



Pathogens

Hazards by
QAssurance

Pathogens

- *Aeromonas*
- *Bacillus*
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- *Escherichia*
- *Listeria*
- *Salmonella*
- *Shigella*
- *Staphylococcus*
- *Yersinia*
- *Vibrio*



Aeromonas

Aeromonas are Gram-negative bacteria that may be found in both soil and water. Some *Aeromonas* species are commonly known for their role in uncommon but dangerous diseases such as wound infections, necrosis, septicaemia, and meningitis.

Parameter	Features
Gram	Negative
Type	Hydrophila, sobria, guinea pig
Oxygen demand (O ₂)	Fa
Temperature, rounded	5-40
pH (acidity)	4-10
Min. aw	0.97
Incubation time	8-48 hours
Duration	2 -7 days
Dose Response relationship DR	100 000 000
Food poisoning (VV) / Food infection (VI)	VI
Symptoms	Infection: diarrhea, abdominal pain, vomiting

Bacillus

Bacillus cereus is a facultative aërobe Gram-positive, rod formed and spore forming micro-organism causing two types of foodborne diseases. The first disease is characterized by diarrhoea and the other by vomiting. *B. cereus* is present in nature. Facultative aërobe meaning that the bacteria also can grow without oxygen.

Spores Bacillus

Bacillus species produce endospores, which are spores produced by *Bacillus* species. Endospores have a thick-walled structure generated by the vegetative cells and are extremely heat resistant. Endospores are distinguished by their capacity to withstand harsh environments. Drought, extremely high temperatures, low or high pH, radiation, and the presence of chemicals like disinfectants have little impact on spores. As a result, they may survive for a long period and germinate under favorable conditions.

Parameter	Characteristics
Gram	Positive
Specie	cereus
D-value	D96=1,2-36 min
Oxygen requirements (O2)	A (sometimes Fa)
Temperature, rounded	5-50
pH (acidity)	5-9
Min. aw	>0,91
Drought	+
Incubation time	0,5-6 uur
Duration	6 -24 uur
Dosis Response relation DR	+/- 10 ug/kg bodyweight
Food poisoning (fp) / Food infection (VI)	fp/fi
Symptoms	Nausea, vomiting, stomach pain
Products	Rice, starchrich products, puddings, sauces, herbs and spices. dairy
Where	Spores are found everywhere

Other Bacillus

In addition to *B. cereus* there are a number of other *Bacillus* species that have been reported in the scientific literature to be involved in food-associated diseases. These organisms include *B. pumilis*, *B. subtilis*, *B. licheniformis* and *B. coagulans*.

Campylobacter

Parameter	Characteristics
Gram	Negative
oxygen requirement (O2)	m.aer.
Temperature, (rounded)	30-45
pH (acidity)	6-8
Min. aw	0.98
Incubation time	2-10 days (Mostly 2)
Duration	days to weeks
Dose Response relation DR	100-50
Foodpoisoning (VV) / foodinfection (VI)	VI
Symptoms	Fever, Stomachache, bloody diarrhea
Parameter	Characteristics
Gram	Neg

Campylobacteriosis is a gastrointestinal infection caused by *Campylobacter jejuni*. The most common cause of bacterial gastrointestinal illnesses in humans is campylobacteriosis. *C. jejuni* is found in the gastrointestinal tracts of birds and animals in the wild. The organism enters raw goods derived from these animals and surface water via the feces of these animals. The pathogens must be consumed by mouth in order to cause illnesses.

Clostridium

Clostridium botulinum is a Gram-positive, spore-forming, rod-shaped anaerobic bacterium that generates the botulinum toxin, a very poisonous chemical. The nerves are paralyzed by this poison, and the muscles lose their ability to operate. Botulism is the name of the illness. If not handled properly, the spores are heat resistant and can survive in food. Regarding growth, there are two clearly distinguishable groups of *C. botulinum*. They are divided into the proteolytic group and the non-proteolytic group *C. botulinum*.

Parameter	Characteristics	Characteristics (non-proteolytic)
Gram	Positive	Positive
Type	Rod, spv	Rod, spv
D value	D121 = 0.21 min	D100 = <0.1 min
Oxygen demand (O2)	Anaer	Anaer
Temperature, rounded	10-50	5-45
pH (acidity)	4.6-8	5-8
Min. aw	0.94	0.97
Drought	+	+
Incubation time	12-36 hours (Sometimes longer)	12-36 hours (Sometimes longer)
Expensive	1 day to few months	1 day to few months
Dose Response relationship DR	0.005-0.1	0.1-0.5ug
Food poisoning (VV) / Food infection (VI)	VV	VV
Symptoms	Difficulty swallowing, talking, breathing, seeing double	(damage to the nervous system), Death

Clostridium perfringens

Clostridium perfringens is a Gram-positive, spore-forming rod that develops anaerobically (without oxygen) and can cause gastroenteritis through the synthesis of a toxin (diarrhea). *C. perfringens* food poisoning is the disease's classification. The organism is widely distributed in nature, mostly in the intestines of humans and animals, and it may be found in both farm and wild animals. *C. perfringens* traces can be found in soil, silt, and areas where animals reside for a long period.

Cronobacter

Cronobacter spp. are one of the few organisms of great concern when detected in infant formula powder. The reason for this is because this bacterium has the potential to cause severe infectious illnesses in infants. The majority of ill newborns are under the age of two months. *Cronobacter spp.* are opportunistic bacteria that mostly cause illnesses in infants whose immune systems are still developing. *Cronobacter spp.* are extensively spread in nature and may be found in a variety of foods, wetlands, and residential and healthcare settings such as hospitals.

Parameter	Features
Gram	Negative
Oxygen demand (O2)	Fa
Temperature, rounded	5-45
pH (acidity)	4-9
Incubation time	1 to 30 days
Food poisoning (VV) / Food infection (VI)	VI
Symptoms	Meningitis, premature babies
Products	milk powder, infant formula

Escherichia

Escherichia coli (*E. coli*) is a typical gut resident that is required for nutrition and intestinal health. It is the most prevalent facultative anaerobic bacteria found in warm-blooded animals and humans' feces. While most *E. coli* strains are innocuous, some can cause disease in humans, the most frequent being certain strains of shiga toxin-producing *E. coli* (STEC), namely *E. coli* O157:H7. Vegetables, raw meat, and raw dairy products are all known to be sources of foodborne STEC infection in people. Exposure to manure compost, animal interaction, farm/zoo settings, and polluted waterways are all known pathways for human illness.

Parameter	Characteristics
Gram	Negative
Type	Rod
D value	D63 = 0.5min
Oxygen demand (O2)	fa
Temperature, rounded	5-50
pH (acidity)	4-9
Min. aw	0.96
Drought	-
Incubation time	3 - 4 days
Expensive	2 - 5 days
Dose Response relationship DR	10-100
Food poisoning (VV) / Food infection (VI)	VI

Symptoms

Escherichia coli diarrhea, which can be bloody. Human STEC infection symptoms range from mild diarrhea to severe stomach pains, bloody diarrhea, and vomiting. STEC infection can also cause hemolytic uraemic syndrome (HUS), which can progress to renal failure and is potentially fatal, especially in newborns and the seniors.

Listeria

Listeria monocytogenes is a bacteria that causes listeriosis, a foodborne illness. The bacterium enters the body through the gastrointestinal system and multiplies in organs such as the spleen and liver in infected people. When the body's immunological defenses are weak, it might lead to a life-threatening scenario. *L. monocytogenes* is found in the intestines of people and animals, as well as in soil and leaf vegetables. The bacterium can also be found in raw milk and some processed foods.

Parameter	Features
Gram	+
Type	Rod
D value	D60 = 5-8 min
Oxygen demand (O2)	Fa
Temperature, rounded	0-45
pH (acidity)	4.5-9
Min. aw	0.90
Drought	+
Incubation time	2 days to 4 weeks
Dose Response relationship DR	> 1 000 > 1 000 000
Food poisoning (VV) / Food infection (VI)	VI
Symptoms	fever, septicemia, meningitis, miscarriage
Products	raw milk cheese, smoked fish, cooked meat, salad
Parameter	Features
Gram	+

Symptoms

Disease symptoms usually occur 2 - 30 days after ingestion of *L. monocytogenes*. Sometimes it can take up to 90 days for disease symptoms to appear. The main symptoms are Nausea and vomiting, Abdominal cramps, Diarrhea or constipation, Headache and persistent fever.

Salmonella

Salmonella enteritidis can cause salmonellosis, a gastrointestinal ailment. They are found in the intestines of animals such as pigs, poultry, birds, rodents, reptiles, and bugs. They spread throughout the environment by these animals' feces. Salmonellosis may be contracted by eating foods infected with Salmonella bacteria. People who have salmonellosis are carriers and excretory of *Salmonella* bacteria for a long period (6 - 8 weeks).

Salmonella typhimurium

Salmonella Typhi (*S. Typhi*) is the causal agent of typhoid fever (also referred to as enteric fever). A related, but evolutionary distinct serovar, *S. Paratyphi A, B* (except *B Java*) and *C* can cause an enteric fever disease virtually indistinguishable from typhoid. These Salmonella serovars are collectively referred to as typhoidal *salmonellae*. Typhoidal species are restricted to the human host and result in life-threatening systemic disease. The organism does not produce toxins in food.

Parameter	Features
Gram	Negative
Type	Rod
D value	D60 = 1-10 min
Oxygen demand (O ₂)	fa
Temperature, rounded	5-50
pH (acidity)	4-9
Min. aw	0.94
Drought	-
Incubation time	8 - 72 hours
Expensive	1 - 3 days
Dose Response relationship DR	> 100 000 (sometimes 10)
Food poisoning (VV) / Food infection (VI)	VI
Symptoms	Diarrhea, nausea, vomiting, headache, fever, stomach pain
Products	Poultry, eggs, raw meat, milk, vegetables

Shigella

Parameter	Features
Gram	Negative
Oxygen demand (O ₂)	Fa
Temperature, rounded	5-45
pH (acidity)	5-8
Min. aw	0.94
Incubation time	12 hours - 7 days
Expensive	1 to 2 weeks
DR	> 10
Food poisoning (VV) / Food infection (VI)	VI
Symptoms	Fever, (green) diarrhea with blood / mucus
Contamination route	Via faeces or contaminated water

Shigella is a bacterial genus that causes dysentery and bloody diarrhea. The illness spreads through person-to-person contact as well as contaminated food or water. *Shigella* bacteria must be present in relatively tiny quantities in order to cause illness in humans. Because the bacterium is somewhat resistant to gastric acid, it reaches the intestines readily through the stomach. *Shigella* species are genetically related, to *E. coli* and their genetic material may be even interchangeable.

Staphylococcus

S. Aureus is a Gram-positive, spherical bacteria (coccus) about 1 - 1.3 μ m in size. They may be seen under a microscope in pairs, short chains, and grape-shaped clusters. Some strains are able to produce enterotoxins through food growth, causing acute symptoms when swallowed with food. Enterotoxin, which was produced by *S. Aureus*, is a heat stable protein. It can withstand a temperature of 100 °C for 30-700 minutes.

Parameter	Features
Gram	Positive
Type	Coccus
D value	D56 = 1-2 min
Oxygen demand (O ₂)	Fa
Temperature, rounded	5-45
pH (acidity)	4-9
Min. aw	0.86
Drought	+
Incubation time	0.5 - 6 hours
Expensive	1-3 days
Dose Response relationship DR	1-25 μ g (100 000 CFU / g)
Food poisoning (VV) / Food infection (VI)	VV
Symptoms	Nausea, vomiting, stomach pain
Products	dairy, raw milk cheese, whipped cream, cooked meats

Symptoms

Toxins generated by *S. Aureus* cause illness. Aureus bacteria are found in food. The number of organisms per gram of product has to be at minimum 10⁵-6. The period between intake of the toxin and onset of symptoms is brief (2-5 hours) and is affected by the amount, kind of food, and health state. The most common symptoms are nausea, vomiting, stomach cramps, and fatigue.

Vibrio

Parameter	V. parahaemolyticus	V. Cholerae	V. Vulnificus
Gram	Negative	Negative	Negative
Oxygen demand (O ₂)	Fa	Fa	Fa
Temperature, rounded	5-45	10-45	5-44
pH (acidity)	5-11	5-9	➤ 7
Min. aw	0.92	0.96	
Incubation time	4-96 hours	Few hours to 5 days	
Expensive	2-5 days	Few days	
Dose Response relationship DR	> 100 000	> 1000	
Food poisoning (VV) / Food infection (VI)	VI	VI	
Symptoms	Diarrhea, nausea, vomiting, headache, fever, stomach pain	Water-thin, thin diarrhea, possibly. fever (a lot of fluid loss)	Infection: for people with liver problems, disease can be fatal (40% mortality), serious wound infection is also possible
Products	crustaceans and shellfish	crustaceans and shellfish, faeces, coastal water	warm coastal waters, especially in summer

- ***Vibrio parahaemolyticus*** is a bacterium from the marine environment, which means that the presence of this bacterium is initially limited to seawater and the products derived from it. These are mainly seafood, but fish can also be contaminated. Cross-contamination can also contaminate other foodstuffs via contaminated products. The water temperature plays an important role. *Vibrios* are rarely insulated when the water temperature is below 15°C. As a result, the organism is found in temperate climate zones in the summer months and in regions with warm seawater (> 20°C) throughout the year
- ***Vibrio Cholerae*** can cause Cholera, which causes mild diarrhea that progresses to diarrhea marked by the formation of abundant pale grey ("rice water") feces. Low blood pressure, nausea, stomach pains, and, on rare occasions, fever are other symptoms. Fluid loss necessitates rehydration, and if this does not occur, mortality due to fluid loss may ensue. It is usual for healthy people to recover in 1-6 days. Non-O1/O139: The diarrhea is milder yet bloody, and it is accompanied by stomach pains and fever. Can last up to 6-7 days. Extraintestinal infections are possible, for example, in wounds exposed to polluted water.
- ***Vibrio Vulnificus*** is a marine bacteria that can grow in both the presence and absence of air (grows in 6% NaCl). Although this is a rare cause, it has a high related case fatality rate.

Yersinia

Yersinia enterocolitica and *Yersinia pseudotuberculosis* can cause gastrointestinal infections, with vomiting and diarrhea as the first signs. Fever and abdominal discomfort, on the other hand, are distinguishing signs. Pigs, birds, beavers, cats, and dogs are the most common hosts for both organisms. *Y. pseudotuberculosis* is mostly seen in rat. These creatures are quite rare in humans. They have been discovered in feces, wounds, saliva, and lymphatic system. *Y. enterocolitica* is also found in foods such as meat, unpasteurized milk, and ice cream. The organism can also be found in surface water. Pork is regarded as the most major cause of infection. Cattle, sheep, deer, rats, cats, and canines can all be infected with *Y. enterocolitica*.

Parameter	Features
Gram	Negative
Oxygen demand (O ₂)	Fa
Temperature, rounded	5-45
pH (acidity)	5-8
Min. aw	0.94
Incubation time	12 hours - 7 days
Expensive	1 to 2 weeks
DR	> 10
Food poisoning (VV) / Food infection (VI)	VI
Symptoms	Fever, (green) diarrhea with blood / mucus
Where	Via faeces or contaminated water

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