

Introduction to Food Preservation

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Key concepts, methods, and practical considerations

1. Why Preserve Food?

Reason	Explanation
Safety	Inhibits growth of pathogenic microorganisms (e.g., <i>Salmonella</i> , <i>E. coli</i>).
Shelf-life extension	Delays spoilage, reducing waste and allowing seasonal produce to be available year-round.
Nutrient retention	Proper techniques retain vitamins, minerals, and bioactive compounds.
Economic benefit	Saves money for producers, retailers, and consumers.
Cultural & culinary value	Enables traditional foods (ferments, cured meats, dried fruits) to be enjoyed beyond harvest.

2. Basic Principles

Principle	How It Works	Typical Applications
Temperature control	Low temps slow enzymatic activity and microbial metabolism.	Refrigeration (0-4°C), Freezing (-18°C or lower).
Moisture reduction	Water activity (a_w) is the amount of free water available for microbes. Reducing a_w limits growth.	Drying, Dehydration, Salting, Sugar curing.
Acidity (pH)	Most microbes cannot grow below pH 4.6.	Pickling, Fermentation, Adding citric/vinegar.
Oxygen limitation	Aerobic microbes need O_2 ; removing it restricts them.	Vacuum packaging, Modified atmosphere packaging (MAP), Oil immersion.
Chemical inhibitors	Antimicrobials (natural or synthetic) disrupt cell membranes, metabolism, or enzyme function.	Salts (NaCl, KCl), Sugars, Nitrites/nitrates, Sorbates, Natamycin, Essential oils.
Heat treatment	Denatures proteins, destroys enzymes, and kills microorganisms.	Pasteurization, Sterilization, Canning, Blanching.

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Radiation	Ionizing (γ, X-ray) or non-ionizing (UV) radiation damages microbial DNA.	Food irradiation, UV surface treatment.
Fermentation	Beneficial microbes produce acids, alcohols, and bacteriocins that inhibit spoilage organisms.	Yogurt, sauerkraut, kimchi, tempeh.

3. Major Preservation Methods

3.1 Thermal Processing

Technique	Temperature / Time	Typical Foods	Advantages	Limitations
Pasteurization	63°C × 30 min (low-temp) or 72°C × 15 s (HTST)	Milk, juices, liquid eggs	Retains most nutrients; destroys most pathogens	Does not sterilize (spores survive)
Sterilization / Canning	115-130°C, 3-30 min (pressure canner)	Vegetables, meats, soups	Shelf-stable for years; kills spores	Texture changes; heat-sensitive nutrients loss
Blanching	85-100°C, 1-5 min	Vegetables before freezing/drying	Inactivates enzymes; reduces microbial load	Requires rapid cooling to avoid overcooking

3.2 Refrigeration & Freezing

Method	Temperature Range	Effect	Typical Use
Refrigeration	0-4°C	Slows microbial growth & enzymatic activity	Fresh produce, dairy, leftovers
Freezing	??	??	??