

Overview of Food Microbiology

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Key concepts, major groups of microorganisms, their roles in food, and practical implications for safety and quality.

1. What Is Food Microbiology?

- **Definition:** The study of microorganisms (bacteria, yeasts, molds, viruses, parasites) that inhabit, contaminate, or are deliberately added to food.
 - **Scope:**
 - **Pathogenic microbes** – cause foodborne illness.
 - **Spoilage microbes** – degrade sensory and nutritional quality.
 - **Beneficial microbes** – used in fermentation, preservation, probiotic products.
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2. Major Groups of Microorganisms in Food

Group	Typical Species	Primary Food Associations	Impact
Bacteria	<i>Salmonella spp.</i> , <i>Listeria monocytogenes</i> , <i>Escherichia coli</i> O157:H7, <i>Clostridium botulinum</i> , <i>Bacillus cereus</i>	Raw meats, dairy, eggs, fresh produce, canned foods	Pathogenic (illness), spoilage, toxin production
Yeasts	<i>Saccharomyces cerevisiae</i> , <i>Candida spp.</i>	Bread, wine, beer, fruit juices, fermented vegetables	Fermentation (flavor, leavening), occasional spoilage
Molds (Fungi)	<i>Aspergillus flavus</i> , <i>Penicillium spp.</i> , <i>Rhizopus stolonifer</i>	Grains, nuts, dried fruits, cheese, cured meats	Spoilage, mycotoxin production, ripening of cheeses
Viruses	Norovirus, Hepatitis A virus, Rotavirus	Ready-to-eat foods, shellfish, fresh produce	Acute gastroenteritis, hepatitis
Parasites	<i>Giardia lamblia</i> , <i>Cryptosporidium spp.</i> , <i>Trichinella spiralis</i>	Fresh water, undercooked meat, unwashed produce	Gastrointestinal disease, systemic infection

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3. Sources of Microbial Contamination

1. **Raw Materials** – intrinsic flora of animals, plants, soil.
 2. **Environment** – air, water, equipment surfaces, workers' hands.
 3. **Processing Steps** – inadequate cooking, cooling, or storage.
 4. **Cross-Contamination** – transfer between raw and ready-to-eat foods.
 5. **Post-Process Handling** – packaging, distribution, retail.
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4. Microbial Growth Factors (The “Four Ps”)

Factor	How It Affects Growth	Typical Control Measures
Product (pH, water activity, nutrients)	Low pH & low a_w inhibit many bacteria; high nutrient density promotes growth.	Acidification, drying, adding salts/sugars.
Process (temperature, time)	Mesophiles thrive 20-45°C; thermophiles >45°C; psychrotrophs grow at refrigeration temps.	Pasteurization, sterilization, chilling, hot-holding.
Preservation (antimicrobials, packaging)	Chemical preservatives (e.g., sorbates) and modified atmosphere inhibit specific groups.	Use of preservatives, vacuum/MAP, hurdle technology.
Pathogen/Spore Load (initial inoculum)	Higher initial counts reduce lag phase, increase risk.	Good Manufacturing Practices (GMP), sanitation, raw material testing.

5. Food-Borne Illness vs. Spoilage

Aspect Food-Borne Illness Spoilage