

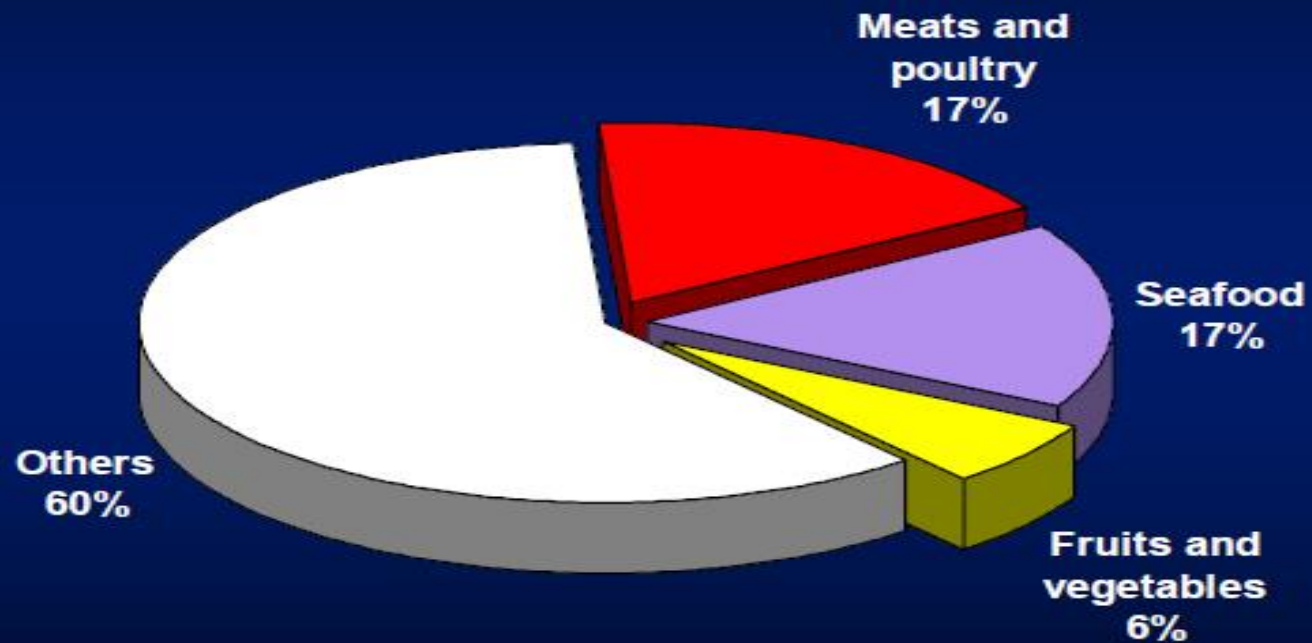
Hazards in Foods

Types of Hazards

- A biological, chemical or physical agent that is reasonably likely to cause illness or injury in the absence of its control
- Types of hazards in foods:
 - Biological – pathogenic bacteria, parasites, and viruses
 - Chemical – toxic residues, solvents, antibiotics
 - Physical – pieces of metal, wood, chips, hair, stones, dirt

Food-Borne Diseases

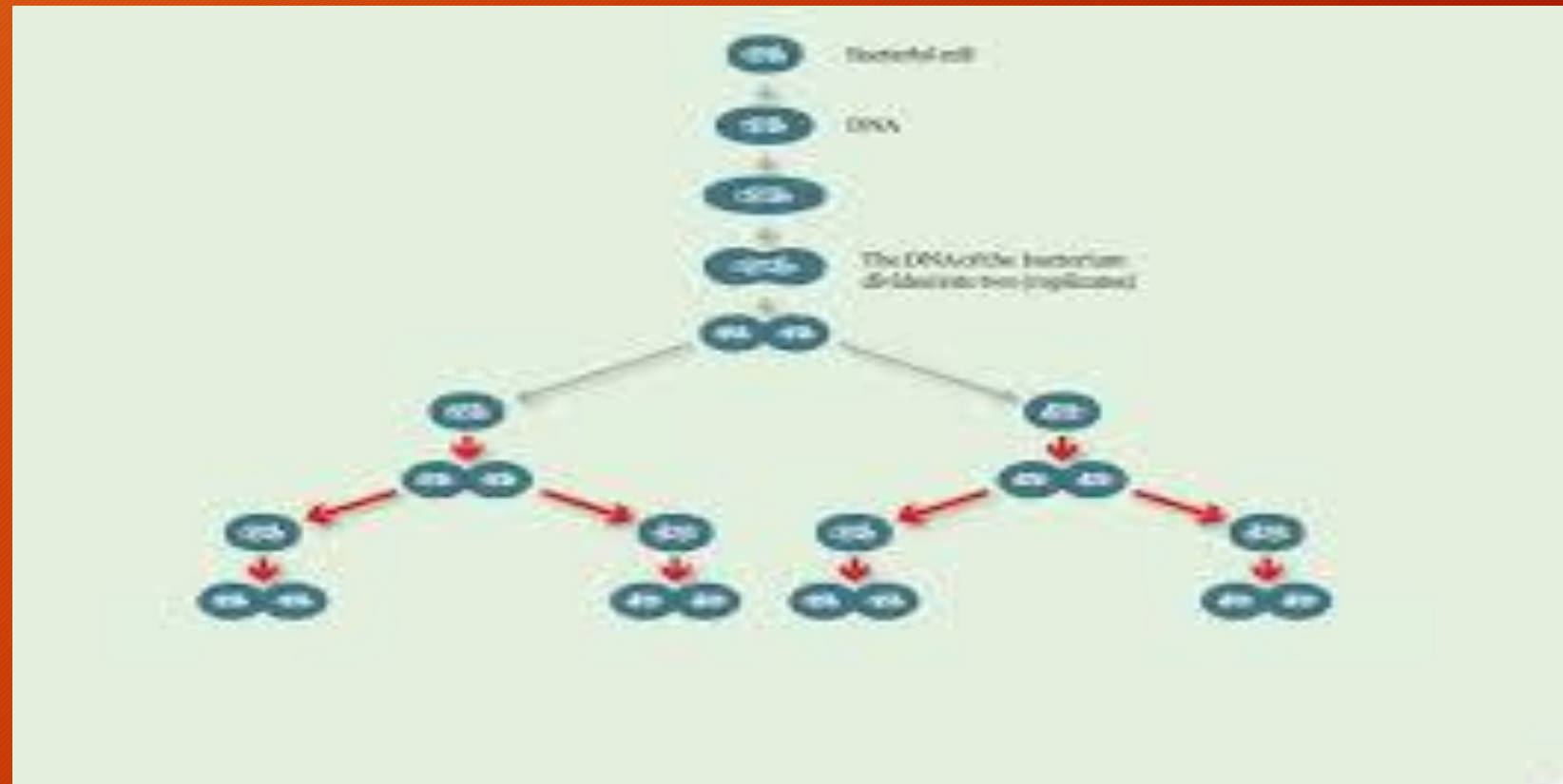
Vehicles associated with foodborne disease outbreaks in the United States



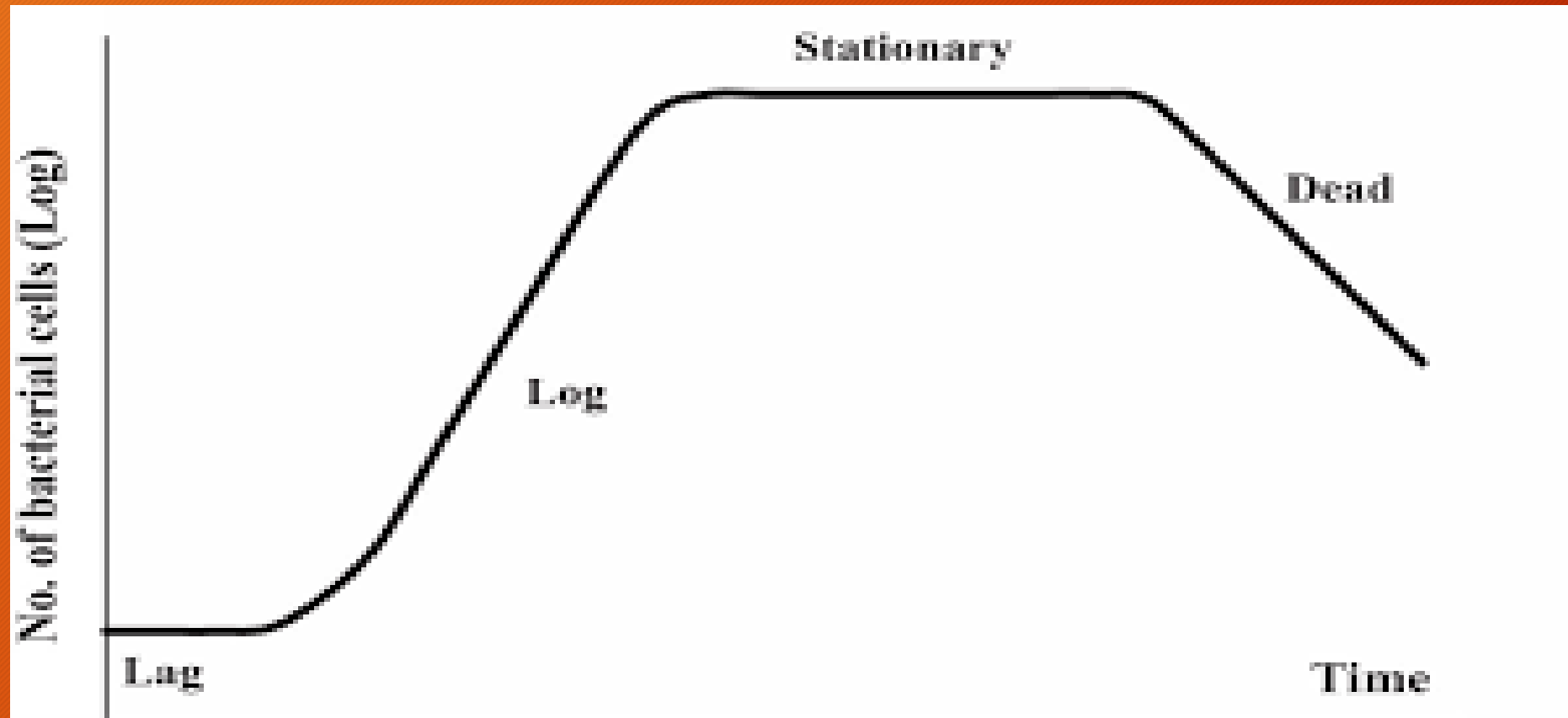
Pathogens commonly associated with meat

- *Salmonella*
- *Escherichia coli* O157:H7 - ground beef
- *Staphylococcus aureus* - processed meats
- *Clostridium perfringens* - cooked meat
- *Campylobacter jejuni* - poultry

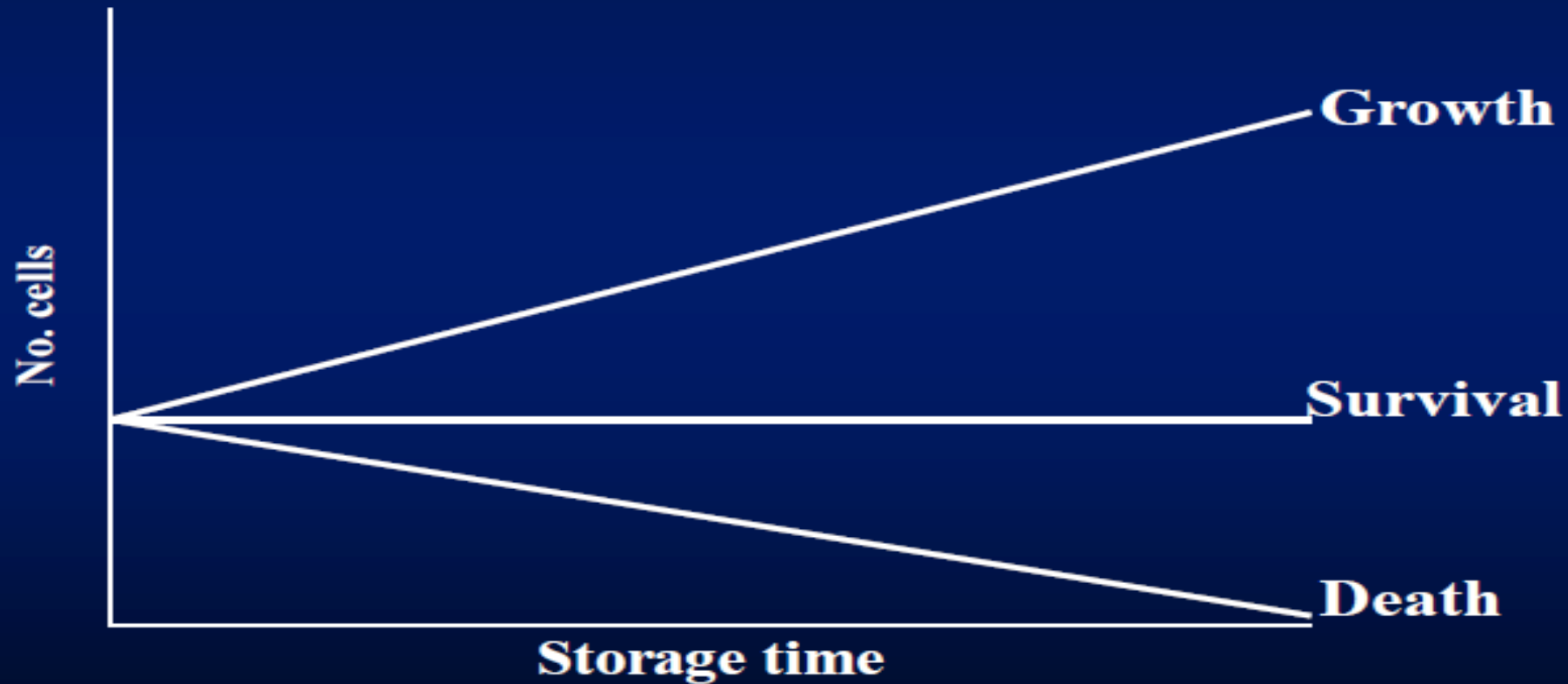
Bacterial Reproduction



Bacterial Growth Curve



Possible fate of a microorganism after entering a food



Intrinsic and Extrinsic Factors

Factors affecting growth and survival of microorganisms in foods

Intrinsic

- pH
- Water activity (A_w)
- Redox potential (Eh)
- Nutritional composition
- Antimicrobial compounds

Extrinsic

- Temperature
 - Freezing (survival)
 - Refrigeration (Growth/survival)
 - Heat (death)
- Storage time
- Gaseous environment
- Relative humidity
- Physiologic condition of the microorganism (stress)

Effect of pH on Growth of Microorganisms

Optimal pH values for growth of different types of microorganisms

| Type of microorganism | Optimum pH |
|-----------------------|------------|
| Bacteria | 6.7 – 7.5 |
| Yeasts | 4.0 – 6.5 |
| Molds | 4.5 – 6.8 |

Effect of a_w on Growth of Microorganisms

Minimum A_w requirements for growth of different types of microorganisms

| Type of microorganism | Minimum required A_w |
|-----------------------|------------------------|
| Most bacteria | 0.90 |
| Yeasts | 0.80 |
| Molds | 0.70 |

Aw of Selected Foods

Aw values for selected foods

| Food | Aw |
|------------------------|---------------------|
| Meat | 0.95 - 0.999 |
| Milk | |
| Fruits | |
| Vegetables | |
| Bread | 0.93 – 0.95 |
| Evaporated milk | |
| Tomato paste | |
| Cheese | 0.85 – 0.93 |
| Condensed milk | |
| Jellies | 0.60 – 0.85 |
| Syrup | |
| Crackers | <0.60 |
| Pasta | |

Favourable Growth Temperatures

Classification of microorganisms on the basis of their temperature for growth

➤ Thermophiles

➤ Grow at $>40^{\circ}\text{C}$ (104°F)

➤ Mesophiles

➤ Prefer $20 - 40^{\circ}\text{C}$ ($68 - 104^{\circ}\text{F}$)

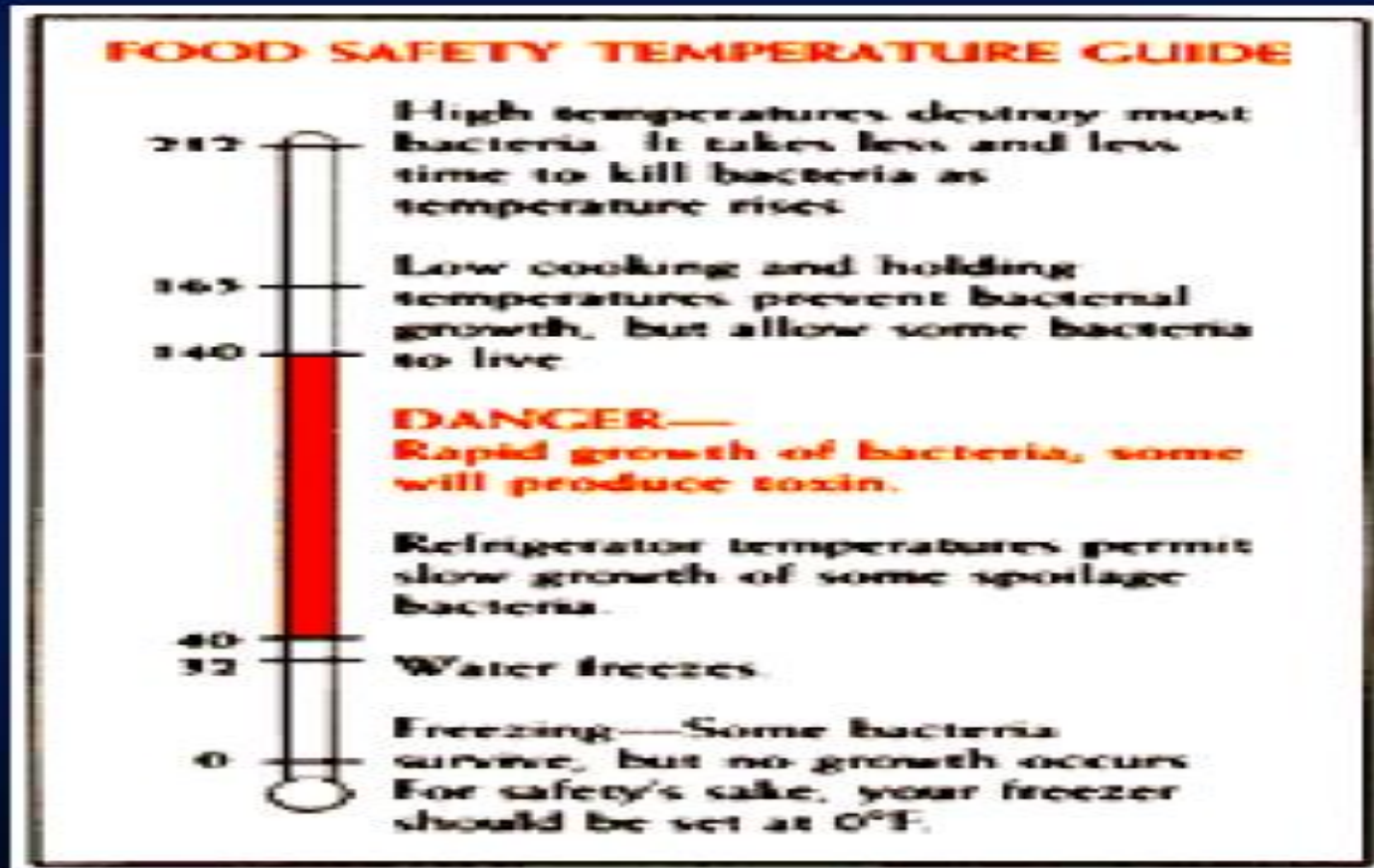
➤ Psychrophiles

➤ Need $<20^{\circ}\text{C}$ (68°F)

➤ Psychrotrophs

➤ Microorganisms capable of growth $<20^{\circ}\text{C}$ (68°F , usually mesophiles)

Food Safety Thermometer



Types of Foodborne Diseases

➤ ***Salmonella***

➤ Causes infection

➤ ***Staphylococcus aureus***

➤ Causes intoxication

➤ ***Clostridium perfringens***

➤ Causes toxicoinfection

Pathogens of Concern

Classified as severe direct hazards

- ***Escherichia coli* O157:H7** (hamburger, salami, apple cider, sprouts)
 - Hemorrhagic colitis, HUS, TTP
- ***Clostridium botulinum*** (homemade preserves)
 - Botulism
- ***Listeria monocytogenes*** (queso blanco, alfalfa, coleslaw)
 - Listeriosis
- ***Vibrio vulnificus*** (oysters)
 - Fulminant septicemia, wound infection

Pathogens causing moderate illness

Wide distribution

- ↗ *Salmonella* spp.
- ↗ *Shigella* spp.
- ↗ Other pathogenic
E. coli
- ↗ *Streptococcus*
pyogenes

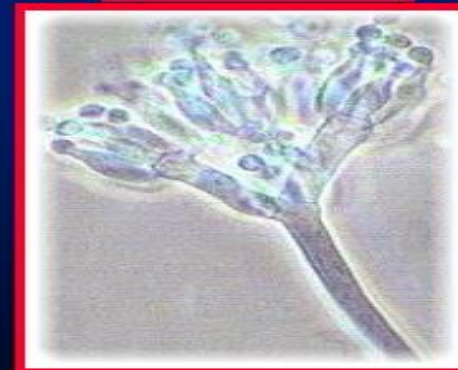
Limited distribution

- ↗ *S. aureus*
- ↗ *C. perfringens*
- ↗ *Campylobacter*
jejuni

Fungi

Molds

- **Grow in organic matter**
- **Each colony forms a mycellium**
 - Micellium composed of hyphae
- **Certain species produce toxins named mycotoxins**
 - Aflatoxins
 - Ochratoxin
 - Zearalenone
- **Mycotoxins can be present in foods**
 - Aflatoxins in cereal products



Diseases caused by Aflatoxins

➤ Low doses

- Liver cancer

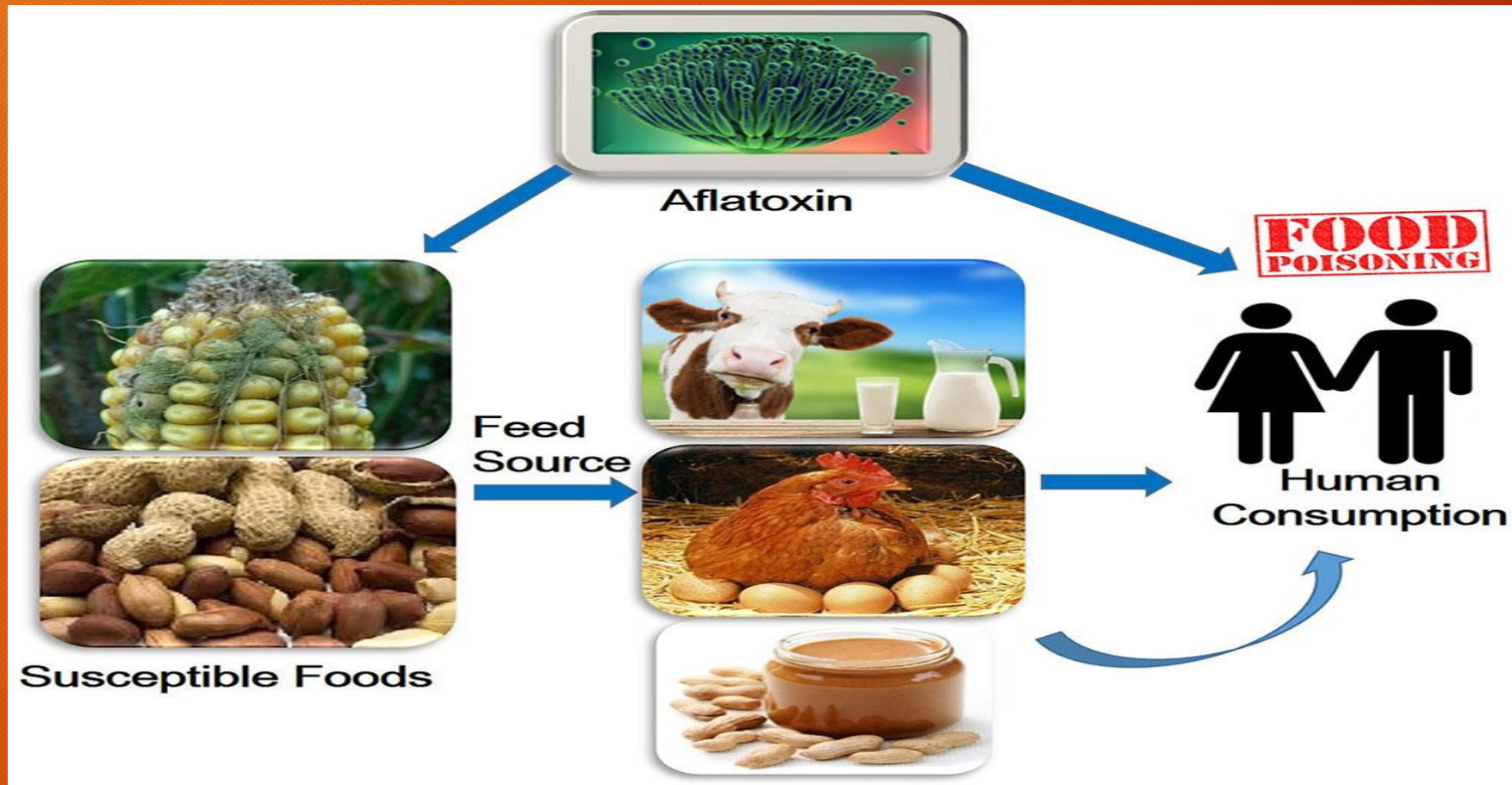
➤ High doses

- Necrosis of the liver

➤ Can be absorbed from GI tract to milk

➤ Peanut products have caused outbreaks in turkeys

Aflatoxin Poisoning



Parasites

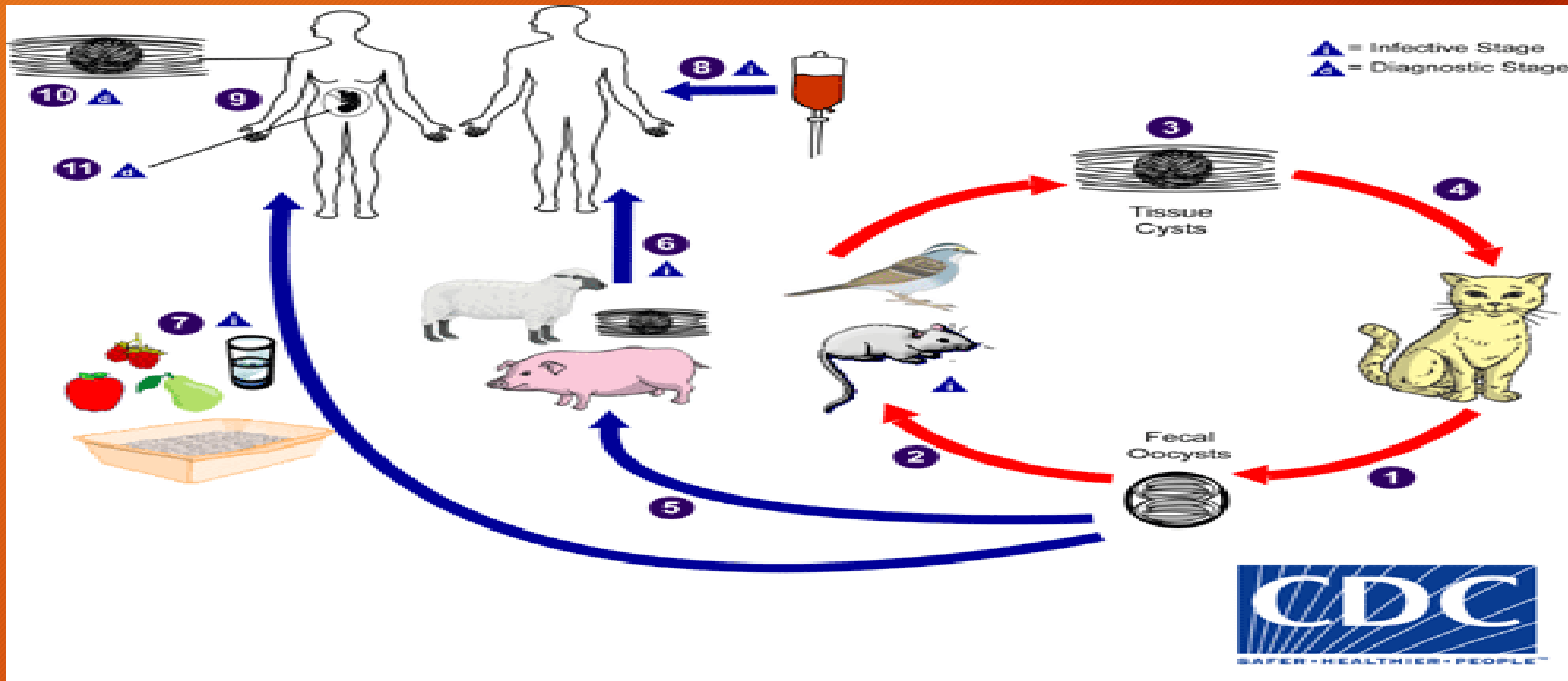
Types of parasites

- Protozoa
- Tape worms
- Round worms

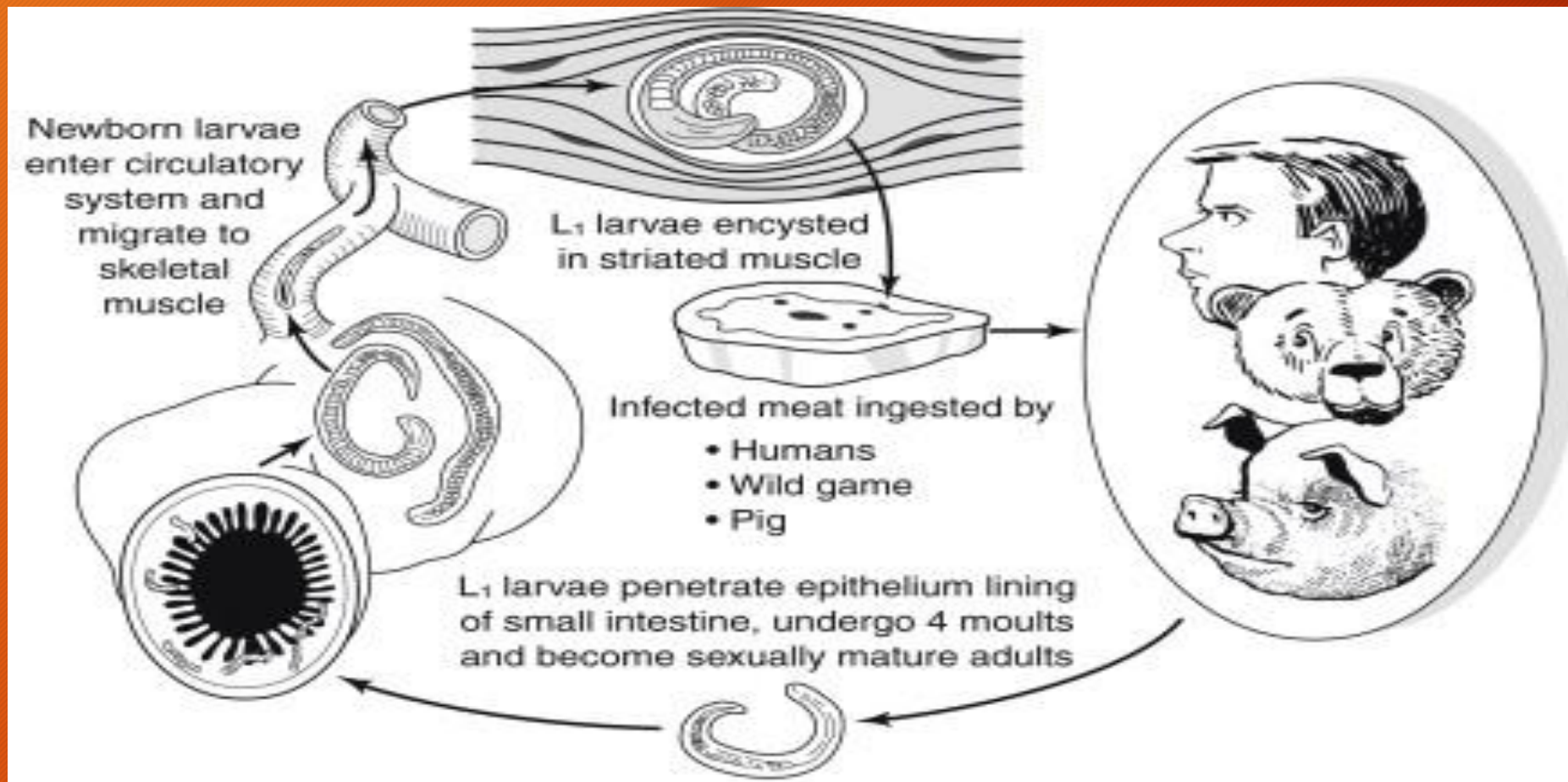
Associated with meat

- Protozoa
 - *Toxoplasma*
- Tape worms
 - *Taenia solium*
 - *Taenia saginata*
- Round worms
 - *Trichinella spiralis*

Toxoplasmosis



Infection with *Trichinella spiralis*



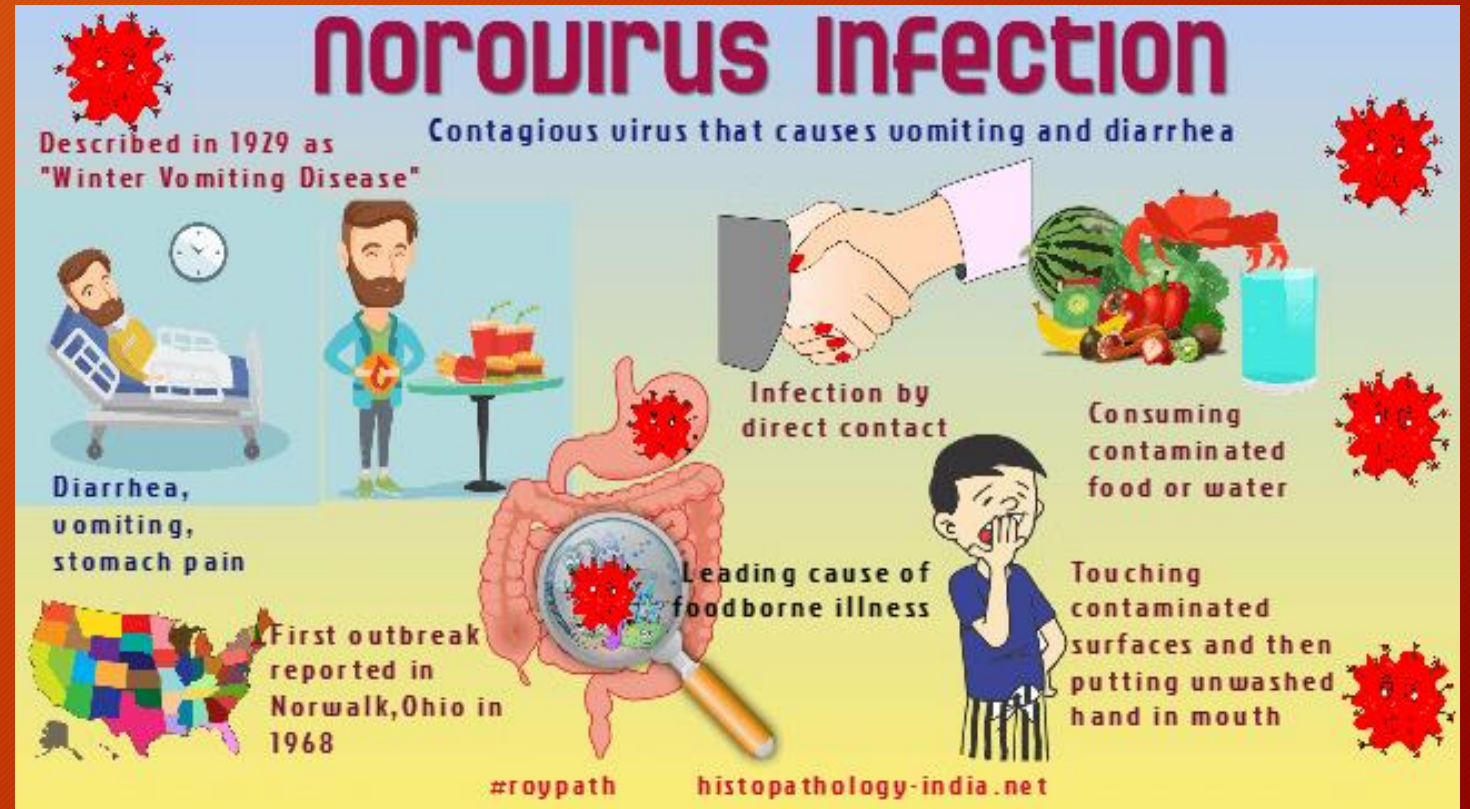
Viruses

- Nucleic acid (DNA or RNA) wrapped in a protein coat



Major Foodborne Viruses

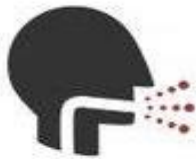
- Hepatitis A
- Norwalk
- Rotavirus
- Do not grow in food
- Survive for a specific period of time



Hepatitis Infection

WHAT IS HEPATITIS **A**?

- 1 Hepatitis A is a highly contagious viral liver infection.



- 2 It is preventable by vaccine, and is caused by ingestion of fecal matter.

- 3 It might last for weeks up to months.



WHAT ARE THE SYMPTOMS?

Jaundice



Nausea



Abdominal Pain



HOW IS IT SPREAD?

Direct Contact



Infected Food



Sewage Contamination



Factors Contributing to FBI

- Inadequate storage temperature
- Insufficient cooking
- Cross contamination
 - Bacteria are transferred from raw to cooked foods
 - No competitors
 - Temperature abuse

Preventing FBI

- Prevent contamination - GMP's
- Destroy pathogens - thermal treatment, irradiation, chemicals
- Prevent bacterial growth - refrigeration



Chemical Hazards

- Prohibited substances that are directly or indirectly added
- A tolerance or action level must be established
- Prohibited substances:
 - Cinnamyl anthranilate, coumarin – flavouring substances
 - Sweeteners – cyclamates, dulcin
 - Preservatives – monochloroacetic acid, thiourea
 - Foam stabilizers – cobalt salts
 - Antioxidants – BHA
 - Fermentation inhibitors – DEPC

Chemicals Associated with Foods

- Colour additives
- Prior-sanctioned substances
- GRAS
- Pesticide chemicals

What is Generally Recognized As Safe?



GRAS
Generally Recognized as Safe
by the FDA

Food Safety



The substance must be shown to be 'generally recognized as safe' under the conditions for its intended use.

An FDA designation for a substance that is considered safe when added to food.

GRAS Substances

- **Spices and other natural seasonings and flavorings**
- **Essential oils, oleoresins and natural extractives**
- **Synthetic flavoring substances and adjuvants**
- **Substances migrating from cotton and cotton fabrics used in dry food packaging**
- **Substances migrating to food from paper and paperboard products**
- **Anticaking agents**
- **Dietary supplements**
- **Stabilizers, emulsifying agents, sequestrants, nutrients**

Control of Chemical Hazards

- **Prior to receipt of food ingredients and packaging materials**
- **Upon receipt of these materials**
- **During processing at the points where these chemicals are used**
- **During storage of food ingredients, packaging materials, and hazardous chemicals**
- **During use of cleaners and sanitizers, lubricants**
- **Prior to shipment of finished goods**

Color Additives Exempt from Certification

- Beet powder
- Ultramarine blue
- Canthaxanthin
- Caramel
- α -Carotene
- Grape color extract
- Synthetic iron oxide
- Fruit and vegetable juice
- Aztec marigold meal
- Carrot oil
- Paprika
- Riboflavin
- Other various natural compounds

Direct Food Additives - Intentionally Added

- Food preservatives
- Coatings, films, and Related substances (RS)
- Dietary and nutritional additives
- Anticaking agents
- Flavoring agents
- Gums, chewing gum bases and RS
- Other specific usage additives

Flavour enhancers: total 18

- Disodium 5'-guanylate E627

Гуанилат натрия



- Disodium 5'-inosinate E631

Инозинат натрия

- Monopotassium L-glutamate E622

Глутамат калия

- Maltol E636

Мальтол



Physical Hazards

- **Metal**
- **Glass**
- **Wood splinters**
- **Insects**
- **Hair**
- **Mold, mold mats**
- **Rodents/dropping**
- **Bullets/shot/BBs**
- **Pen/pencil caps**
- **Gum, wrappers**
- **Dirt, rocks**
- **Jewelry, buttons**
- **Cigarette butts**
- **Band-aid**
- **Hypoddermic needles**
- **Carcass ID tag/pin**
- **Knives**
- **Grease**
- **Gasket materials**
- **Pieces of machinery**

Equipment for Detecting Physical Hazards

| Equipment | Function |
|-------------------------|---|
| Magnet | Removes hazardous metallic metal |
| Metal detector | Detects ferrous objects > 2 mm |
| Screen or sifter | Removes foreign objects > opening |
| Aspirator | Removes materials lighter than product |
| Riffle board | Removes stones from fry beans/peas |
| Bone separator | Removes bone chips from meat/poultry |