Outline

1. Taxonomic classification
2. Classification by mode of pathogenesis
3. Overview of how pathogens enter foods

Taxonomic classification of foodborne pathogens

- Prions
- Viruses
- Bacteria
- Fungi
- Protozoa

Infectious agents

Properties of foodborne infections:
- Agent must be present in food in viable (infectious) form at the time of ingestion
- Agent multiplies to cause illness (incubation period)
### Infectious agents
- **Prions**—new variant CJD
- **Viruses**—hepatitis A, noroviruses, etc.
- **Bacteria**—Campylobacter, Clostridium perfringens, Escherichia coli, Listeria, Salmonella, Shigella, Vibrio, etc.
- **Protozoa**—Cryptosporidium parvum, Entamoeba histolytica, Giardia lamblia, Toxoplasma gondii, etc.
- **Metazoan parasites**—roundworms, tapeworms, flukes

### Intoxicating agents
- Properties of foodborne intoxications:
  - Toxic substance is present in food at the time of ingestion
  - Onset of illness is often more rapid

- **Bacteria**—Bacillus cereus, Clostridium botulinum, Staphylococcus aureus
- *(Algae, cyanobacteria)*

- **Fungi**—Aspergillus, Fusarium, Penicillium, etc.
- **Toxic plants and animals**—mushrooms, cassava, fugu, etc.
- **Chemicals**

- "Exceptional" foodborne diseases:
  - **Allergy**—serologic reaction
  - **Intolerance**—enzyme deficiency (abnormal people?)
Other classes of foodborne disease

Idiopathic illnesses:
- Acute—"Chinese restaurant syndrome"
- Chronic—cancer, heart disease

"Food Chain"

Grower (inputs) ➔ Retailer

Distributor ➔ Consumer

Processor ➔ Food Service

Sources of foodborne pathogens

Preharvest:
- Inherent toxicants—acorns, cassava, olives, etc.

Zoonoses—enterohemorrhagic *E. coli*, *Trichinella spiralis*, (*Brucella, Coxiella burnetii, Mycobacterium bovis*, prions of BSE), etc.

Sources of foodborne pathogens

Preharvest:
- Field contaminants—*Cryptosporidium parvum*, enterohemorrhagic *E. coli*, *Vibrio parahaemolyticus*, etc.

Cross-contamination—*Listeria, Salmonella*

Water—enterohemorrhagic *E. coli*, hepatitis A virus, etc.

Humans—hepatitis A virus, *Salmonella*, etc.?
Sources of foodborne pathogens

Processing:
- Problems rare in U.S. at present
- Colonization of facilities by *Listeria, Salmonella*
- If bakeries are included, viruses

Sources of foodborne pathogens

Storage and distribution—most problems with temperature control, rather than contamination

Sources of foodborne pathogens

Retailing and food service;
- Opportunities for human-source contamination: hepatitis A virus, *Shigella*, pathogenic *E. coli* (other than EHEC)
- Cross-contamination with EHEC, *Listeria*, *Salmonella*, etc.
**Sources of foodborne pathogens**

Final preparation and serving
- Opportunities for human-source contamination:
  - bacteria & viruses
  - *Giardia lamblia*
  - *Taenia solium*
  - etc.

**Summary**

- Foodborne pathogens can be classified
  - taxonomically or
  - by mode of pathogenesis
- Pathogens may enter food at any stage; some risks are more easily remedied than others