BASIC FOOD MICROBIOLOGY
Bacteria Microbiology

- Microscopic
- Single Cell
- Shape
  - Cocci - Spherical*
  - Bacilli – Rod *
  - Sperilli – Corkscrew, Comma

*Most Food Borne Pathogens are Cocci or Rod shape
Bacterial Reproduction

- Doubling
- Binary Fission

1 → 2 → 4 → 8 → 16 → 32 → 64

Under **optimal conditions** most bacteria can double every **20 minutes**.
Growth Curve Phases

• Lag – Bacteria adapting to environment
• Log – Logarithmic growth reproduce to high numbers in short period of time
• Stationary – Death= Growth
• Death – Sharp decline in numbers
  – Ran out of Nutrients
  – Accumulation of waste
  – Accumulation of toxin

Objective - Extend the Lag Phase
Spores vs Vegetative

• Vegetative Cells
  – Living cells, metabolically active (ingest nutrients, secrete waste)

• Spores – Endospore
  – Function – Protection from the environment
  – Dormant cell – no intake of nutrients, not secreting waste
  – Resistant to Heat, Cold, Chemicals, Radiation
What Microorganisms Need to Grow

- Acronym – FAT TOM
  - F – Food
  - A – Acidity
  - T – Temperature
  - T – Time
  - O – Oxygen
  - M – Moisture
Intrinsic Factors

- Intrinsic
  - pH
  - Moisture Content
  - Oxygen Needs
  - Nutrient Content
  - Antimicrobial Constituents
  - Biological Structures
pH

- Effects of pH
  - Enzymes
  - Nutrients
- Other Environmental Factors
  - Temperature
  - Salt
  - Age
- No known pathogen grows below pH of 4.6
  - Clostridium botulinum
Moisture

- Remove and/or Bind Moisture
  - Humectants
  - Dehydration
- Water Activity – Aw
- Most Fresh Foods - Aw > 0.99

0 1

No water Pure water
Microbial Growth and Aw

- Halophilic 0.75
- Xerophilic molds 0.61
- Osmophilic yeasts 0.61
- Lowest Aw for Pathogen Growth
  - 0.86
  - Staphylococcus aureus
Oxygen Conditions

- **Aerobic**
  - Requires air to grow and multiple
- **Anaerobic**
  - Requires no air to grow and multiple
- **Microaerobic**
  - Requires an atmosphere less than air
- **Facultative anaerobes**
  - can live in the absence as well as in the presence of atmospheric oxygen
Others Factors

• Nutrients
  – Fastidious vs non-fastidious
  – unusual and/or complex nutritional needs and must be grown on enriched media.

• Biological Structure

• Antimicrobial Factors
  – Naturally occurring factors
Extrinsic Factors

- Temperature
- Relative Humidity
- Gases in the Environment
- Presence of Other Microorganisms
Temperature

- Microorganisms grow over a wide range of Temperatures
- Psychrotrophs
- Mesophiles
- Thermophiles
- Psychroduric
- Thermoduric
Other Factors

• Relative Humidity of Environment
  – Can change the Aw

• Environmental Gasses
  – CO$_2$, Ozone, modified atmosphere packaging
Temperature Control for Safety Foods (TCS)

- High Moisture ($H_2O$) – $A_w > 0.85$
  - $A_w$ – Water Activity – water available in a food for microbial growth and chemical reactions
- pH > 4.6
- High Protein
- High Starch
Examples TCS Foods

- Milk/Milk Products
- Shell Eggs
- Meat: Beef, Pork, Lamb
- Shellfish and Crustaceans
- Fish
- Baked Potatoes
- Rice, beans, and vegetables
- Poultry
- Sliced Melons
- Raw Sprouts and Sprout Seeds
- Untreated garlic-and-oil mixtures
Types of Illness

• Foodborne illness – Illness carried or transmitted to people by food.
• Foodborne Infections – result of a person eating food containing pathogens, which then grow in the intestines and cause illness.
  – typically symptoms of foodborne illness do not appear immediately
Types of Illness

• Foodborne intoxication
  – Result of a person eating food containing toxins (poisons) that cause an illness. The toxins may have been produced by pathogens found on the food or may be result of a chemical contamination, or part of the natural food.
  – Appear quickly, within a few hours.
Types of Illness

• Foodborne Toxin-mediated infection
  – Result of a person eating food containing pathogens which then produce illness-causing toxins in the intestines.

• Gastrointestinal illness
  – Illness relating to the stomach or intestine
Questions