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The Thistle QA CEU No is: **MT-13/00142**.

Each attendee should claim **THREE** CEU points for completing this Quality Control Journal Club exercise, and retain a copy of the relevant Thistle QA Participation Certificate as proof of registration on a Thistle QA EQA.

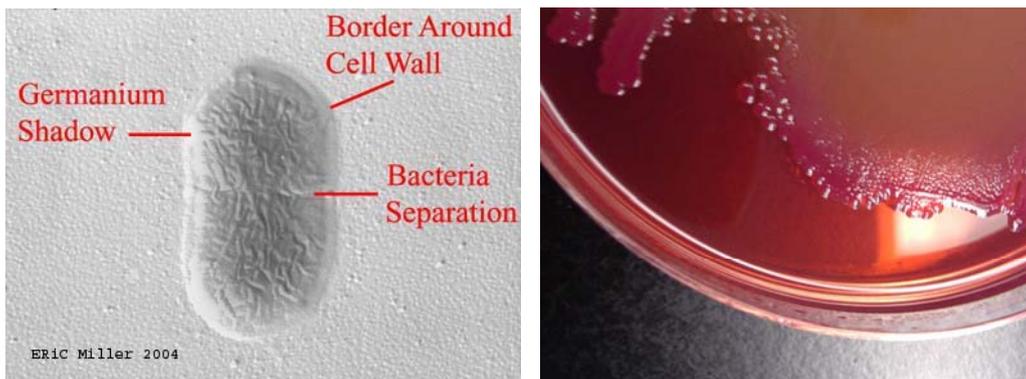
MICROBIOLOGY LEGEND

CYCLE 33 ORGANISM 5

Citrobacter freundii

Citrobacter freundii are facultative anaerobic Gram-negative coliform bacteria in the Enterobacteriaceae family. The bacteria are long rod-shaped with a typical length of 1-5 μm . Most *C. freundii* cells are surrounded by several flagella used for locomotion, but a few are non-motile. *Citrobacter* species are differentiated by their ability to convert tryptophan to indole, ferment lactose, and use malonate. *C. freundii* can use citrate as a sole carbon source.

The *Citrobacter* genus was discovered in 1932 by Werkman and Gillen. Cultures of *C. freundii* were isolated and identified in the same year from soil extracts.



Citrobacter freundii, an opportunistic pathogen that lives in our intestines

Clinical significance

These bacteria can be found almost everywhere in soil, water, wastewater, etc. They can also be found in human and animal intestines. *Citrobacter freundii* is an opportunistic microbe, and often causes major opportunistic infections, i.e. the bacterium does not produce any disease-symptoms in healthy humans; it only afflicts those who have a weak and debilitated immune system. People who have a weakened immune system tend to develop infections of the urinary tract, respiratory tract, and the blood. Pancreatic, hepatic, and biliary diseases are also commonly caused by *C. freundii*.

Symptoms

1. Urinary tract infections caused by *Citrobacter freundii* trigger:
 - a burning sensation during
 - urination, increased urge to urinate,
 - offensive smelling urine,
 - scanty urination,
 - blood in the urine
 - fever
 - burning or pain in the lower back and / or pelvis.
2. *C. freundii* is also known to cause abnormal inflammatory changes in the intestine, sometimes even resulting in necrotic changes.
3. *Citrobacter freundii* has been linked to neonatal meningitis as well. The meninges or coverings of the brain get inflamed due to bacterial infiltration. *C. freundii* has the capacity to break through the blood-brain barrier (comprising of the brain capillary endothelium and the choroid plexus epithelium). It can invade and replicate in the brain too. Common clinical features and *Citrobacter freundii* symptoms include:
 - high grade fever
 - projectile vomiting
 - seizures.
 - peritonitis and tunnel infection due to *Citrobacter freundii* have also been reported. This has most frequently been seen in hospitalized and immune-compromised patients who have been kept on ventilators and urinary catheter.

Surprisingly, this infectious microbe in humans plays a positive role in the environment. *C. freundii* is responsible for reducing nitrate to nitrite in the environment. This conversion is an important and crucial stage in the nitrogen cycle. The bacteria also help in recycling nitrogen. *Citrobacter freundii* has also been investigated for biodegradation of tannic acid used in tanneries.

C. freundii strains have inducible *ampC* genes encoding resistance to ampicillin and first-generation cephalosporin's. In addition, isolates of *Citrobacter* may be resistant to many other antibiotics as a result of plasmid-encoded resistance genes

Diagnoses

Clinical features, demonstration of the infection, bacterial culture and imaging techniques such as X-rays and sonographies help make an accurate diagnosis. Quick and precise diagnosis is an important aspect of treating the *C. freundii* infection appropriately.

Treatment

Citrobacter freundii infection is usually treated with antibiotics like fluoroquinolones, carbapenems and cephalosporins. The treatment plan depends up on the vulnerability of the microbe to the antibiotics and the site of the infection. Conversely, there is a growing alarm over the levels of

resistance of *C. freundii* to a number of antibiotics. Supportive treatment is given as well to hasten cure.

Prognosis

The overall prognosis for *Citrobacter freundii* infection is moderate. Untreated and neglected cases show extremely poor prognosis and almost always result in death. *Citrobacter* bacteremia commonly develops in elderly patients (65 %) and in hospitalized patients (77 %). The outcome for *C. freundii* urinary tract infection is good; whilst that for peritonitis is rather moderate to poor. The mortality rate of *Citrobacter freundii* meningitis is incongruously high, with the death rate of the patient ranging from 25 % to 50 %. Furthermore, serious neurological problems are known to persist in 75 % of the survivors.

References

1. <http://www.citrobacterfreundii.com/Citrobacter-Freundii-Symptoms.html>

Questions

1. Discuss the morphological characteristics of *Citrobacter freundii*.
 2. Discuss the role of *C. freundii* in disease.
 3. Discuss the lab diagnosis of *C. freundii*.
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