



Ministry of Higher education and scientific research

University of Tikrit

College of science

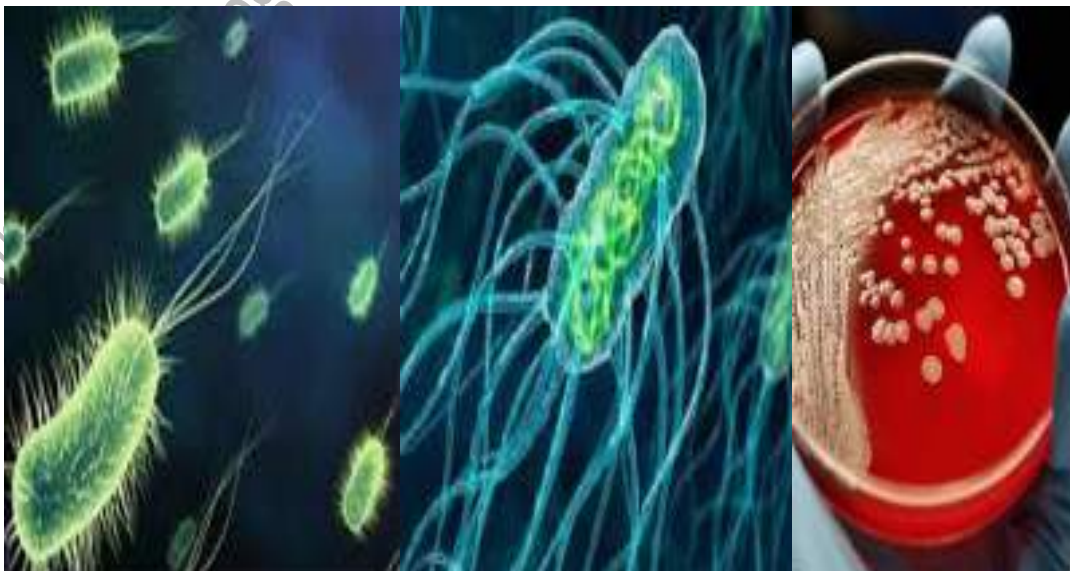
Department of Biology

Lectures of Pathogenic Bacteria

For Diploma students – Pathological analyses - 2025-2026

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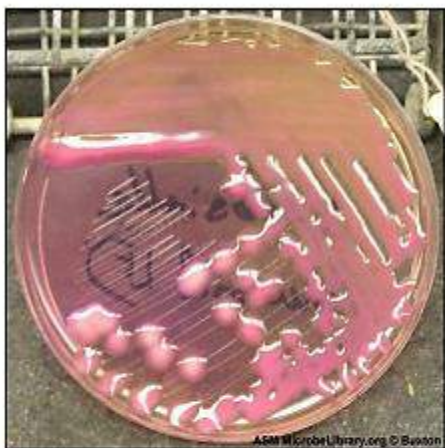
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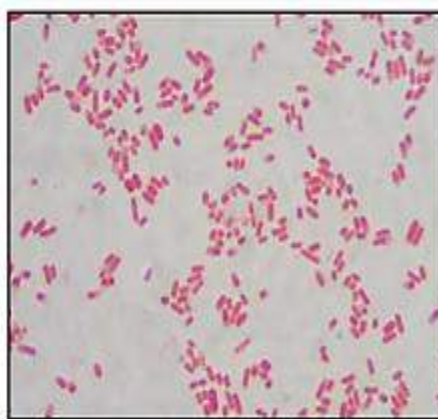
Klebsiella genus:

Are large ,non-motile ,bacilli ,possess a luxurious capsule (encapsulated), lactose-fermenting, facultative anaerobic, rod-shaped bacterium. It appears as a mucoid lactose fermenter on MacConkey agar. *K. pneumoniae* and *K. oxytoca* are the two strains responsible for most human illnesses. They cause necrotizing labor pneumonia in individuals compromised by alcoholism, diabetes or chronic obstructive pulmonary disease. *K. pneumoniae* also causes UTI and bacteremia particularly in hospitalized patients (nosocomialinfection).

Members of the genus *Klebsiella* typically express two types of antigens ontheir cell surfaces. The first, O antigen, is a component of the lipopolysaccharide (LPS), of which 9 varieties exist. The second is K antigen, a capsular polysaccharide with more than 80 varieties. Both contribute to pathogenicity and form the basis for serogrouping.



K. pneumoniae on MacConkey agar
(Lactose fermenter)



Gram stain (Gram-negative rods)

Morphology

Klebsiella bacteria tend to be rounder and thicker than other members of the Enterobacteriaceae family. They typically occur as straight rods with rounded or slightly pointed ends. They can be found singly, in pairs, or in short chains. Diplobacillary forms are commonly found in vivo. Typical colonies are large and often slimy in appearance because of capsule formation; colonies are pink on MacConkey agar. Species of *Klebsiella* are all gram-negative and non-motile. They tend to be shorter and thicker when compared to others in the Enterobacteriaceae family.

CULTURE

Members of the genus produce a prominent capsule, or slime layer. Typical colonies are large and often slimy in appearance because of capsule formation; colonies are pink on MacConkey agar. They have no specific growth requirements and grow well on standard laboratory media, but grow best between 35 and 37 °C and at pH 7.2. The species are facultative anaerobes, and most

strains can survive with citrate and glucose as their sole carbon sources and ammonia as their sole nitrogen source.

Klebsiella in humans klebsiella organisms can lead to a wide range of disease states, notably , Pneumonia. Urinary tract. Infections. Septicemia. Meningitis. Diarrhea. soft tissue infections.

Proteus , Providencia , and Morganella

Members of these genera are agents of urinary tracts and other extra intestinal infections . It is common causes of uncomplicated as well as nosocomial UTI , wound infection, pneumonia and septicemia . Proteus organisms produces urease which colonizes the hydrolysis of urea to ammonia . The resulting alkaline environment promotes the precipitation of struvite stones containing insoluble phosphate of magnesium and phosphate.

Proteus species are most commonly found in the human intestinal tract as part of normal human intestinal flora. Proteus is also found in multiple environmental habitats, including long-term care facilities and hospitals. This bacteria can colonize both the skin and oral mucosa of both patients and hospital personnel. Infection primarily occurs from these reservoirs.

However, Proteus species are not the most common cause of nosocomial infections. Proteus mirabilis causes 90% of Proteus infections and can be considered a community-acquired infection.

Proteus vulgaris and Proteus penneri may be isolated from individuals in long-term care facilities and hospitals and from patients with underlying diseases or compromised immune systems.

Macroscopic morphology

Typical colonies are thin, moist and spreading on blood agar . Small colorless colonies are produced on MacConkey agar. These organisms usually are highly motile and produce a —swarming overgrowth on blood agar, which can frustrate efforts to recover pure cultures of other organisms. Growth on blood agar containing phenylethyl alcohol inhibits swarming, thus allowing isolated colonies of Proteus and other organisms to be obtained. They produce non-lactose-fermenting (colorless) colonies on MacConkey's or EMB agar. P. vulgaris and P. mirabilis produce H₂S, which blackens the butt of TSI agar.



Proteus spp. on MacConkey agar
(Lactose non-fermenter)



Proteus spp. on Blood agar (swarming)

Pathogenesis & Epidemiology

The organisms are present in the human colon as well as in soil and water. Their tendency to cause urinary tract infections is probably due to their presence in the colon and to colonization of the urethra, especially in women. The vigorous motility of *Proteus* organisms may contribute to their ability to invade the urinary tract. Production of the enzyme urease is an important feature of the pathogenesis of urinary tract infections by this group. Urease hydrolyzes the urea in urine to form ammonia, which raises the pH, producing an alkaline urine. This encourages the formation of stones (calculi) called —struvite composed of magnesium ammonium phosphate. Stones in the urinary tract obstruct urine flow, damage urinary epithelium, and serve as a nidus for recurrent infection by trapping bacteria within the stone. Because alkaline urine also favors growth of the organisms and more extensive renal damage, treatment involves keeping the urine at a low PH.

Providencia

pathogens of humans The genus *Providencia* is a urease-producing gram-negative bacillus and the most important species includes *Providencia stuartii*, and *P. rettgeri* are the most common cause of catheter-associated urinary tract infections, especially in the elderly with long-term indwelling urinary catheters. While *Providencia* species do not routinely cause urinary tract infections or bacteremia, when implicated, the overall mortality rate of bacteremia due to *Providencia* species can be high, especially in the elderly with severe underlying conditions. *P. rettgeri* and *P. stuartii* are commonly found in water, soil, and animal reservoirs, and are opportunistic pathogens in hospitalized patients and elderly residents in a nursing care facility.

Morganella

Are motile, non-lactose fermenting gram-negative bacteria, which share with *Proteus* the capacity for urease production and presence of phenylalanine deaminase. They can be separated from *Proteus* species by the lack of swarming activity or gelatin liquefaction or H₂S production. Commonly found in the environment and in the intestinal tracts of humans, mammals, and reptiles as normal flora. Despite its wide distribution, it is an uncommon cause of community-acquired infection and is most often encountered in postoperative and other nosocomial settings.

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