FACTS ON

Foodborne Pathogens

Manitoba

Foodborne disease is caused by consuming contaminated foods or beverages. Many different disease causing microbes, or pathogens, can contaminate foods, so there are many different foodborne infections. Use this resource as a reference on foodborne bacterial and non-bacterial agents that can potentially result in food contamination.

Contact us

For more technical information or to obtain a copy of this publication, call **204-795-8418** in Winnipeg, or e-mail ***foodsafety@gov.mb.ca***

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Bacillus cereus

Characteristics

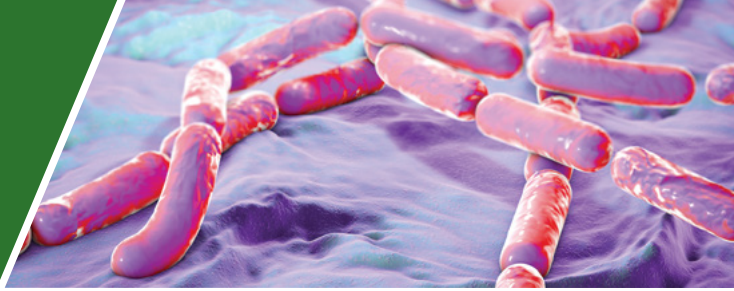
- oxygen requirements: aerobic
- temperature range for growth: 5-55 ºC
- pH range for growth: 4.3 minimum, 9.3 maximum
- water activity for growth: 0.912-0.95
- motile, spore-forming organism
- spores resist heat and dry environment conditions

Foods at risk

- boiled or fried rice stored at room temperature
- starchy food (pasta, noodles, potato products)
- cooked vegetables and salads
- cooked meat (mince beef, veal, lamb, pork, poultry)
- ready-to-eat foods
- dried herbs and spices
- dried products such as cereals and flours
- cream ('sweet curdling' or 'bitty cream' spoilage)
- puddings, sauces and soups

Sources

- distributed in soil, dust, air, water and decaying organic matter



Risk to consumers

- diarrhea
- vomiting

Transmission

- ingestion of contaminated food

Prevention

- vegetative cells destroyed by heat (56 ºC, 5 minutes)
- spores destroyed by heat (126 ºC, 90 min)
- spores lose heat resistance in acidic environments, reduce pH of food to <4.3
- most chemical sanitizers destroy *B. cereus* on surfaces
- reduce water activity to 0.921
- preservatives which have an effect on *B. cereus* include: benzoate, EDTA and sorbate

Testing

- PEMBA agar used for identification; the bacteria colonies retain a turquoise-blue color after 24 hours of incubation at 37 ºC
- commercial kits also available

In general

- cook food thoroughly and cool rapidly to prevent spore germination
- keep hot foods above 60 ºC and cold foods below 4 ºC
- reheat cooked food to 74 ºC

Campylobacter jejuni

Characteristics

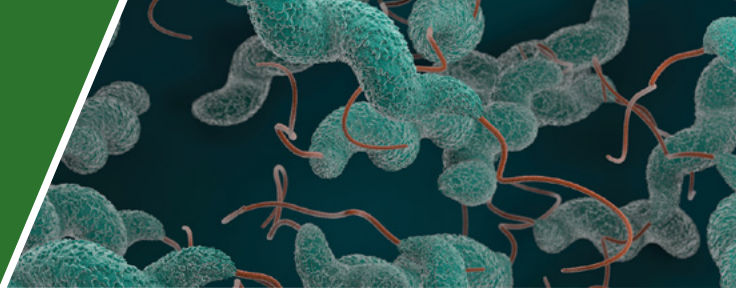
- oxygen requirements: micro-aerophilic (low levels of oxygen 3-5%)
- temperature range for growth: 25-45 °C
- pH range for growth: 4.9 minimum, 9.5 maximum
- water activity for growth: 0.987-0.997
- non-spore-forming organism
- motile

Foods at risk

- meat carcasses contaminated with intestinal contents during slaughter and evisceration
- raw poultry
- shellfish
- raw milk
- red meat
- salads
- mushrooms

Sources

- alimentary tract of wild, domesticated animals and birds, sewage



Risk to consumers

- gastrointestinal disease

Transmission

Food is a vehicle for transmission. Direct transmission person-to-person or from contact with infected animals.

Prevention

- inactivated by heating at 55 °C and above, cannot survive cooking or pasteurization temperatures
- sensitive to drying
- reduce pH of food to <4.9, rapid death especially above refrigeration temperatures
- survives poorly at atmospheric oxygen concentrations and room temperature
- sensitive to NaCl concentrations above 1%
- ascorbic acid inhibits growth of several species
- sensitive to sanitizers, e.g., chlorine
- sensitive to ultraviolet radiation

Testing

- incubation media (FBP) containing blood, pyruvate, ferrous salts, charcoal and metabisulfite

In general

- avoid cross contamination from raw foods to cooked foods
- reheat cooked food to 74 °C

FOODBORNE
BACTERIAL AGENTS

Clostridium botulinum

Characteristics

Motile and spore-forming bacteria, extremely heat-resistant spores. Toxin produced at pH 4.83-5.2.

Group I, type A, B and F (proteolytic)

- oxygen requirements: anaerobe
- temperature range for growth: 10-48 °C
- pH range for growth: 4.6 minimum, 9 maximum
- water activity: 0.935 minimum

Group II, type B, E and F (non-proteolytic)

- oxygen requirements: anaerobe
- temperature range for growth: 3.3-45 °C
- pH range for growth: 5 minimum, 9 maximum
- water activity: 0.970

Foods at risk

- uncooked vegetables (type A) that have close contact with the ground (asparagus, potatoes, cabbage) and grains
- smoked and salted fish, seafood (type E)
- spores germinate in low-acid frozen or cold food
- canned products: vegetables, meat, corn, peppers, green tomatoes, chicken, ham, sausage, lobster
- honey

Sources

- distributed in dust, mud, water and animal carcasses

Risk to consumers

- botulism caused by toxin, neurological symptoms

Transmission

- food contaminated with spores or vegetative cells

Prevention

- spore inactivation in low-acid (pH>4.3) foods by heating to 121 °C for 3 minutes
- toxin inactivated by heating to 85 °C for 1 minute, 80 °C for 6 minutes or 65 °C for 1.5 hours
- vegetative cell destroyed by few minutes exposure to 60 °C
- thermal death increase at extreme pH (<5 & >9)
- group I inhibition by 10% NaCl and group II inhibition by 5% NaCl
- toxin inactivation by pH 11
- reduce pH of food to ≤4.6
- use of preservatives, e.g., nitrite, sorbates, EDTA
- lactic acid bacteria added in starter cultures inhibit growth in meat products
- spores inactivated by ozone or chlorine dioxide

Testing

- horse-blood or egg-yolk agar incubated anaerobically

In general

- hold foods at ≤3.3 °C or ≥60 °C
- cool cooked foods under refrigeration for 3 days, colonies show lipolytic activity

Clostridium perfringens

Characteristics

- oxygen requirements: anaerobe
- temperature range for growth: 10-52 °C
- pH range for growth: 5 minimum, 9 maximum
- water activity for growth: 0.93-0.95
- spore-former, heat resistant spores (up to 100 °C)
- non-motile
- produces enterotoxins

Foods at risk

- cooked meat: stews, roast joints
- gravies, thick soups, vegetable curry (heating drives air off and creates anaerobic conditions for spores to germinate)
- pies
- poultry dishes, prepared in advance and allowed to cool slowly
- rolled meats and stuffed poultry

Sources

- distributed in soil, dust, water, vegetation and human gastrointestinal tract

Risk to consumers

- gastroenteritis: diarrhea and abdominal pain
- wound infection and gas gangrene

Transmission

- ingestion of contaminated foods

Prevention

- vegetative cells are destroyed by heating or by freezing
- enterotoxins inactivated by heating for 5 minutes at 60 °C
- vegetative cells growth is prevented at <12 °C
- 6-8% NaCl inhibits growth
- curing salts (e.g., sodium nitrite and chloride) can inhibit growth
- pH below 5 and above 8.3 destroy cells
- high concentration of ethanol (as sanitizer) cause spore death on food contact surfaces

Testing

- TSC and OPSP media containing antibiotics, incubated anaerobically for 24 hours at 37 °C
- commercial kits available

In general

- cook food thoroughly and cool rapidly to prevent spore germination
- keep hot foods above 60 °C and cold foods below 4 °C
- reheat cooked food to 74 °C

FOODBORNE
BACTERIAL AGENTS

Escherichia coli

Characteristics

- oxygen requirements: facultative anaerobe
- temperature range for growth: 10-44.5 °C
- pH range for growth: 4.4 minimum, 9 maximum
- water activity: 0.95 minimum
- non-spore-forming
- non-motile
- indicator of faecal contamination and the possible presence of enteric pathogens (e.g., *Salmonella typhi*)
- not heat resistant
- survives frozen storage for a short period of time

Foods at risk

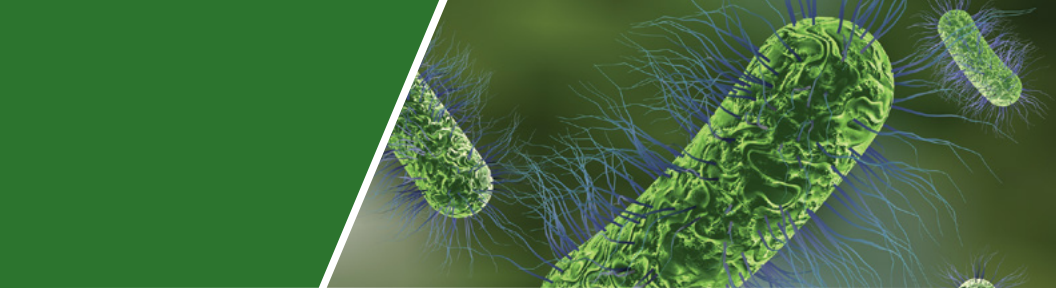
- raw milk
- raw meat
- raw poultry
- raw vegetables
- foods that are handled under poor hygienic conditions

Sources

- intestinal tract of human and warm-blood animals, soil and water

Risk to consumers

- gastroenteritis: diarrhea, vomiting, stomach pain
- urinary tract infections



Transmission

- faecal contamination of water supplies and contaminated food due to poor hygiene practices of food handlers

Prevention

- rapidly inactivated by heating
  - destroyed at pH values outside the range allowing growth (pH 4.4-9)
  - growth can be inhibited by a slightly acidic environment (e.g., acetic, lactic acid)
  - follow Good Manufacturing Practices (GMPs), e.g., good personnel practices followed by food handlers
- thoroughly washing of fruits and vegetables

Testing

- eosin/methylene blue agar
- β-glucuronidase activity, tested by adding a fluorogenic compound (MUG) in the media
- IMViC, group of tests to differentiate *E. coli* from other members of the Enterobacteriaceae group

In general

- cook food thoroughly and cool rapidly
- keep hot foods above 60 °C and cold foods below 4 °C
- reheat cooked food to 74 °C

Escherichia coli 0157:H7

Characteristics

- oxygen requirements: facultative anaerobe
- temperature range for growth: 10-44.5 °C
- pH range for growth: 4 minimum, 9 maximum
- water activity for growth: 0.950-0.995
- non-spore-forming
- survives well in chilled or frozen food
- non-motile
- produce potent toxins that cause severe damage to the lining of the intestine

Foods at risk

- undercooked ground meat: (e.g., raw hamburgers)
- raw milk
- alfalfa sprouts
- unpasteurized fruit juice (e.g., apple juice)
- lettuce
- cheese curds
- dry-cured salami, fermented sausages

Sources

- cattle, cows, sheep and deer, water contaminated from faecal sources

Risk to consumers

- hemorrhagic colitis (bloody diarrhea)
- hemolytic uremic syndrome (acute renal failure, anemia)

Transmission

- contaminated food or water, person-to-person transmission due to poor personal hygiene

Prevention

- rapidly inactivated by heating
- cook beef hamburgers until the centre reaches a temperature of 71.1 °C (160 °F)
- thoroughly wash fruits and vegetables
- acidify foods to pH 3.6 or below
- benzalkonium chloride, ethanol or hot water (70 °C) are effective food contact surface sanitizers if organic matter is not present
- sensitive to ultraviolet radiation

Testing

- tests for *E. coli* are not sensitive to *E. coli* O157:H7
- latex agglutination kits commercially available
- serological tests

In general

- cook food thoroughly and cool rapidly
- keep hot foods above 60 °C and cold foods below 4 °C
- reheat cooked food to 74 °C

FOODBORNE
BACTERIAL AGENTS

Listeria monocytogenes

Characteristics

- oxygen requirements: facultative anaerobe
- temperature range for growth: -0.4-50 °C
- pH range for growth: 4.4 minimum, 9.6 maximum
- water activity: 0.92 minimum
- non-spore-forming
- salt tolerant, e.g., can grow in 10% sodium chloride
- grows at refrigeration conditions

Foods at risk

- raw milk
- cheeses (soft-ripened varieties)
- ice cream
- raw vegetables
- raw and fermented meat sausages
- raw meats (all types)
- raw and smoked fish
- ready-to-eat foods contaminated after cooking

Sources

- soil, water, sewage, domesticated animals, drains, condensate, pooled water, cracked or worn tiles, ventilation systems and filters

Risk to consumers

- listeriosis (influenza-like symptoms, meningitis), affects newborns, elderly, pregnant women and immune compromised individuals

Transmission

- contaminated food, ready-to-eat foods with long shelf live (e.g., hot dogs and deli meats – contamination may occur after cooking but before packaging)
- person-to-person spread

Prevention

- growth is inhibited at pH values below 4.4
- inactivated at temperatures above 70 °C
- inactivated in vegetables by lysozyme
  - sanitizers (aldehydes, alcohols, quaternary ammonium compounds) are effective in eliminating contamination of food contact surfaces
- sensitive to ultraviolet radiation
- hold foods at < 5 °C up to 7 days
- hold foods at < 7.2 °C up to 4 days

Testing

- selective agars containing lithium chloride, phenylethanol, glycine anhydride and antibiotics
- CAMP test (production of a characteristic zone of hemolysis when grown in proximity to *S. aureus*)

In general

- reheat cooked food to 74 °C
- avoid post-cooking contamination of ready-to-eat foods with long shelf lives

FOODBORNE
BACTERIAL AGENTS

Salmonella

Characteristics

- oxygen requirements: facultative anaerobe
  temperature range for growth: 5-47 °C
- pH range for growth: 3.7 minimum, 9.6 maximum
- water activity for growth: 0.93-0.95
- non-spore-forming
- motile
- heat sensitive
- survives in refrigerated, frozen or dehydrated foods for long periods

Foods at risk

- undercooked meat and poultry
- unpasteurized milk
- eggs and eggs products (eggshell contaminated with faecal material in the hen's cloaca, egg white and yolk contaminated when breaking the egg)
- mayonnaise prepared with raw eggs

Sources

- gastrointestinal tract of animals, hogs, rodents, pets, birds, reptiles, insects

Risk to consumers

- Salmonellosis: gastrointestinal infection
- Typhoid fever (caused by *S. typhi*): fever, headache, constipation, chills

Transmission

- ingestion of contaminated food.
- disseminated via animal and human faeces to soil and water

Prevention

- avoid direct handling of food by infected employees
- acidify foods at pH 3.8 or below
- thoroughly wash fruits and vegetables
- heat sensitive, thermal destruction
- growth inhibited by 0.1% acetic acid
- not resistant to sanitizers used in the food industry
- pasteurization of raw eggs, milk

Testing

- impedance-conductance techniques using TMAO culture medium
- ELISA kits commercially available

In general

- cook food thoroughly and cool rapidly
- keep hot foods above 60 °C and cold foods below 4 °C
- reheat cooked food to 74 °C

Shigella

Characteristics

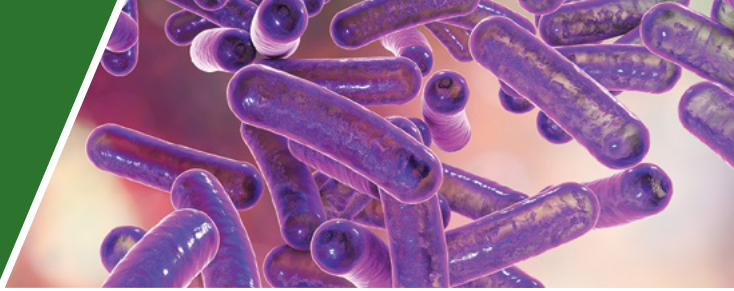
- oxygen requirements: facultative anaerobe
- temperature range for growth: 6.1-47 °C
- pH range for growth: 4.8 minimum, 9.3 maximum
- water activity: 0.96 minimum
- non-spore-forming
- non-motile
- survives better at low temperatures

Foods at risk

- uncooked prawn
- salads: tuna, shrimp, chicken
- raw vegetables
- sliced fruits at room temperature

Sources

- gastrointestinal tract of humans and other primates, water



Risk to consumers

- Shigellosis (bacillary dysentery: abdominal discomfort, cramps, diarrhea, fever, vomiting, blood, pus or mucus in stools)

Transmission

- ingestion of contaminated foods through fecal-oral route, faecally contaminated water, unsanitary food handling and flies carrying sewage contamination

Prevention

- rapidly inactivated at temperatures above 65 °C
- inactivated at pH values < 4
- thoroughly wash fruits and vegetables
- avoid contamination of ready-to-eat foods from flies

Testing

- Gram-negative broth and selenite broth
- rapid techniques based on immunoassays
- polymerase chain reaction (PCR)

In general

- cook food thoroughly and cool rapidly to prevent spore germination
- keep hot foods above 60 °C and cold foods below 4 °C
- reheat cooked food to 74 °C

Staphylococcus aureus

Characteristics

- oxygen requirements: facultative anaerobe
- temperature range for growth: 7-50 °C
- pH range for growth: 4 minimum, 10 maximum
- water activity: 0.83 minimum
- enterotoxin production
- heat resistant
- salt tolerant (can grow in up 20% sodium chloride)
- produce toxins, especially in the presence of oxygen and high numbers

Foods at risk

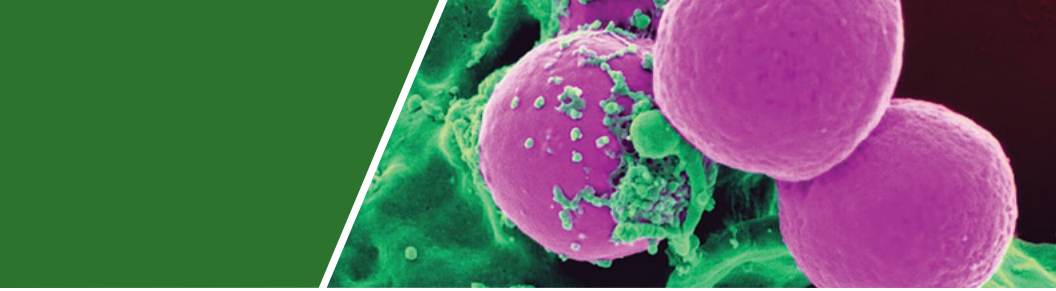
- raw poultry, poultry products, cold cooked meats
- raw milk, hard cheeses
- salted meats (e.g., ham, corned beef)
- cold sweets, custards and cream-filled bakery products
- food requiring considerable handling during preparation and kept at slightly elevated temperatures after preparation

Sources

- skin, skin glands and mucous membranes of warm blooded animals, humans nasal tract, soil, marine and fresh water, plant surfaces, dust and air

Risk to consumers

- nausea, vomiting, stomach cramps, diarrhea



Transmission

- food contaminated by food handlers from skin lesions, by coughing and sneezing over foods

Prevention

- during food fermentation, lactic acid bacteria produce substances that are inhibitory to *S. aureus*, including: lactic acid, sorbate and benzoate
- chemical sanitizers such as chlorine, halogens and quaternary ammonium compounds eliminate *S. aureus* on food contact surfaces
- reduce pH of food to ≤ 4.2
- reduce water activity to 0.83
- avoid direct handling of cooked ready-to-eat foods or cured/salted foods

Testing

- Baird-Parker agar gives characteristic shiny, jet-black colonies surrounded by a clear zone
- enterotoxin identification from contaminated food identified by ELISA or reverse passive latex agglutination test

In general

- keep hot foods above 60 °C and cold foods below 4 °C
- reheat cooked food to 74 °C

Vibrio cholerae

Characteristics

- oxygen requirements: facultative anaerobe
- temperature range for growth: 10-45 °C
- pH range for growth: 5 minimum, 10 maximum
- water activity: 0.94 minimum
- non-spore-forming
- produce a potent toxin
- tolerant to alkaline conditions

Foods at risk

- fruits or vegetables washed with contaminated water and consumed without cooking
- foods coming from a contaminated environment: seafood and frog's legs
- uncooked fish marinade in lime
- fish and shellfish (raw or partially cooked)
- raw oysters

Sources

- marine environment: temperate, tropical and sub-tropical waters
- contaminated water supplies due to poor sanitation

Risk to consumers

- profuse watery diarrhea, vomiting, leg cramps
- rapid loss of body fluids that leads to dehydration and shock

Transmission

- waterborne infection, ingestion of food that was in contact with contaminated water

Prevention

- rapidly inactivated at pH values <4.5
- sensitive to drying
- thoroughly wash all fruit and vegetables
- avoid cross contamination from raw to cooked foods
- avoid direct food handling by infected employees
- peracetic acid and hypochlorite are effective food contact surface sanitizers in the absence of protein

Testing

- TCBS agar incubated for 18-24 hours at 35 °C aerobically produces yellow colonies

In general

- keep hot foods above 60 °C and cold foods below 4 °C

Yersinia enterocolitica

Characteristics

- oxygen requirements: facultative anaerobe
- temperature range for growth: -1-40 °C
- pH range for growth: 4.2 minimum, 10 maximum
- water activity: 0.945 minimum
- non-spore forming
- motile
- tolerate 6% salt
- resist environmental stress: high pH, dehydration, freezing

Foods at risk

- meats (beef, lamb)
- raw or undercooked pork products
- oysters
- raw milk
- shellfish
- dairy products
- fruit and vegetables

Sources

- soil, fresh water, intestinal tract of many animals

Risk to consumers

- gastroenteritis: abdominal pain, diarrhea, mild fever

Transmission

- person-to-person transmission, by ingestion of contaminated food and waterborne transmission

Prevention

- pasteurization
- 5-7% sodium chloride inhibits growth
- inactivated by a pH value lower than 4.2
- growth is retarded by potassium sorbate up to 500 ppm at pH 6.5
- sensitive to ultraviolet radiation
- avoid direct handling of food by infected food handlers
- avoid post-processing contamination of ready-to-eat foods with a long shelf life

Testing

- CIN agar incubated at 28 °C for 24 hours produces dark-red centre surrounded by a transparent border colonies

In general

- keep hot foods above 60 °C and cold foods below 4 °C
- reheat cooked food to 74 °C

Cryptosporidium parvum

Characteristics

- protozoa, intracellular parasite
- most likely to be present as an oocyst (resting stage equivalent to a bacterial spore)
- oocyst survives on stainless steel if kept wet
- oocyst survives heating at 60 °C for 1 minute
- resistant to chlorine

Foods at risk

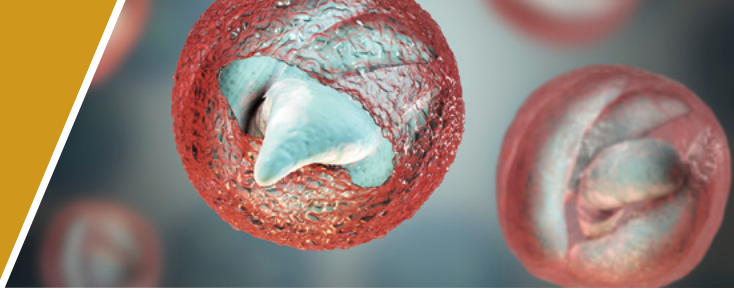
- raw milk
- raw sausages (non-fermented)
- any food touched by a contaminated food handler
- salad vegetables fertilized with manure

Sources

- livestock, calves, domestic animals and water faecally contaminated

Risk to consumers

- diarrhea
- serious infection in immunocompromised persons
- abdominal pain
- nausea
- vomiting



Transmission

- person-to-person transmission, by ingestion of contaminated food and waterborne transmission

Prevention

- pasteurization
- temperature above 73 °C render the oocyst non-infectious
- inactivated by freezing at –15 °C
- acid conditions (pH 4) results in loss of oocyst viability
- sensitive to drying
- sensitive to ultra violet light
- 0.35% peracetic acid inactivates oocysts
- avoid cross contamination from raw to ready-to-eat foods
- thoroughly wash fruits and vegetables

Testing

- Enzyme Immuno Assay (EIA) and Immuno Fluorescent Antibody (IFA) (both direct and indirect methods) can detect Cryptosporidium

In general

- keep hot foods above 60 °C and cold foods below 4 °C
- reheat cooked food to 74 °C

Enteric Viruses (other than hepatitis A and noroviruses)

Characteristics

Rotavirus, astrovirus, hepatitis E, adenovirus, calicivirus:

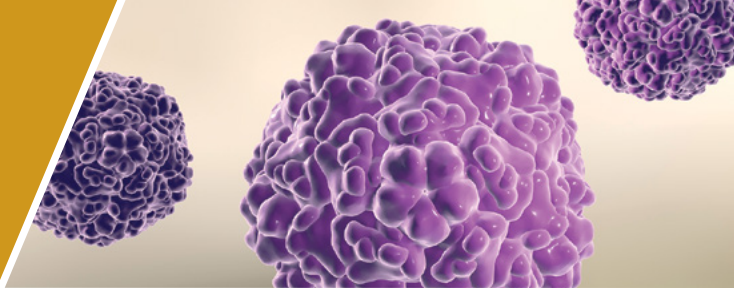
- do not replicate in food, require human cells to multiply
- pass through the gastrointestinal tract
- resistant to environmental stress such as heat and acid conditions
- stable at pH 3
- resist freezing and drying

Foods at risk

- foods may become contaminated during: handling, preparation, serving or processing
- salads
- shellfish grown in shallow, coastal waters

Sources

- contaminated water and contamination by infected food handlers



Risk to consumers

- diarrhea and vomiting
- severe childhood gastroenteritis

Transmission

- all foodborne viruses are transmitted by fecal-oral route
- can also be transmitted by ingesting contaminated foods that undergo extensive handling in their preparation and are consumed without reheating

Prevention

- heating for 30 minutes at 50 °C
- reduce pH levels to < 3 or increase to pH >10
- thoroughly wash fruits and vegetables
- thorough cleaning and disinfection must follow after vomiting on food premises
- food handlers trained in effective hand washing techniques

Testing

- rapid antigen detection of enteric virus in stool samples
- strains further characterized by enzyme immunoassay

In general

- reheat cooked food to 74 °C
- boil, filter or treat non-potable water before drinking

Giardia lamblia

Characteristics

- survives in food and water as cysts (infective form)
- water survival at low temperatures (~ 8 °C)
- cool moist conditions favor survival
- cysts resistant to ultraviolet radiation and chlorination

Foods at risk

- salads
- vegetables such as lettuce
- fruits such as strawberries
- foods washed with contaminated water or handled by infected employees
- herbs
- root crops (beet, carrot)

Sources

- environmental waters which have been faecally polluted
- found in animals, birds, reptiles and amphibians

Risk to consumers

- Giardiasis: diarrhea, abdominal cramps, nausea, weight loss and dehydration

Transmission

- person-to-person due to poor hygiene
- contaminated water, food contaminated by water or by a food handler

Prevention

- cysts eliminated by normal cooking procedures in food preparation
- heating food to 60-70 °C for 10 min
- boiling for 3 minutes
- pasteurization
- cysts inactivated by freezing
- water filtration (8 µm pore size filter)
- avoid cross contamination from raw to ready-to-eat foods
- thoroughly wash fruits and vegetables
- avoid food handling by infected employees

Testing

- detection in stool samples by microscopic examination
- ELISA test

In general

- reheat cooked food to 74 °C
- boil, filter or treat non-potable water before drinking

Hepatitis A Virus (HAV)

Characteristics

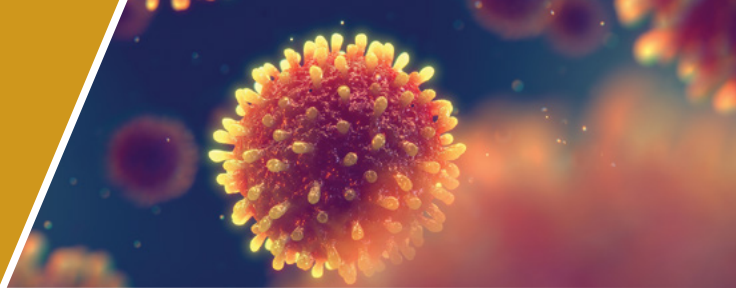
- high resistance to chemical and physical agents, including: heat, acid and solvents
- under freezing and refrigeration conditions the virus remains infective
- stable at pH 1

Foods at risk

- milk
- fruits (strawberries, raspberries)
- salad vegetables (lettuce)
- shellfish
- manually prepared food products
- cream-filled cookies
- cold cuts (precooked or cured meat, sausages or meat loaves, that are sliced and served on sandwiches or on party trays)

Sources

- human faeces, contaminated water (fresh and seawater, wastewater, marine sediments) and soil



Risk to consumers

- hepatitis A: fever, nausea, vomiting, liver damage, malaise, anorexia, jaundice

Transmission

- Transmission occurs by the fecal-oral route, either by direct contact with a Hepatitis A virus infected person or by ingestion of Hepatitis A virus contaminated food or water.

Prevention

- cook shellfish at 90 °C for 1.5 min
- thoroughly wash all fruit and vegetables
- avoid handling of food by infected employees
- ensure training of food handlers in effective hand washing (asymptomatic food handlers can spread the infection)
- infectivity is decreased by exposure to 70% alcohol
- inactivated by ultraviolet radiation

Testing

- food is rarely analyzed because of the long incubation period (2-6 weeks)

In general

- boil, filter or treat non-potable water before drinking

Norovirus

Characteristics

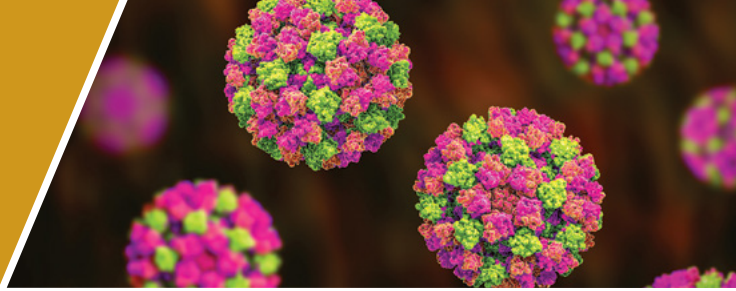
- most widely recognized viral agent associated with food and waterborne outbreaks
- stable and resistant to heat and acidic conditions
- under refrigeration and freezing conditions the virus remains intact
- resist gastric acids at pH 3-4
- resistant to drying

Foods at risk

- shellfish, raw or insufficiently steamed clams and oysters poses a high risk
- salads
- water and ice
- manually prepared food products
- bakery products

Sources

- environmental surfaces (e.g., carpets), feces from infected humans may contaminate soil or water
- fecal pollution from sewage discharges



Risk to consumers

- projectile vomiting
- stomach cramps
- diarrhea and abdominal pain

Transmission

- ingestion of contaminated food due to poor hygiene practices
- person-to-person spread following projectile vomiting
- transmission via contaminated surfaces (carpets and toilet seats)

Prevention

- cook shellfish at 90 °C for 1.5 min
- thoroughly wash all fruit and vegetables
- avoid handling of food by infected food handlers
- ensure training of food handlers in effective hand washing (asymptomatic food handlers can spread the infection)

Testing

- molecular methods, including DNA sequencing; the virus is non-culturable and does not grow in food

In general

- boil, filter or treat non-potable water before drinking

Scombroid (Histamine) Poisoning

Characteristics

- bacteria act as an indirect agent of food poisoning by converting a food component (histidine) into a harmful compound (histamine)
- histamine is produced during temperature abuse and spoilage
- cooking or heating does not destroy histamine
- vacuum packaging is not effective in retarding histamine production

Foods at risk

- scombroid fish: tuna, bonito, mackerel (temperature abused raw fish allows bacterial growth and toxin production)
- fish: sardines, pilchards, herrings
- canned fish
- cheese, specially Swiss cheese (ripened at warm temperatures)
- fermented meat products, e.g., salami
- fermented vegetables, e.g., sauerkraut

Sources

- foods contaminated with histamine, mainly fish

Risk to consumers

- chemical intoxication: diarrhea, facial and neck rashes, inflammation, dizziness, itching, vomiting

Transmission

- ingestion of contaminated food with histamine

Prevention

- in cheese production the use of starter cultures with low decarboxylase activity prevent histamine formation
- short fermentation time for meat products, use appropriate starter culture and rapidly decrease the pH
- transport and store fish under refrigeration
- chill fish rapidly to < 10 °C
- hold fish at 0 °C up to 14 days, 4.4 °C up to 7 days
- raw fish should be purchased from known and reputable suppliers

Testing

- FDA chemical method: alcohol extraction followed by fluorescence spectroscopy
- Commercial kits for histamine detection available

In general

- fish should be rapidly retrieved from the water, cooled as quickly as possible and handled using good hygienic procedures

Glossary

Aerobe: requires oxygen

Anaerobe: requires the absence of oxygen

Baird-Parker agar: lithium chloride, tellurite, egg yolk and pyruvate

CAMP test: named for the initials of the 4 discovers, Christie, Atkins, Munch and Petersen

CIN agar: cefsulodin, irgasan and novobiocin

ELISA: enzyme-linked immunosorbent assay

Enterotoxin: toxin released by a micro-organism in the lower intestine. It alters the permeability of the intestinal wall causing water and electrolytes to leak into the intestinal tract.

Facultative anaerobe: grows either with or without oxygen

FBP agar: ferrous sulfate, sodium bisulfite and sodium pyruvate

Hemolysis: breakdown of red blood cells

IMViC test: indole test, methyl red and Voges-Proskauer test and citrate test

Micro-aerophilic: requires limited levels of oxygen

MUG: fluorogen 4-methylum-belliferyl-β-D-glucuronide

NaCl: sodium chloride

OPSP agar: oleandomycin, polymyxin, sulfadiazine and perfringens

Pemba agar: polymyxin, pyruvate, egg yolk, mannitol and bromothymol blue agar

ppm: parts per million, ex: one particle of a given substance for every 999,999 other particles

TCBS agar: thiosulfate, citrate, bile salt and sucrose

TMAO: selenite-cysteine broth containing dulcitol and trimethylamine oxide

TSC agar: tryptose, sulfite and cycloserine

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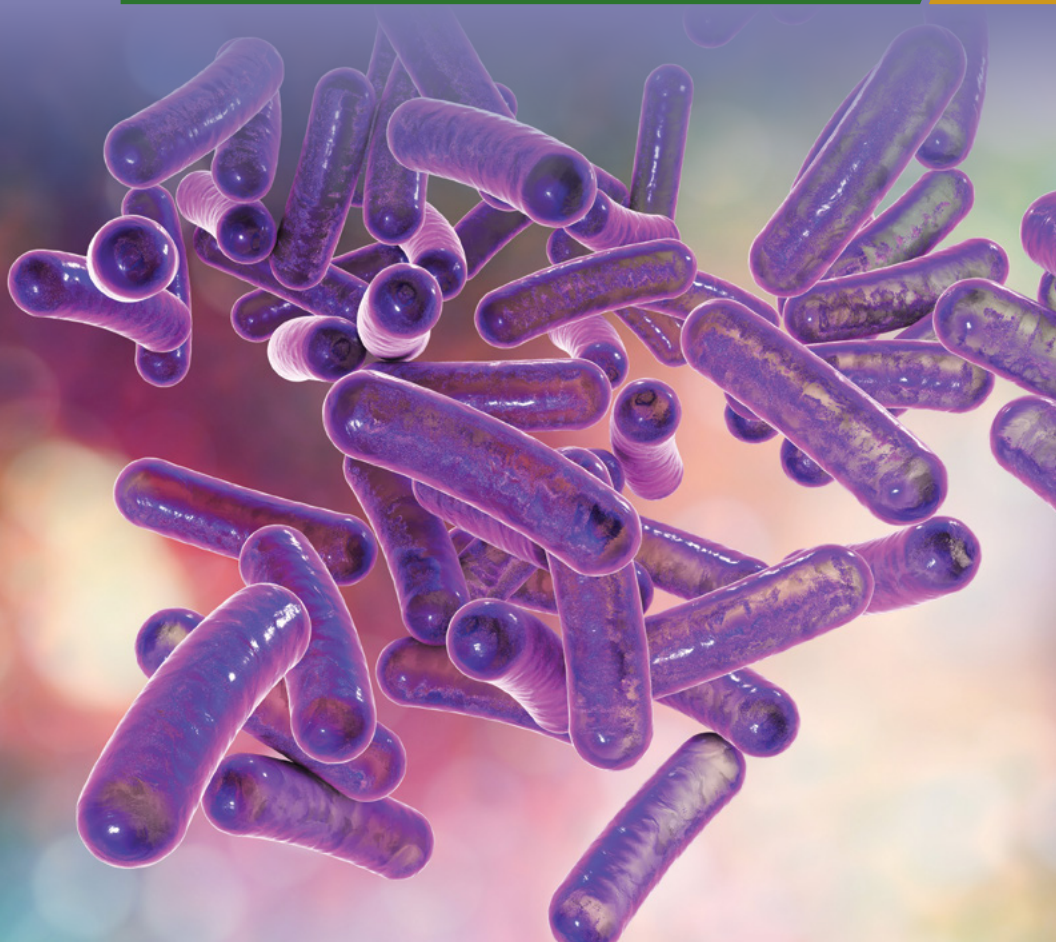
Foodborne Pathogens



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