Salmonella

Salmonella is a Gram-negative facultative rod-shaped bacterium belonging to family ***Enterobacteriaceae,*** *Salmonella* is the most complex, currently comprise above 2463 serotypes or species, all of them potentially pathogenic. In addition to humans, they infect many animals and are capable of invading extra intestinal tissues

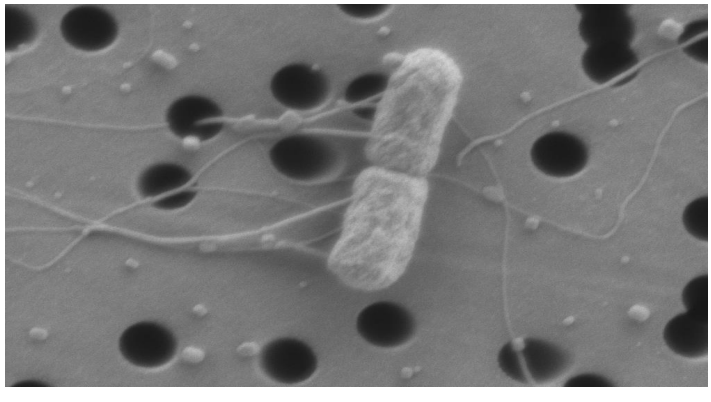

Figure 3-1 Scanning Electron Microscopy (SEM) image of Salmonella

Morphology and identification

- Salmonellae are gram-negative bacilli, 2-4 × 0.6 μm in size
- They are motile with peritrichous flagella
- They are nonacid-fast, noncapsulate and nonsporing
- They are resistant to sodium deoxycholate, which inhibits many other Enterobacteriaceae

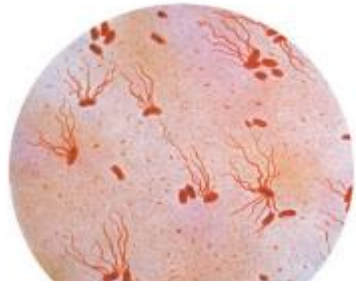

Figure 3-2 Typhoid, under the microscope

Cultural Characteristics

- Salmonellae are aerobes and facultative anaerobes
- Growing readily on pH 6 to 8 and temp. To 45° C (optimum 37°C).
- do not ferment lactose
- on xylose lysine deoxycholate (XLD) agar, many Salmonella spp. form pale colonies with black centers as a result of H2S production

Figure 3-3 Salmonella spp on H2S production

Antigenic Structure

1. Flagella antigen H

- These antigens represent determinant groups on the flagella protein
- they are heat-labile and alcohol- labile
- The H antigen is strongly immunogenic

2. Somatic antigen O

- Is the outer polysaccharides of the cell wall
- Unaffected by boiling heat-stable Alcohol-stable
- The O antigen is less immunogenic
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3. Surface antigen Vi

- Covering the outer layer of the cell wall.
- This antigen is an acidic polysaccharide
- The Vi antigen is heat-labile, poorly immunogenic

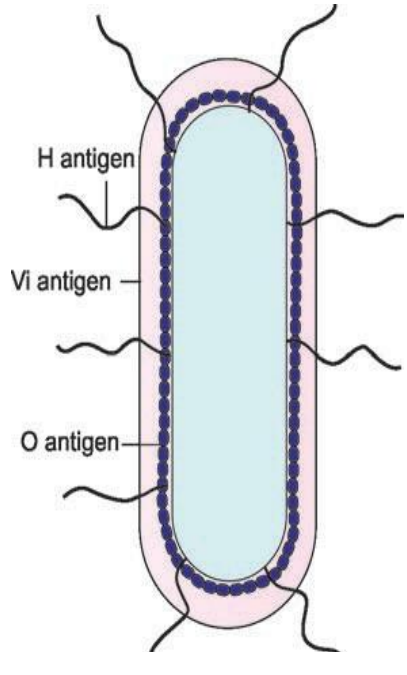


Figure 3-4 Antigenic structure of salmonellae

Pathogenesis

Sources of Infection: food and drink that have been contaminated with salmonellae, Water, Milk and Other Dairy Products, Shellfish, Meats and Meat Products, Household Pets

Salmonellae are strict parasites of animals or humans and can Cause the following three major syndromes

1. Enteric fever (**حمى المعوية**)
2. Bacteremia (**تجرثم الدم**)
3. Gastro-enteritis or food poisoning (**التهاب المعدة والأمعاء**)

Enteric fever (typhoid fever) Causative agent: *Salmonella typhi*

Typhoid fever is an acute illness associated with fever caused by the ***Salmonella typhi*** bacteria. It can also be caused by ***Salmonella paratyphi***, a related bacterium that usually causes a less severe illness. **The bacteria are deposited in water or food by a human carrier and are then spread to other people in the area.**

About **3%-5%** of people become carriers of the bacteria after the acute illness. These people may become long-term carriers of the bacteria -- even though they have no symptoms -- and be the source of new outbreaks of typhoid fever for many years. Chronic carriers (1%-5% of patients): bacteria persist in the **gallbladder** (المرارة) and the **biliary tract** (القنوات الصفراوية) for more than one year

What are the symptoms?

After the ingestion of contaminated food or water, the Salmonella bacteria invade the small intestine and enter the bloodstream temporarily. The bacteria are carried by white blood cells in the liver, spleen, and bone marrow, where they multiply and reenter the bloodstream.

Symptoms Gradually increasing **fever**, **malaise** (توعك), **headache**, **myalgia**(ألم عضلي), and **anorexia** (فقدان الشهية), **abdominal pain which persist for a week or longer, Rose spots** may appear on the trunk and they contain salmonellae The fatality rate is 2-10%

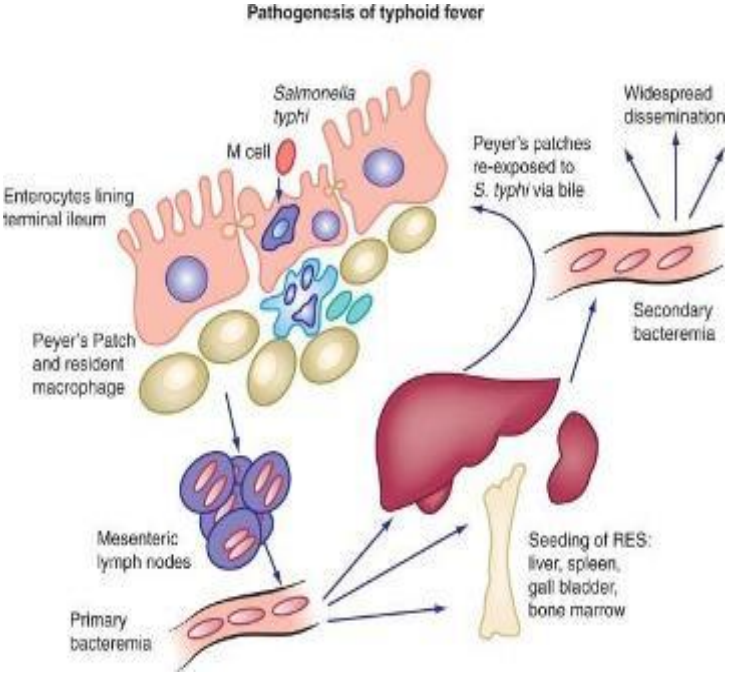


Figure 3-5 typhoid fever symptoms

Bacteremia

- Most common causal species: S. Choleraesuis, S Typhi and S. Paratyphi
- invasion of the bloodstream
- possible focal lesions in lungs, bones, meninges
- intestinal manifestations are often absent
- Blood cultures are positive.

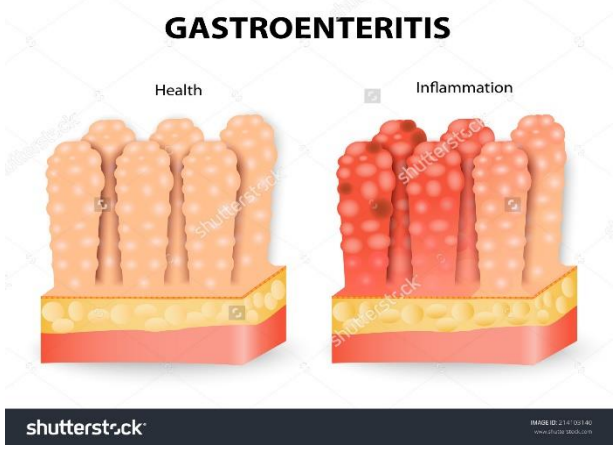
Gastro-enteritis or food poisoning

Infection is usually caused by eating raw or undercooked meat, poultry, eggs or egg products. The incubation period ranges from several hours to two days Symptoms

Possible signs and symptoms include:

- Nausea
- Vomiting
- Abdominal cramps
- Diarrhea
- Fever
- Chills
- Headache
- Blood in the stool

Blood cultures are usually negative, but stool cultures are positive for salmonellae



Diagnostic Laboratory

A. Specimens

- Blood for culture must be taken repeatedly.
- Bone marrow cultures and Urine cultures may be positive
- Stool specimens also must be taken repeatedly

B. Bacteriologic Methods for Isolation of Salmonellae

Differential Medium Cultures

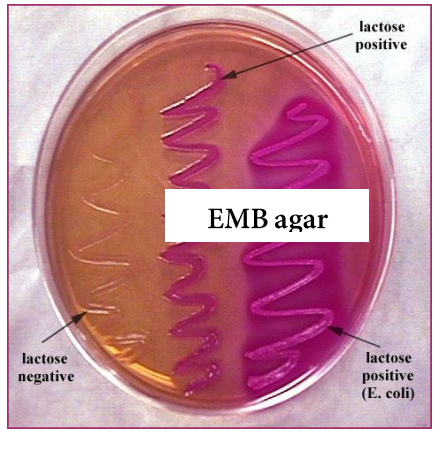
- EMB, MacConkey's, or deoxycholate medium permits rapid detection of lactose no fermenters
- Bismuth sulfite medium permits rapid detection of salmonellae which form black colonies because of H_2S production

Selective Medium Cultures

- (SS) agar, Hektoen enteric agar, XLD, or deoxycholate-citrate agar, which favor growth of salmonellae and shigellae over other Enterobacteriaceae

Hektoen enteric agar

Bismuth sulfite medium



C. Serologic Methods

1. Agglutination Test

In this test, known sera and unknown culture are mixed on a slide. Clumping, when it occurs, can be observed within a few minutes. There are commercial kits available to agglutinate and serogroup salmonellae by their O antigens: A, B, C1, C2, D, and E.

Figure 3-6 Agglutination Test for salmonellae

2. Tube Dilution Agglutination Test (widal test)

- The Widal test to detect these antibodies against the O and H antigens
- The test is not useful in diagnosis of enteric fevers caused by salmonella other than *Salmonella Typhi*.

Treatment

- Enteric fever and bacteremia require antibiotic treatment: chloramphenicol, ampicillin
- Salmonella enterocolitis needs only supportive therapy (antibiotic treatment may prolong the symptoms and excretion of the salmonellae).
- Chronic carriers of S. Typhi may be cured by antibiotics alone or combined with cholecystectomy.

Prevention

- Sanitary measures must be taken to prevent contamination of food and water by rodents or other animals that excrete salmonellae.
- Infected poultry, meats, and eggs must be thoroughly cooked.
- Carriers must not be allowed to work as food handlers and should observe strict hygienic precautions.

For further information you can refer to

1. Kayser, Medical Microbiology © 2005

2. Jawetz, Melnick, & Adelberg's Medical Microbiology 23ed.

3. Jaypee_Textbook of Microbiology 1st ed 2012.

4. Lecture notes. Medical microbiology and infection 5th ed -Wiley-Blackwell (2011).