SALMONELLA & SHIGELLA

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Objectives

1- Develop an algorithm using biochemical tests to identify and classify *Salmonella* and *Shigella*

2- Describe the antigenic structures and virulence factors of *Salmonella* and *Shigella*

3- Compare the pathogenesis of various species of *Salmonella* and *Shigella*

4-Describe the clinical features and risk factors for the infection with the two organisms

5- Describe the general concepts for the management of gastroenteritis caused by both organisms.

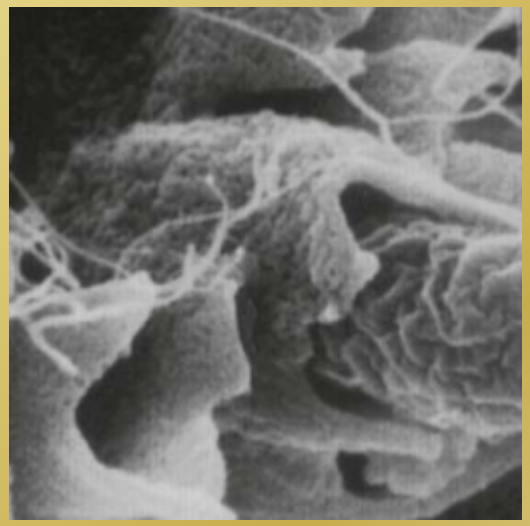
Salmonella

Salmonella

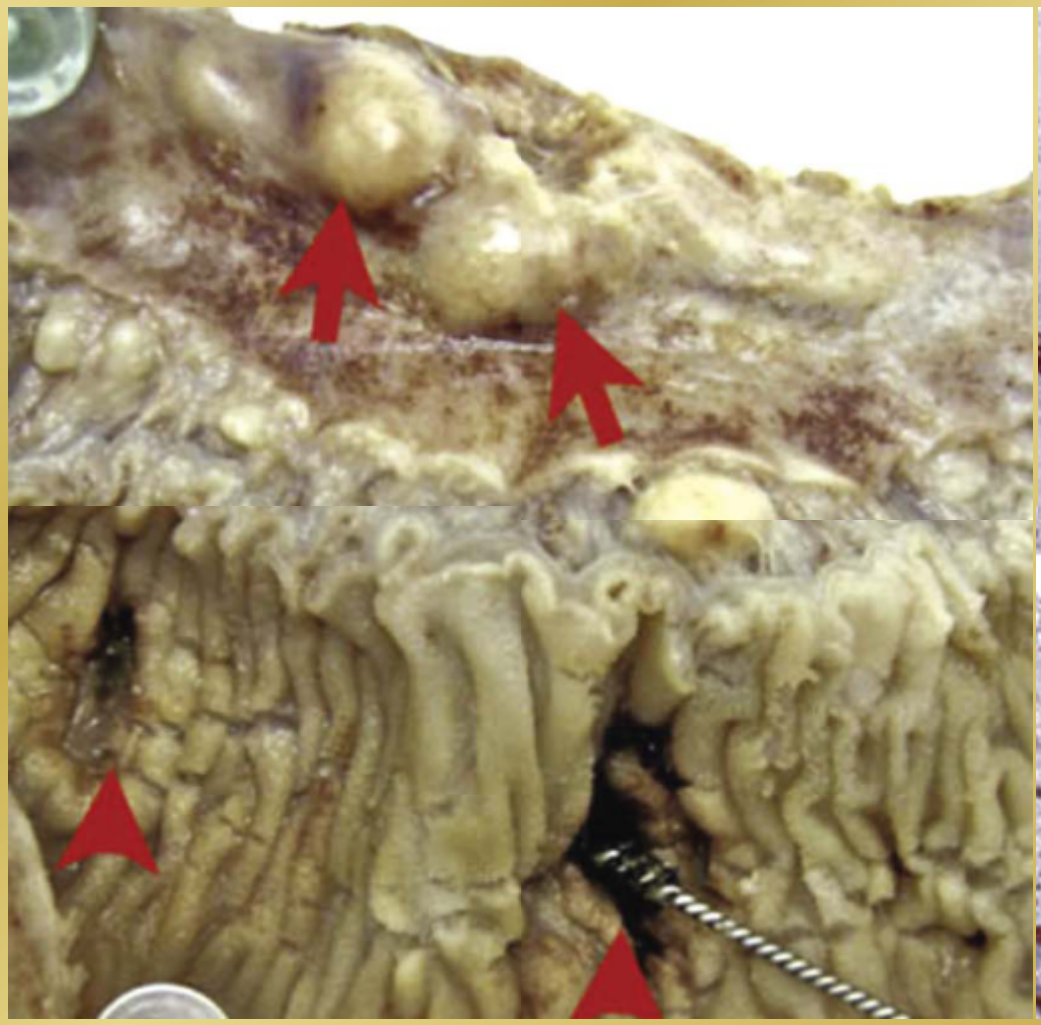
- Gram negative ,motile ,facultative anaerobic bacilli
- Non lactose fermenting colonies
- highest during the rainy season in tropical climates and during the warmer months in temperate climates.

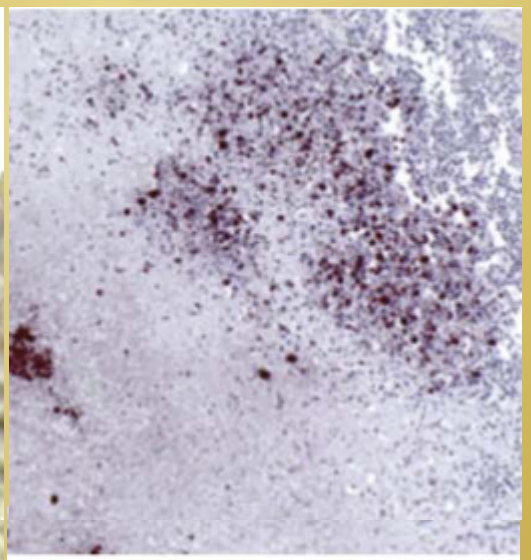
VIRULENCE FACTORS

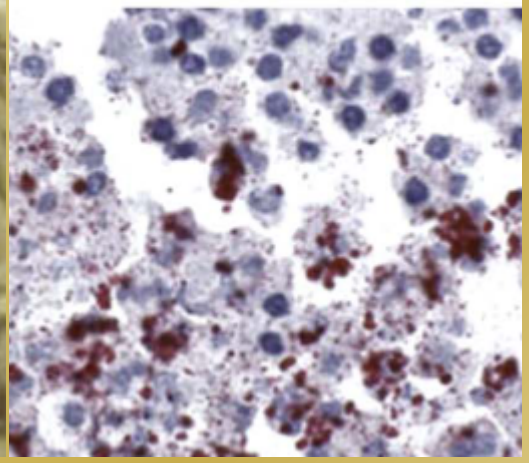
- Fimbria - Adherence
- Endocytosis
  - SPI 1 T3SS
  - TLR
- Replication in microphage
- Enterotoxin



Histopathology







Two species of Salmonella :

- *S.enterica* (six *subspecies I, II, III, IV, V, VI*)
- *S.borgori* **(rare)**

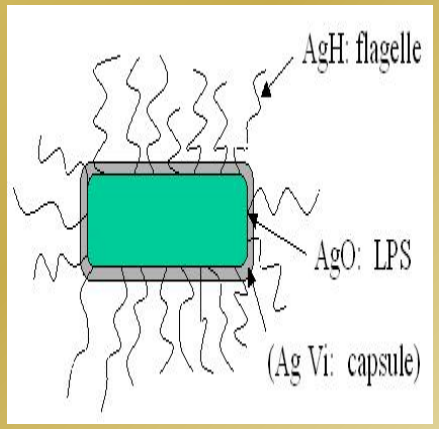
Found in cold blooded animal, birds, rodents, turtles, snakes and fish

***SALMONELLA* SPECIES AND SUBSPECIES**	**NO. OF SEROTYPES WITHIN SUBSPECIES**	**USUAL HABITAT**
S. enterica subsp. *enterica* (I)	1504	Warm-blooded animals
S. enterica subsp. *salmae*(II)	502	Cold-blooded animals and the environment*
S. enterica subsp. *arizonae* (IIIa)	95	Cold-blooded animals and the environment*
S. enterica subsp. *diarizonae* (IIIb)	333	Cold-blooded animals and the environment*
S. enterica subsp. *houtenae* (IV)	72	Cold-blooded animals and the environment*
S. enterica subsp. *indica*(VI)	13	Cold-blooded animals and the environment*
S. bongori (V)	22	Cold-blooded animals and the environment*
Total	2541	

Antigenic structures

- **O. Somatic antigen**
- **H. Flagellar antigen**
- **K. Capsular antigen**

- **V_I in *Salmonella serotype typhi* (virulence heat-labile capsular homopolymer of N-acetyl-galactosamino-uronic acid) *vs* phagocytosis**
- **O Antigen (Heat – stable) is lipopolysaccharide in the outer membrane A,B,C1,C2,D,E**
- **H antigen (Heat labile)**



Clinical diseases

- Acute gastroenteritis
- Typhoid fever
- Nontyphoidal bacteremia
- Carrier state following *Salmonella* infection

Source

- Water, food and milk contaminated with human or **animal** excreta.
- *S.typhi* and S.*paratyphi* : the source is **human.**

Salmonella gastroenteritis

- Food poisoning through contaminated food
- *S. enterica* subsp. *enterica the common cause*
- Source :poultry, milk, egg & egg products and handling pets
- Infective dose: 10^6 bacteria
- Incubation period : 8 – 36 hrs.
- fever, chills, watery diarrhea and abdominal pain. Self limiting.
- In sickle cell ,hemolytic disorders , ulcerative colitis, elderly or very young patients; the infection may be very severe.
- Patients at high risk for dissemination and antimicrobial therapy is indicated.

Enteric fever (Typhoid fever)

- Prolonged fever
- Bacteremia
- Involvement of the reticulo endothelial system (liver, spleen, intestines and mesentery)
- Dissemination to multiple organs
- Ingestion of contaminated food by infected or carrier individual
- Caused by *Salmonella* serotype *typhi* or *S. paratyphi* A, B and C (less severe)
- Common in tropical , subtropical countries, and travelers (sewage ,poor sanitation).
- IP : 9 – 14 days.

First week: fever, malaise, anorexia, myalgia and a continuous dull frontal headache then,

- Patient develops constipation
- Mesenteric lymph node → blood stream liver, spleen and bone marrow
- **Engulfment of *Salmonella* by mononuclear phagocytes .**
- Bacteria released into the blood stream again and can lead to high fever . Blood culture is positive.

2nd and 3rd week

- Sustained fever & prolonged bacteremia.
- Invade gallbladder and Payer's patches
- Rose spots 2nd week of fever
- Billiary tract → GIT
- Organism isolated from stool .

Management & Antibiotics

Enteric fever:

- **Ceftriaxone**
- **Ciprofloxacin**
- **Trimelhoprim – Sulfamethoxazole**
- **Ampicillin**
- **Azithromycin or Ceftriaxone for patients from India and SE Asia due to strains resistant to Ciprofloxacin. Ciprofloxacin can be used for patients from other areas.**

Salmonella gastroenteritis:

- **Uncomplicated cases require fluid and electrolyte replacement only.**

COMPLICATIONS

- Necrotizing cholecystitis
- Bowel hemorrhage and perforation
- Pneumonia and thrombophlebitis
- Meningitis, osteomyelitis, endocarditis and abscesses.

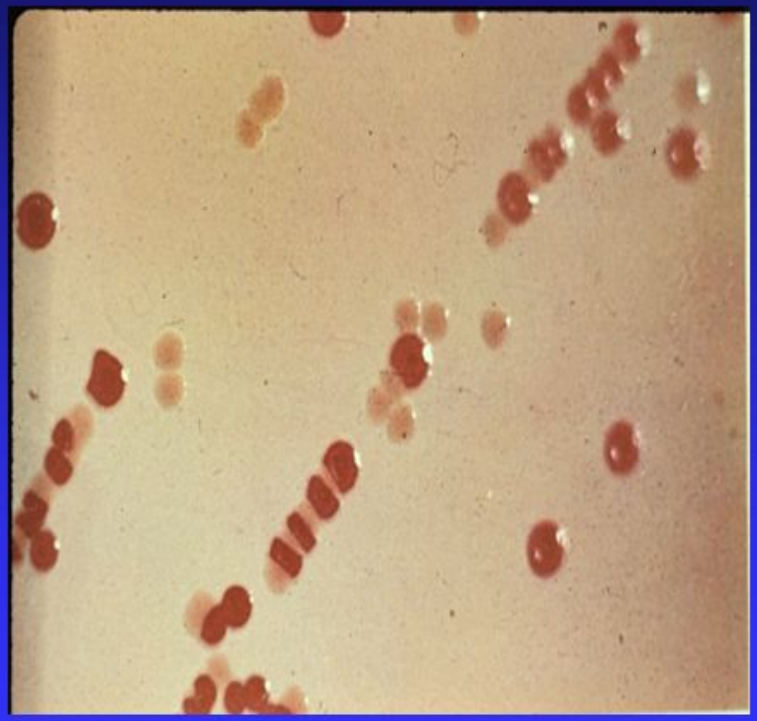
Shigella

- **Shigella is non lactose fermenting Gram negative bacteria.**
- **Cause bacillary dysentery (blood, mucus and pus in the stool)**

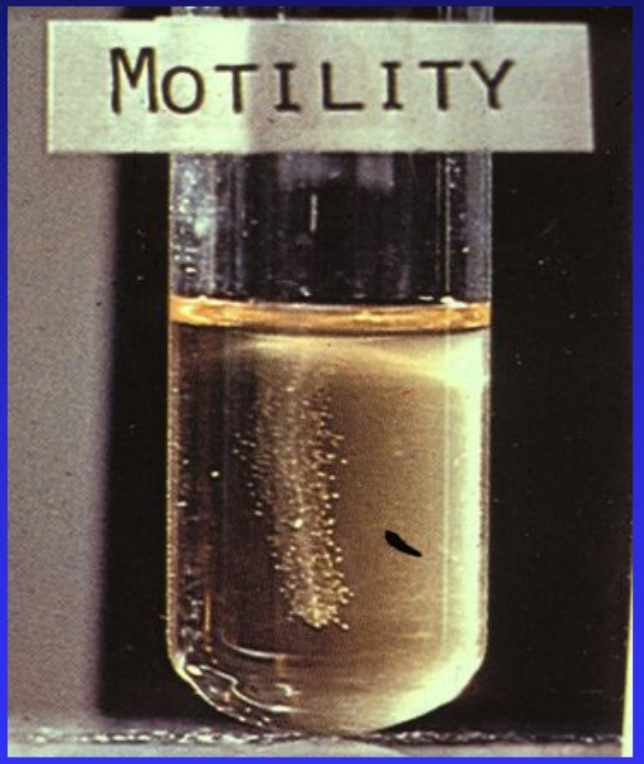
ANTIGENIC STRUCTURES

- **Shigella has 4 species and 4 major O antigen groups:**
- **All have O antigens , some serotypes has K antigen(heat labile removed by boiling)**
- ***Shigella* are non motile , lack H antigen**

Shigella on MacConkey Agar



Non-lactose fermenter



Non-motile

CLINICAL INFECTION

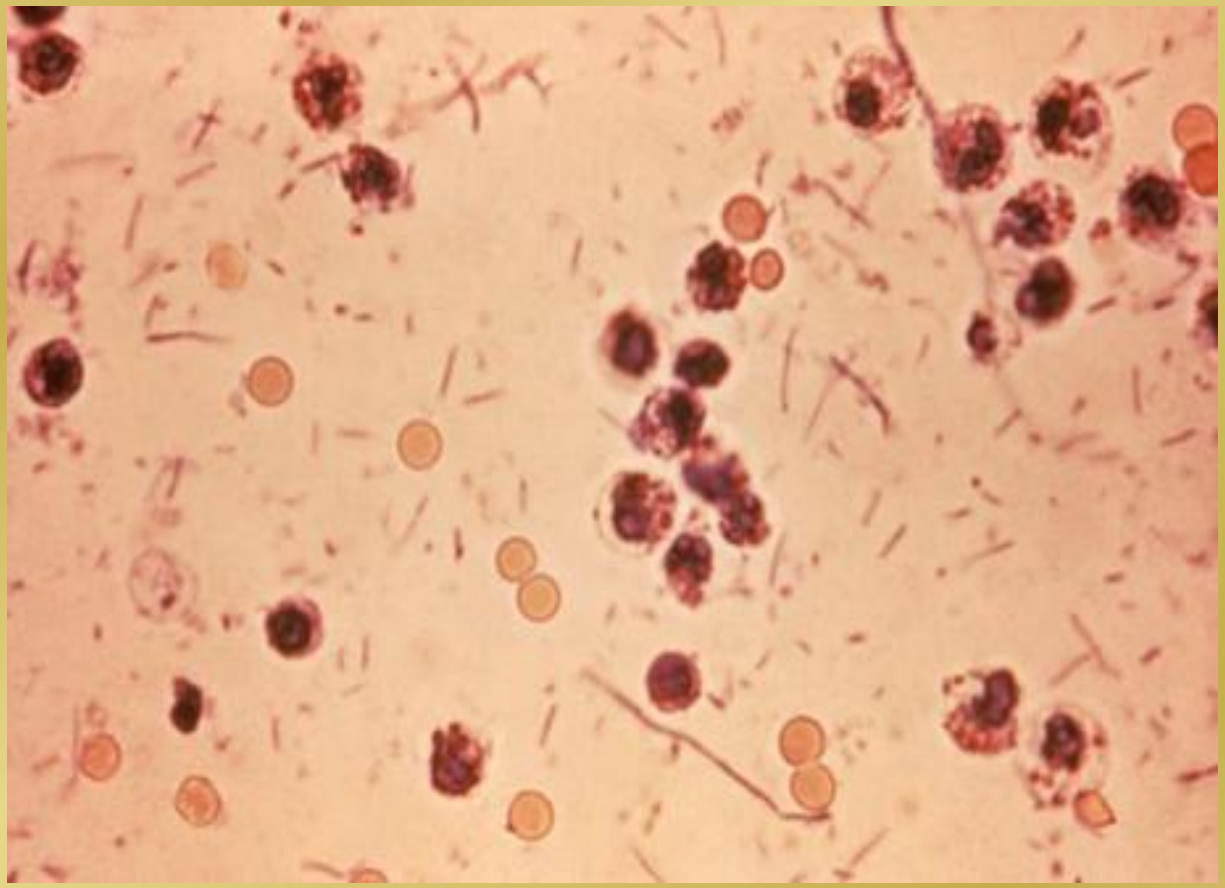
- ***S.sonnei*** **(group D1) most predominant in USA (fever, watery diarrhea)**
- ***S.flexneri*** **(group B15) 2nd most common**
- **Young adult (man who have sex with man)**
- ***S. dysenteriae*** **(*group A 6*)and *S. boydii* (*group C 20)* are most common isolates in developing countries**
- ***S. dysenteriae*** **type 1 associated with morbidity and mortality.**
- **Human is the only reservoir**

- Person to person through fecal –oral route .
- Flies, fingers (have a role in spread).
- Food and water.
- Young children in daycare, people in crowded area and anal oral sex in developed countries.
- Low infective dose < 200 bacilli
- Penetrate epithelial cells ,leads to local inflammation, shedding of intestinal lining and ulcer formation.

SYMPTOMS

- High fever, chill, abdominal cramp and pain accompanied by **tenesmus , bloody stool with mucus & leukocytes.**
- Incubation period : 24 - 48 hrs
- Can lead to rectal prolapsed in children
- Complications: ileus, obstruction dilatation and toxic mega colon
- Bacteremia in 4 % of severely ill patient
- Seizures, HUS

DYSENTRY STOOL



Laboratory diagnosis of *Salmonella* & *Shigella* from stool

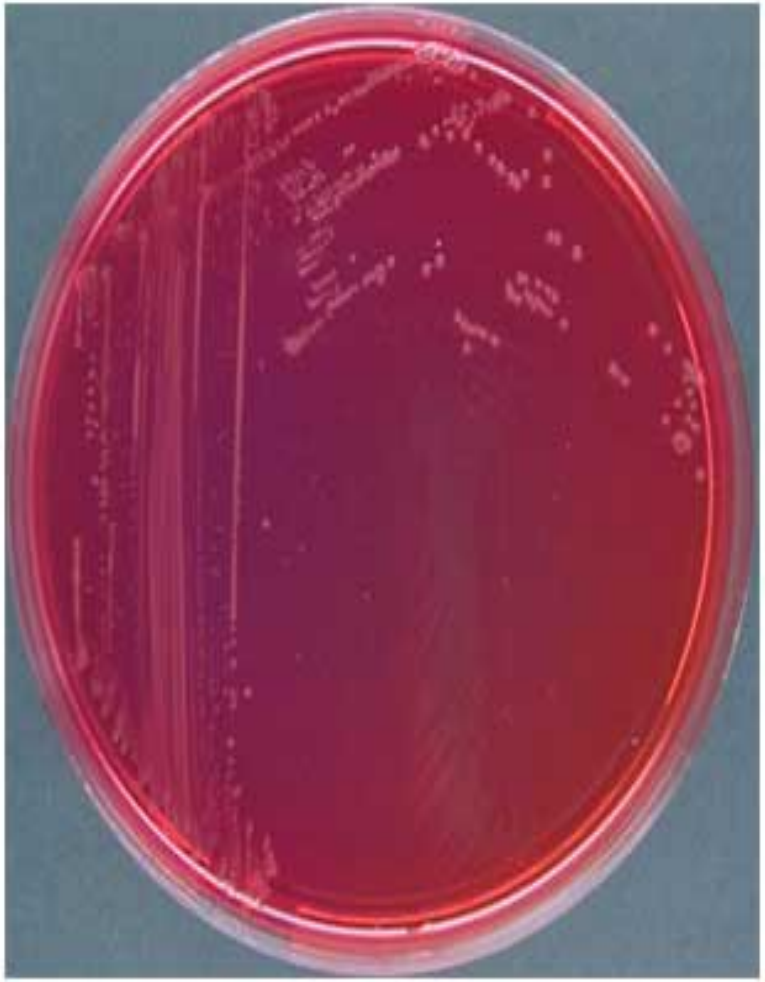
-Both are Gram negative bacilli

-Culture on selective media (*Salmonella* produce black colonies due to H2S)

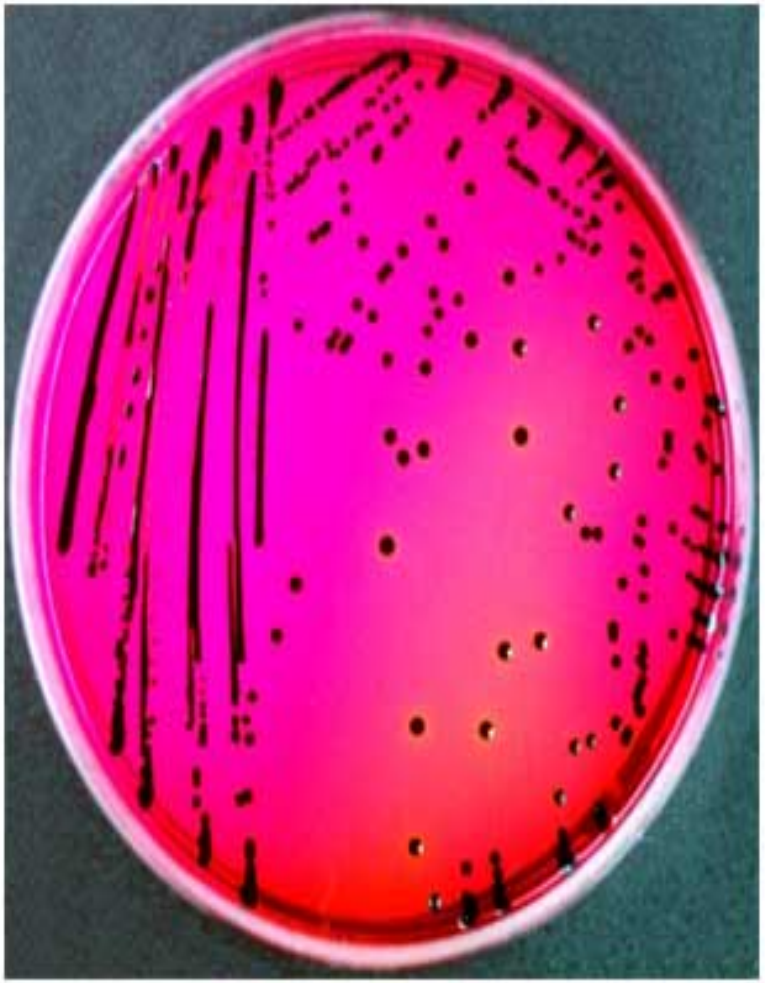
-Biochemical tests

-Motility test

-Serology for serotypes.



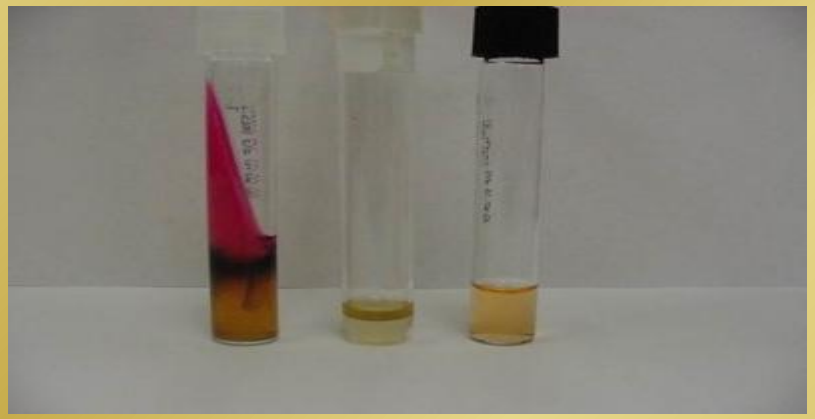
Shigella on XLD.



Salmonella on XLD.

Image Source: Faculty of Health and Medical Sciences - University of Copenhagen, Denmark

BIOCHEMICAL TESTS



Serology

Usually in ***Salmonella, Shigella*** and ***E.coli*** *the* final detection is by serotyping using agglutination Ag+Ab test.

Diagnosis

- Stool culture on selective selenite enrichment broth media MAC, SS and XLD,HEA BS
- Sero-grouping based on O and H antigen

1. Sereny test

TREATMENT

Antibiotic s used to reduce duration of illness

IV ceftriaxone and ampicillin , oral TMP-SMX or ciprofloxacin or doxycycline.

References

Ryan, Kenneth J.. Sherris Medical Microbiology, Seventh Edition. McGraw-Hill Education.

- Intestinal flora, part of chapter 1

- Enteric infections and food poisoning, part of the chapter on Infectious Diseases.

-Typhoid fever

- Dysentry