Microbiology Legend
Cycle 42 Organism 5

Salmonella

Salmonella is a genus of rod-shaped, Gram-negative, non-spore-forming, predominantly motile enterobacteria with diameters around 0.7 to 1.5 µm, lengths from 2 to 5 µm, and flagella which grade in all directions (i.e. peritrichous). They are chemo-organotrophs, obtaining their energy from oxidation and reduction reactions using organic sources, and are facultative anaerobes. Most species produce hydrogen sulfide, which can readily be detected by growing them on media containing ferrous sulfate, such as TSI. Most isolates exist in two phases: a motile phase I and a non-motile phase II.

Salmonella is closely related to the Escherichia genus and are found worldwide in cold- and warm-blooded animals (including humans), and in the environment. They cause illnesses like typhoid fever, paratyphoid fever, and the food borne illness.

Flagellar stain of a Salmonella Typhi
Salmonella growing on XLD agar

Salmonella as disease-causing agents
Salmonella infections are zoonotic and can be transferred between humans and nonhuman animals. Many infections are due to ingestion of contaminated food. A distinction is made between enteritis Salmonella and typhoid/paratyphoid Salmonella, where the latter — because of a special virulence factor and a capsule protein (virulence antigen) — can cause serious illness, such as Salmonella enterica subsp. enterica serovar typhi. Salmonella typhi is adapted to humans and does not occur in animals.

Enteritis Salmonellosis or Food Poisoning Salmonella
This is a group consisting of potentially all other serotypes (over a thousand) of the Salmonella bacterium, most of which have never been found in humans. These are encountered in various Salmonella species, most having never been linked to a specific host, and can also infect humans. It is therefore a zoonotic disease. The organism enters through the digestive tract and must be ingested in large numbers to cause disease in healthy adults. Gastric acidity is responsible for the destruction of the majority of ingested bacteria. The infection usually occurs as a result of massive...
ingestion of foods in which the bacteria are highly concentrated similarly to a culture medium. However, infants and young children are much more susceptible to infection, easily achieved by ingesting a small number of bacteria.

It has been shown that, in infants, the contamination could be through inhalation of bacteria-laden dust. After a short incubation period of a few hours to one day, the germ multiplies in the intestinal lumen causing an intestinal inflammation with diarrhoea that is often muco-purulent and bloody. In infants, dehydration can cause a state of severe toxicosis. The symptoms are usually mild. There is normally no sepsis, but it can occur as a complication in weakened elderly patients e.g. Hodgkin’s disease. Extra-intestinal localizations are possible, especially Salmonella meningitis in children. Enteritis Salmonella (e.g., Salmonella enterica subsp. enterica serovar enteritidis) can cause diarrhoea, which usually does not require antibiotic treatment. However, in people at risk such as infants, small children, the elderly, Salmonella infections can become very serious, leading to complications. If these are not treated, HIV patients and those with suppressed immunity can become seriously ill. Children with sickle cell anaemia who are infected with Salmonella may develop osteomyelitis.

Sources of infection

- Unclean food, particularly in institutional kitchens and restaurants
- Excretions from either sick or infected but apparently clinically healthy people and animals
- Polluted surface water and standing water (such as in shower hoses or unused water dispensers)
- Unhygienically thawed fowl (the melt water contains many bacteria),
- An association with reptiles (pet tortoises, snakes, frogs and primarily aquatic turtles) is well described.

Salmonella are not destroyed by freezing. Ultraviolet radiation and heat accelerate their demise; they perish after being heated to 55 °C for one hour, or to 60 °C for half an hour. To protect against Salmonella infection, it is recommended that food be heated for at least ten minutes at 75 °C so that the centre of the food reaches this temperature.

Classification

Salmonella nomenclature is complicated. Initially, each Salmonella species was named according to clinical considerations, e.g. Salmonella typhi-murium (mouse typhoid fever); S. cholerae-suis (hog cholera). After it was recognized that host specificity did not exist for many species, new strains (or serovar, short for serological variants) received specie names according to the location at which the new strain was isolated. Later, molecular findings led to the hypothesis that Salmonella consisted of only one species, S. enterica, and the serovar were classified into six groups, two of which are medically relevant. But as this now formalized nomenclature is not in harmony with the traditional usage familiar to specialists in microbiology and infectologists, the traditional nomenclature is common.

Currently, there are two recognized species: S. enterica and S. bongori, with six main subspecies: enterica (I), salamae (II), arizonae (IIIa), diarizonae (IIIb), houtenae (IV), and indica (VI). Historically, serotype (V) was bongori, which is now considered its own species. The serovar classification of Salmonella is based on the Kauffman-White classification scheme that permits serological varieties to be differentiated from each other. Newer methods for Salmonella typing and subtyping include genome-based methods such as pulsed field gel electrophoresis (PFGE), Multiple Loci VNTR Analysis (MLVA), Multilocus sequence typing (MLST) and (multiplex-) PCR-based methods.

References


Questions

1. Discuss the morphological characteristics of the genus Salmonella.
2. Discuss the pathophysiology of Salmonella.
3. Discuss the classification of Salmonella.