

# **Alpha-Proteobacteria**

**By-**

**Dr. Ekta Khare**

# $\alpha$ -Proteobacteria

- The  $\alpha$ -proteobacteria include most of the oligotrophic proteobacteria (those capable of growing at low nutrient levels).
- Some have unusual metabolic modes such as methylotrophy (*Methylobacterium*), chemolithotrophy (*Nitrobacter*), and the ability to fix nitrogen (*Rhizobium*).
- Members of genera such as *Rickettsia* and *Brucella* are important pathogens; in fact, *Rickettsia* has become an obligately intracellular parasite.
- Many genera are characterized by distinctive morphology such as prosthecae.
- The class Alphaproteobacteria has six orders and 18 families.

# *Rickettsia*

- In the second edition of Bergey's Manual, the genus *Rickettsia* will be located in the order Rickettsiales and family Rickettsiaceae of the  $\alpha$ -proteobacteria.
- These bacteria are rod-shaped, coccoid, or pleomorphic with typical gram-negative walls and no flagella.
- *Rickettsia* is 0.3 to 0.5  $\mu\text{m}$  in diameter and 0.8 to 2.0  $\mu\text{m}$  long.
- All species are obligate intracellular parasite.
- The parasitic forms grow in vertebrate erythrocytes, macrophages, and vascular endothelial cells.
- Often they also live in blood-sucking arthropods such as fleas, ticks, mites, or lice, which serve as vectors or primary hosts.
- Rickettsias enter the host cell by inducing phagocytosis.
- Members of the genus *Rickettsia* immediately escape the phagosome and reproduce by binary fission in the cytoplasm.
- Besides incurring damage from cell lysis, the host is harmed by the toxic effects of rickettsial cell walls (wall toxicity appears related to the mechanism of penetration into host cells).

## ... *Rickettsia*

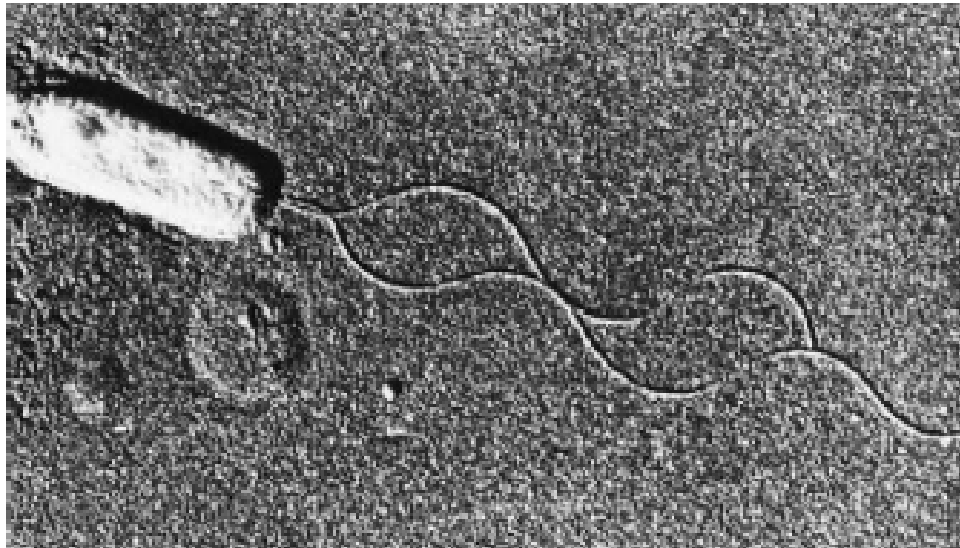
- Rickettsias are very different from most other bacteria in physiology and metabolism.
- They lack the glycolytic pathway and do not use glucose as an energy source, but rather oxidize glutamate and tricarboxylic acid cycle intermediates such as succinate.
- The rickettsial plasma membrane has carrier-mediated transport systems, and host cell nutrients and coenzymes are absorbed and directly used.
- Their membrane also has an adenylate exchange carrier that exchanges ADP for external ATP.
- Results from genome sequencing show that *R. prowazekii* is similar in many ways to mitochondria.
- Possibly mitochondria arose from an endosymbiotic association with an ancestor of *Rickettsia*.
- This order contains many important pathogens.
- *Rickettsia prowazekii* and *R. typhi* are associated with typhus fever, and *R. rickettsii*, with Rocky Mountain spotted fever.
- Also important pathogens of domestic animals such as dogs, horses, sheep, and cattle.

# Family Rhizobiaceae

- In the second edition of *Bergey's Manual*, the order *Rhizobiales* of the  $\alpha$ -proteobacteria will contain 10 families with a great variety of phenotypes.
- The first family in this order is *Rhizobiaceae*, in
- which are located the gram-negative, aerobic genera *Rhizobium* and *Agrobacterium*.

# *Rhizobium*

- Members of the genus *Rhizobium* are 0.5 to 0.9 by 1.2 to 3.0  $\mu\text{m}$  motile rods, often containing poly--hydroxybutyrate granules, that become pleomorphic under adverse conditions.
- They grow symbiotically within root nodule cells of legumes as nitrogen-fixing bacteroids.



# *Agrobacterium*

- The genus *Agrobacterium* is placed in the family *Rhizobiaceae* but differs from *Rhizobium* in not stimulating root nodule formation or fixing nitrogen.
- Instead agrobacteria invade the crown, roots, and stems of many plants and transform plant cells into autonomously proliferating tumor cells.
- The best-studied species is *A. tumefaciens*, which enters many broad-leaved plants through wounds and causes crown gall disease (**figure 22.9**).
- **The ability to produce tumors is dependent on the presence of a large Ti (for tumor-inducing) plasmid.**



**Figure 22.9** *Agrobacterium*. Crown gall tumor of a tomato plant caused by *Agrobacterium tumefaciens*.