

Foodborne gastroenteritis caused by *E. coli*, *Salmonella* and *Listeria*

Foodborne gastroenteritis caused by *E. coli*

E. coli is the most common aerobic organism in the intestinal tract of humans and warm blooded animals. Generally the *E. coli* strains that colonize the gastrointestinal tract are harmless commensals, and they play an important role in maintaining intestinal physiology. However, certain strains of *E. coli* are pathogenic and cause gastrointestinal disturbances.

Pathogenic strains

Within the species of *E. coli* there are at least 4 types of pathogenic strains

- ✚ Enteropathogenic *E. coli* (EPEC)
- ✚ Enterotoxigenic *E. coli* (ETEC)
- ✚ Enteroinvasive *E. coli* (EIEC) or shiga dysentery-like *E. coli*
- ✚ Enterohaemorrhagic *E. coli* (EHEC) or Verocytotoxin producing *E. coli* (VTEC) or *E. coli* O157:H7

Characters

- Various *E. coli* types can be separated by serotyping, phage typing and genetic methods.
- No specified phenotypic marker is available to separate between pathogenic and non-pathogenic strains.
- However, some atypical properties such as being lactose-negative or failure to produce indole at 44°C are more common between the pathogenic strains.
- VTEC strains do not grow at all on selective media at a 44°C.
- Disease condition produced by pathogenic *E. coli* strains vary in severity from extremely mild to life-threatening depending on type of pathogenic strains involved, susceptibility of victim and degree of exposure.
- *E. coli* can be isolated from environments polluted by faecal material or sewage, and the bacterium can multiply and survive for a long time in the environment. There are reports of occurrence of *E. coli* in unpolluted warm tropical waters.
- Most infections are related to contamination of water or handling of food under unhygienic conditions. Seafoods have not been reported as important source of *E. coli* infection.

Prevention of food poisoning outbreaks

- Good personal hygiene and health education of food handlers are essential in the control of disease.
- Proper treatment (e.g. chlorination) of water and sanitary disposal of sewage.
- Risk of infection can be minimized or eliminated by proper cooking before consumption.
- The growth is generally inhibited in the presence of 4-5% NaCl. Increased inhibition is seen at low temperature/ or reduced pH.

Foodborne gastroenteritis caused by *Salmonella*

Food poisoning caused by the ingestion of viable cells of genus *Salmonella* is called Salmonellosis. This is one of the frequently occurring bacterial infections.

Characters

Salmonella are Gram negative, non-spore forming rods that ferment glucose usually producing gas. There are over 2000 serotypes based on antigenic characters and all serotypes are considered potential pathogen. The primary habitat is the alimentary tract of mammals, birds, amphibians and reptiles. Found to be non endemic to intestinal tract of finfishes, crustaceans and mollusks. Because of fecal origin, contaminates food due to pollution with sewage. The most common disease illness associated is gastroenteritis/salmonellosis.

Disease symptoms

A large variety of foods including fish and shellfish are involved in salmonellosis. Food poisoning symptoms include nausea, vomiting, abdominal cramps, diarrhea, fever and headache. Symptoms occur 6~8 hrs after ingestion of contaminated food. Infective dose varies depending on serotype and ranges from few cells on 10⁵ to cause illness. Persons of all age groups are susceptible. The infection is severe and prolonged among elderly and infants. The likelihood of infection depends on resistance of consumer, infectiveness of salmonella strain and number of organisms ingested. More severe form of infection is typhoid and paratyphoid caused by *S. Typhi* and *S. Paratyphi*. Septicemia caused could be fatal.

Conditions necessary for outbreak

- ✚ Food (fresh / processed) must contain or contaminated with *Salmonella*
- ✚ Must be present in considerable numbers
- ✚ Viable organisms must be ingested.

Prevention

- Avoidance of contamination of food from animals, humans, diseased food handlers and carriers.
- Destruction of the organism by heat
- Prevention of growth in foods by keeping at low temperature.
- Avoidance of consumption of warmed left over foods without refrigerator.

Foodborne gastroenteritis caused by *Listeria*

Among *Listeria* species, *Listeria monocytogenes* is most important human pathogen causing the disease listeriosis and is of great concern to special risk groups. The susceptible groups include pregnant women and their fetuses, cancer patients and others undergoing immuno-suppressive therapy, as well as diabetics and cirrhotics and the elderly. Although the risk of contracting listeriosis is less for normal, healthy individuals, they may also contract the disease.

Characters

- *Listeria monocytogenes* is a facultative intracellular pathogen. The organism enters the body through the intestine and has a variable incubation period from 1 day to a month or longer. The ingested cells enter the body through ileal villi cells, subsequently taken up by macrophage cells in the bloodstream, multiply inside the host cell and released after bursting of macrophages and liberated cells infect other cells.
- *Listeria* is widely distributed in the environment, human beings and a variety of animals including seagulls. Most of these environmental strains are non-pathogenic. *Listeria sp.* other than *L. monocytogenes* appears to be more common in tropical areas. Though it has been isolated from a variety of seafoods including refrigerated and frozen crabmeat, reports of listeriosis involving seafood is rare.
- *Listeria* are relatively heat resistant but unable to survive in foods receiving adequate heat treatment. The presence of *L. monocytogenes* in cooked seafood is mainly due to cross-contamination of the product or under processing.
- *Listeria* are aerobic under most circumstances but can be facultatively anaerobic and thus grow well under reduced levels of oxygen in packaged products. *Listeria* can also survive and grow under refrigeration temperature and also survive freezing conditions.
- Contaminated food is increasingly recognized as an important vehicle of *L. monocytogenes*. Dairy products, salads and vegetables have been implicated in outbreaks of listeriosis. Frequent isolations from seafood as well as its ability to grow in chilled smoked salmon at +4°C is an indication of possible involvement of seafoods in the transmission of *L. monocytogenes*.

Listeria species involved in food poisoning

- Six species of *Listeria* are currently recognized, but only three species, *L. monocytogenes*, *L. ivanovii* and *L. seeligeri* are associated with disease in humans and / or animals. However, human cases involving *L. ivanovii* and *L. seeligeri* are extremely rare.
- *Listeria* are commonly identified by serotyping. Types 1-7 are known, with Types 1/a, 1/b, and 4b predominating as both environmental and clinical isolates. The serotyping scheme is based on both somatic and flagellar antigens. Phage typing has also been employed as a method of further identifying isolated strains. *L. monocytogenes* is subdivided into 13 serovars on the basis of somatic (O) and flagellar (H) antigens.

Symptoms

Typical *Listeria* infections result in septicemia, meningitis and encephalitis, and enteritis. High mortality is reported among infected individuals. Mortality rate of 29% is noticed among patients in a New England outbreak involving fluid milk. This causes the transitory flu-like symptoms at the initial stage of infection with or without symptoms of stomach disturbances and diarrhea. The actual disease known as listeriosis occurs only after the attainment of severe form of septicemia, encephalitis, lesions, or meningitis. All of these forms of listeriosis is noticed among individuals who are not immunocompetent.

Prevention of outbreak

To prevent risk due to *L. monocytogenes*, FDA in the US has recommended complete absence in ready-to-eat seafood products such as crabmeat or smoked fish. This zero-tolerance is also required for products which receive a listericidal treatment, and for products which have been directly implicated in a food borne outbreak. However this restriction does not apply to raw product that will be cooked before eating. Low number of *L. monocytogenes* is allowed in other types of products in which the organism is shown to die-off. But, numbers greater than 10 *L. monocytogenes* / g are likely to constitute a risk to human beings particularly predisposed persons (very old, very young or immuno-suppressed). Following proper GMP and factory hygiene is expected to maintain the level of *L. monocytogenes* contamination on fish products at very low level of less than 1-10/g.