

Microbial Hazard



Microbial Hazard

- Microbial foodborne illness, also commonly called 'food poisoning', is illness caused by eating food contaminated with specific types of microorganisms or toxins formed by these microorganisms.
 - Microorganisms that are capable of causing illness are called 'pathogenic microorganisms' or simply 'pathogens'.
 - Microorganisms that may be pathogenic are bacteria, viruses, parasites and moulds.
-

Microorganisms

- Some microorganisms can be pathogenic (concerns food processors and public health officials). "Ugly"

 - Microorganisms can be beneficial, even essential "Lovely"
-

What are pathogens? "Ugly"

- Organisms that can invade our bodies and cause disease. Classification of disease causing organisms:
 - **Accidental Pathogens** (ex. *Clostridium tetani*, *Neisseria meningitidis*, *Bacteriodes fragilis*)
 - **Obligate Pathogens** (ex. *Neisseria gonorrhoeae*)
 - **Opportunistic Pathogens** (ex. skin infections caused by *Pseudomonas aeruginosa*, *Vibrio cholerae*).

- A highly virulent organism is one that can cause an acute infection. Virulent organisms must either produce really nasty toxins or be very invasive (or both!).

- Virulence:
 - Infectivity:
Ability of the pathogen to establish a focal point of infection
 - Invasiveness:
Ability of the pathogen to spread to other tissues
 - Toxigenicity:
Ability of the pathogen to produce toxins

Infection process

I. Transmission

- Airborne e.g. Flu Virus, Mycobacterium tuberculosis
- Contact e.g. person-to-person (direct) contact, e.g. AIDS
- Vehicle
- Vector-borne ex. *via* ticks, fleas.

II. Attachment & Colonization

- mucosal surfaces inside the respiratory, gastrointestinal or genitourinary tracts.
- Most pathogens have very specific mechanism for attachment to the specific mucosal surfaces that they colonize.
- After adherence, some pathogens simply colonize the mucosal surface and cause damage *via* the release of toxins (ex. *Vibrio cholerae*, *Corynebacterium diphtheriae*).

III. Growth

VI. Evasion of Host Defenses

- Immune Response

V. Toxicogenicity

Toxins

Exotoxins:

Function by destroying specific components of cells or by inhibiting certain cellular activities.

Algal Toxins:

One of this is produced by the blue-green alga *Microcystis aeruginosa*

Mycotoxins:

Alfatoxins are produced by *Aspergillus*.

Exotoxins: are released to the surrounding environment during the lifetime of the organism.

Most exotoxins fall into one of the following categories:

- 1) Enterotoxins - cause dysentery; ex. *E. coli* toxin.
- 2) Neurotoxins - disrupt nerve impulses; ex. Tetanus and botulinum toxins
- 3) Cytotoxins - inhibit protein synthesis, ex. diphtheria toxin

Endotoxins are derived from the cell wall of gram negative bacteria. Chemically are lipopolysaccharide-protein complexes.

ex. *Escherichia*, *Salmonella*, *Neisseria*, *Serratia*, *Shigella*

Endotoxins cause the release of a fever inducing substances from polymorphonuclear leukocytes, which interferes with the temperature regulatory centers in the brain.

Pathogenic bacteria and foods they have been associated with

Bacteria	Associated foods
<i>Aeromonas</i> species	Raw fish and shellfish, fresh produce exposed to untreated water
<i>Bacillus cereus</i>	Bolled or fried rice, porridge, pasta, processed meats, cooked vegetables, soups and sauces
<i>Campylobacter</i> species	Raw chicken, beef and offal (e.g. liver and kidneys)
<i>Clostridium botulinum</i>	Foods incorrectly preserved at home, smoked fish, vegetables in oil, incorrectly processed or cooled canned foods
<i>Clostridium perfringens</i>	Cooked meat, poultry, sauces, pies, casseroles and curries left to cool slowly at warm temperatures

Bacteria	Associated foods
<i>Escherichia coli</i> O157 and related types	Minced meat, salad vegetables, bean sprouts and sprouted seeds, and fermented smallgoods
<i>Listeria monocytogenes</i>	Coleslaw, soft cheeses, sliced processed meats, frankfurters, dips, pâté, cooked poultry and ready-to-eat seafood
<i>Salmonella</i> species	Poultry, raw or undercooked eggs, bean sprouts and sprouted seeds, and a wide range of fruits and vegetables
<i>Shigella</i> species	Ready-to-eat foods that are contaminated by an infected food handler who has poor hygiene or contaminated water used in food preparation
<i>Staphylococcus aureus</i>	Ham, cream-filled pastries, cheese and foods contaminated by a food handler
<i>Vibrio cholerae</i>	Raw seafood, fruits and vegetables washed in contaminated water or contaminated by a food handler
<i>Vibrio parahaemolyticus</i>	Raw fish, shellfish, and crustaceans (e.g. prawns, crabs, lobsters and crayfish)
<i>Vibrio vulnificus</i>	Raw oysters
<i>Yersinia enterocolitica</i>	Raw meat (particularly pork), raw poultry, unpasteurised milk and tofu

Infection/ Intoxication

Food borne illnesses are classified into two groups:

- A food borne infection is a disease that results from eating food containing living harmful microorganisms.
- A food borne intoxication results when toxins, or poisons, from bacterial or mould growth are present in ingested food and cause illness in the host (the human body).

Examples of Food borne
Infections of bacteria origins

Salmonellosis: (infection)


- Results from eating food contaminated with live pathogenic Salmonella.
- *S. enteritidis*; *S. typhimurium*
- There are more than 2,000 types of this bacteria. Gram negative rods.



- Symptoms:
Diarrhea, fever, chills, abdominal pain, and possibly a headache or vomiting.
- Incubation period: 6 to 48 hr.
- Duration of illness: 2-3 days
- Source:
Domestic and wild animals (especially poultry), shell egg, eggs, milk, pets, and human beings.

- Prevention and Control Measures:
 - Cook foods adequately.
 - Chill foods within four hours.
 - Store food at refrigeration temperature.
 - Avoid cross-contamination.
 - Keep eggs refrigerated.
 - Sanitation and hygiene.

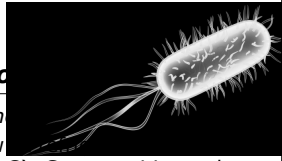
Shigellosis: (infection)



- *Shigella sonnei*; *Sh. flexneri*
- Some times called bacillary dysentery.
- Facultative, mesophile (37°C), non spore former, Gram negative rods.
- Symptoms:
Diarrhea, cramp, and chill, often accompanied by fever.
- Incubation period: 1 to 7 days

- Source:
Humans can carry this pathogen for periods of several weeks. Carriers excrete shigella in their feces.
Flies.
- Food Involved:
Potatoes, tuna, shrimp, turkey and macaroni salads, lettuce, moist and mixed foods.

Listeriosis: (infectio



- *Listeria monocytogenes*
- Facultative, can grow at low temperature (0 - 1.1°C), Gram positive rods.
- Symptoms:
Meningitis in immuno-compromise individuals (inflammation of the brain and spinal cord).
In healthy adults; nausea, vomiting and headache.
Pregnant woman; miscarriage or stillborn baby.

- Incubation period: 1 day to 3 weeks.
- Sources:
Domestic mammals and fowl, soil, water, and plants.
- Foods Involved:
Raw vegetables, dairy products (especially unpasteurised milk and soft cheese), raw meat


FOODBORNE INTOXICATIONS OF BACTERIAL ORIGIN

Staphylococcal Food Intoxication

- *Staphylococcus aureus*
Facultative, cocci, non-spore former, Gram positive cocci.
- The toxin is not destroyed or inactivated by cooking.
- Symptoms:
nausea, vomiting, diarrhea, dehydration and cramp.





- Incubation period: 1 - 6 hr
- Source:
Human being are considered to be the most important reservoir of *S. aureus*.
It is estimated that 40 to 50% of all healthy people carry this bacteria (nasal passages, throat, hand, skin, burns boils, pimples, and in infected cuts.
- Food Involved:
Cooked meat products, cheeses, and high protein salty foods

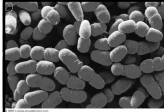


□ **Botulism Intoxication**

- *Clostridium botulinum*
- Attacks the nervous system, spore former, anaerobic, Gram positive rods.
- Symptoms:
Headache, vertigo, double vision, weakness, difficulty swallowing and speaking, and progressive respiratory paralysis.
- Incubation period: 12-36 hours



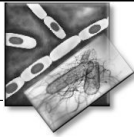
- Source: Soil, water, and in the intestinal tracts of animals, including fish.
- Food involved:
Improperly processed foods, low-acid foods (green beans, asparagus, pepper, corn, beets, spinach, and mushrooms), smoked vacuum-packed fish and baked potatoes.



Clostridium perfringens

- Bacteria: Anaerobic, spore-forming, non-motile
- Source: Soil, dust, intestinal tract of animals and humans
- Illness: Infection (toxin released on sporulation)
- Symptoms: Intense abdominal cramps and diarrhea
- Food: Temperature abuse of prepared foods such as meats, meat products, and gravy.
- Transmission: Spores present in raw foods
- Control: Proper time/temperature control; preventing cross-contamination of cooked foods

Bacillus cereus intoxication

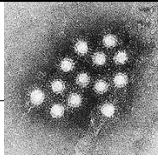


- Spore former, aerobic or facultative anaerobic, gram positive rods.
- Symptoms: Diarrhea, vomiting, and an abdominal pain.
- Incubation period: 30 min to 5 hours.
- Source: soil
- Food involved: grains, rice, flour, spices, dry mix products, starch, alfalfa sprout, meat, and milk.

Hazards from Viruses in Foods

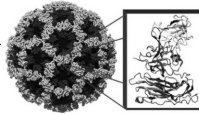
- Hepatitis A and E**
- Norwalk virus group**

Hepatitis A



- Source: Human intestine
- Illness: Infection
- Symptoms: Fever, malaise, nausea, abdominal discomfort, jaundice.
- Foods: Cold cuts, sandwiches, fruits, fruit juices, milk and milk products, vegetables, salads, shellfish, iced drinks.
- Transmission: Fecal contamination of food or water
- Control: Proper cooking, preventing cross contamination, good sanitation, employee hygiene

Norwalk Virus Group



- Source: Human intestines
- Illness: Infection
- Symptoms:
Self-limiting and mild; nausea, vomiting, diarrhea, abdominal cramps, fever
- Foods:
Salad ingredients, raw or insufficiently cooked clams and oysters, fecal contamination of food or water
- Control:
Proper cooking, good sanitation, employee hygiene, preventing cross contamination
