:

1. **Refrigeration:** Slows down the growth of microorganisms by keeping food at low temperatures (typically 0-4°C).
2. **Freezing:** Stops microbial growth by keeping food at very low temperatures (-18°C or lower). It also slows down enzymatic activities that cause spoilage.
3. **Thermal Processing:** Includes methods like pasteurization (mild heat) and sterilization (high heat) to kill or inactivate microorganisms.

Moisture Control:

1. **Drying:** Removes moisture from food, making it inhospitable for microbial growth. Methods include sun drying, air drying, and dehydrators.
2. **Dehydration:** A more controlled form of drying using specific equipment to remove moisture.

Chemical Preservation:

1. **Additives:** Use of natural or synthetic chemicals (e.g., salt, sugar, vinegar, and preservatives like sodium benzoate) to inhibit microbial growth and oxidation.
2. **Smoking:** Introduces chemicals like formaldehyde and phenols from smoke, which have antimicrobial properties.

Control of pH:

1. **Fermentation:** Uses beneficial microorganisms to produce acids (like lactic acid) that lower the pH and inhibit harmful microorganisms.
2. **Pickling:** Involves immersing food in acidic solutions (like vinegar) to lower pH and prevent microbial growth.

Exclusion of Air:

1. **Canning:** Seals food in airtight containers and heats it to destroy microorganisms.
2. **Vacuum Packaging:** Removes air from the packaging to inhibit aerobic microorganisms.
3. **Modified Atmosphere Packaging (MAP):** Adjusts the composition of gases around the food to extend shelf life.

Radiation:

1. **Irradiation:** Uses ionizing radiation (e.g., gamma rays, X-rays) to kill or inactivate microorganisms without significantly affecting the food's nutritional and sensory qualities.

Hurdle Technology:

1. Combines multiple preservation methods (hurdles) to create an environment that is hostile to microbial growth. Examples

include using a combination of refrigeration, low pH, and preservatives.

ENZYMES AND THEIR CONTROL

Enzymes are biological catalysts that speed up chemical reactions in living organisms. In the context of food, enzymes play significant roles in both desirable processes, such as ripening and fermentation, and undesirable processes, like spoilage and browning. Controlling enzyme activity is crucial for maintaining the quality and safety of food products.

Key Enzymes in Food

Proteases: Break down proteins into peptides and amino acids.

1. Used in tenderizing meat and cheese production.
2. Undesirable in fish and seafood as it can lead to spoilage.

Lipases: Hydrolyze fats into glycerol and free fatty acids.

1. Useful in dairy products to develop flavors.
2. Can cause rancidity in fats and oils.

Amylases: Convert starches into sugars.

1. Essential in brewing, baking, and high-fructose corn syrup production.
2. Can lead to undesirable sweetness or texture changes.

Pectinases: Break down pectin, a polysaccharide in plant cell walls.

1. Aid in fruit juice clarification and extraction.
2. Can cause loss of texture in fruits and vegetables.

Polyphenol oxidase (PPO): Catalyzes the oxidation of polyphenols, leading to browning.

1. Causes enzymatic browning in fruits and vegetables.

Methods of Enzyme Control

Temperature Control:

1. **Heat Treatment (Blanching):** Quickly heating food to inactivate enzymes. Common in processing vegetables before freezing.
2. **Cooling/Freezing:** Slows down enzymatic activity without inactivation.

pH Control:

1. Adjusting the pH of food can inhibit enzyme activity. For example, adding acids like lemon juice can slow down browning in cut fruits.

Chemical Inhibitors:

1. Adding chemicals that specifically inhibit enzymes. For example, sulfur compounds are used to prevent browning in dried fruits.

Water Activity Reduction:

1. Lowering water activity through drying or adding solutes like salt or sugar can reduce enzyme activity as enzymes require water to function.

Use of Enzyme Inhibitors:

1. Naturally occurring or synthetic compounds that inhibit specific enzymes. For example, EDTA (ethylenediaminetetraacetic acid) can inhibit PPO.

Genetic Modification:

1. Developing genetically modified organisms (GMOs) to reduce or eliminate specific enzymes responsible for undesirable changes in food.

Packaging Atmosphere:

1. Modified atmosphere packaging (MAP) can reduce the oxygen level, thus inhibiting enzymes like PPO that require oxygen.

Applications in Food Processing

- **Blanching:** Used before freezing vegetables to inactivate enzymes and preserve color, flavor, and texture.
- **Pasteurization:** Used in milk to inactivate lipases and proteases that can cause spoilage.
- **Juice Clarification:** Enzymes like pectinases are used to break down pectin, making juice clearer and more stable.
- **Bread Making:** Amylases convert starch to fermentable sugars, aiding yeast fermentation and improving bread texture.
- **Fermentation:** Controlled use of enzymes in fermentation processes for products like cheese, yogurt, and alcoholic beverages.

Controlling enzyme activity is essential to maintain the quality, flavor, texture, and safety of food products. By using various techniques, food processors can effectively manage enzyme activity to optimize food preservation and production.