LAB 7:

FAMILY: ENTEROBACTERIACEAE

GENUS: - *PROTEUS*

Taxonomy:

Kingdom: Bacteria

Phylum: Proteobacteria

Class: Gammaproteobacteria

Order: Enterobacteriales

Family: Enterobacteriaceae

Genus: *Proteus*

A) *Proteus vulgaris* (UTI, wound infection)

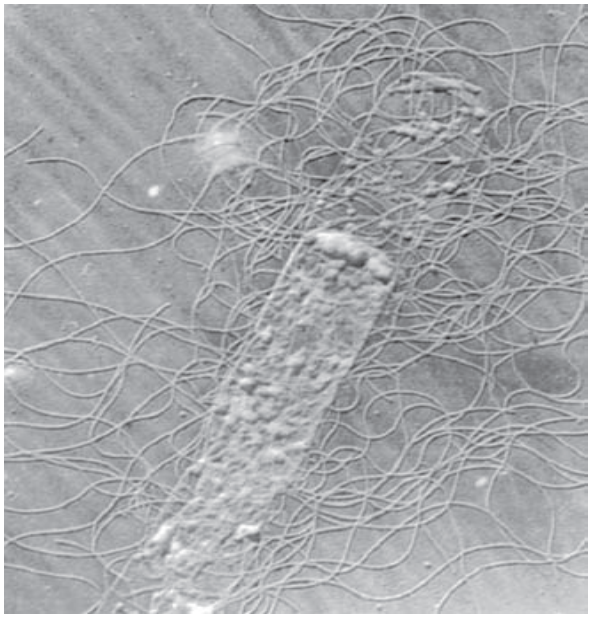
B) *Proteus mirabilis* (UTI, wound infection, nosocomial infections)

C) *Proteus penneri* (UTI, wound infection, nosocomial infections)

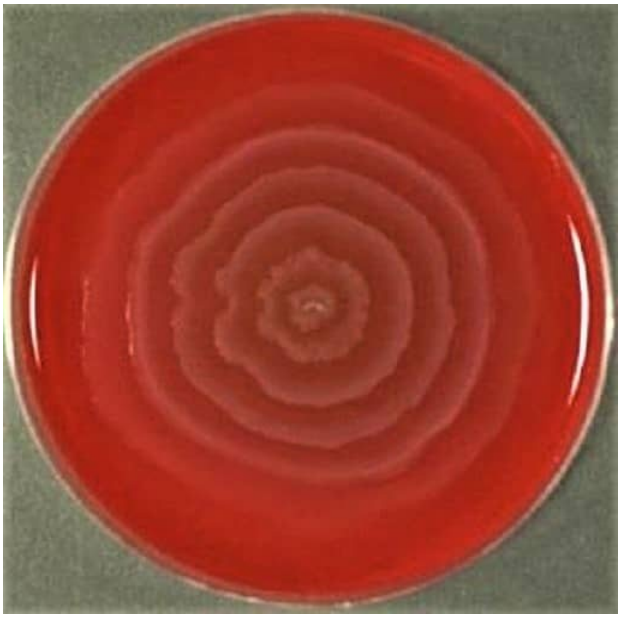
Distinguishing Features:

Gram negative, pleomorphic (bacilli or coccobacilli), actively motile with peritrichous flagella (see figure below), non-lactose fermenter, facultative anaerobes, non-capsulated, non-spore former, swarming on agar, growth at 25-37 C˚.

Natural habitat: some are free living in water, sewage, soil and vegetable. some are normal intestinal flora.
Proteus species produce infections in humans only when the bacteria leave the intestinal tract. They can cause urinary tract infections, bacteremia, pneumonia, and focal lesions in debilitated patients or those receiving contaminated intravenous infusions.



Electron micrograph of *Proteus vulgaris* showing peritrichous flagellation (9000×)



Swarming on blood agar

Proteus spp. are common causes of UTIs, occasionally in normal hosts and very commonly in those with indwelling

catheters or anatomic or functional abnormalities of the urinary tract. UTIs caused by *Proteus* spp. tend to be more severe than those caused by *E. coli*.

Pathogenesis:

Proteus species produce urease, resulting rapid hydrolysis of urea with liberation of ammonia. Thus, in urinary tract infections with *Proteus* species, the urine becomes alkaline, promoting stone formation in bladder and ureters. Furthermore, Ammonia inactivate the complement system(C4+).

- Motility may aid entry into bladder
- Endotoxin causes fever and shock when septicemia occurs.

* Serological classification is not dependable due to cross reactivity with Rickettsia (Typhus fever), and for differentiation among different biotype of *Proteus* will be done by carbohydrate fermentation test.

Enzymes produced by *Proteus* spp.:

Proteolytic enzymes: Protease, Gelatinase, Phenylalanine deaminase, Urease and Hemolysin.

**Highly sensitive to piperacillin, cefotaxime and Gentamycin, the drug of choice is piperacillin.

Some factors inhibit the swarming phenomena:

1- Adding 4% agar to media.

2- Presence of bile salts (MacConkey agar).

3- Anaerobic conditions.

Diagnostic tests for *proteus spp.*:

1- Gram stain: Gram negative bacilli or coccobacilli (pleomorphic).

2- Inoculation MacConkey agar.

3- Blood agar (swarming and hemolysis)

4-TSI

5- Urease test

6- IMViC.

7- Gelatin liquification.

8- Phenylalanine deaminase test: also known as phenylpyruvic acid (PPA) test is used to test the ability of an organism to produce enzyme deaminase. This enzyme removes the amine group from the amino acid phenylalanine and produces phenylpyruvic acid (PPA) and ammonia. phenylpyruvic acid reacts with ferric salts to give a green color (see figure below). This test is useful in initial differentiation of *Proteus, Morganella,* and *Providencia* from the rest of the Enterobacteriaceae.

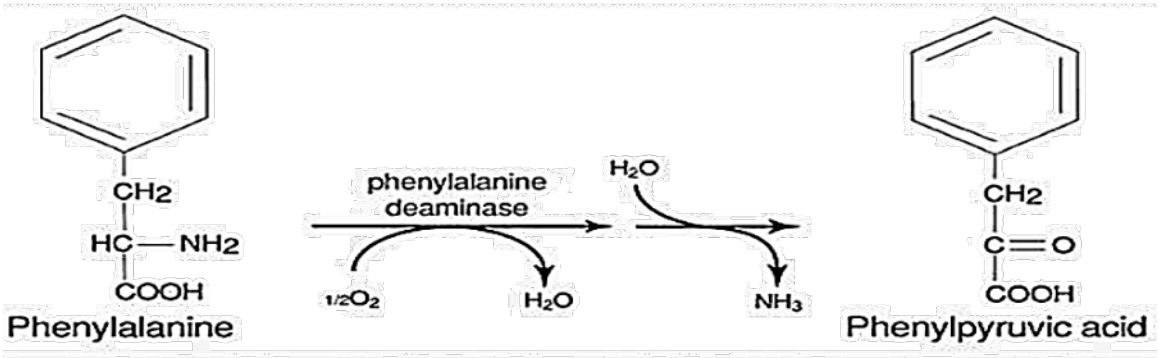
Procedure:

The long slant of the phenylalanine agar is inoculated with the tested organism. The tube is incubated at 37oC for 18-24 hours. Four to five drops of 10% ferric chloride solution is allowed to run down over the slope. If the test is positive, a green color will develop in the fluid and in the slope.

9 - Maltose (Differentiation and fermentation).

10 - Glucose (Differentiation and fermentation)

11 - Antibiotic Sensitivity test.



Principle of Phenylalanine deaminase test

Some biochemical and culture characteristics of *Proteus* spp.

Test	*P. vulgaris*	*P. mirabilis*	*P. penneri*
Urease	+	+	+
Catalase	+	+	+
Oxidase	-	-	-
Phenylalanine	+	+	+
MacConkey agar	**L.N.F**	**L.N.F**	**L.N.F**
Motility	+	+	+
Gelatinase	+	+	+
TSI	**A/K** -+	**A/K** -+	**A/K** - -
IMViC: Indol	+	-	-
IMViC: MR	+	+	+
IMViC: VP	-	-	-
IMViC: Citrate	**v+/-**	+	-
Glucose	+	+	+
Maltose	+	-	+
H_2S	+	+	-
Blood hemolysis	**α**	**α**	**β**
Swarming	+	+	+