

Commentary

Bacterial cell envelope: Types, construction and functions

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CELL ENVELOPE

A cell envelope is a combination of cell membranes, cell wall, and outer membranes if it is present. It includes the inner cell wall and the bacterial cell wall. The cell envelope provides structural integrity to the cell. In prokaryotes, it protects the cell from internal turgor-induced stress caused by high concentrations of macromolecules within the cell. While all bacterial cell walls contain peptidoglycan, not all cell walls have the same structures. This is notably expressed through the classification into gram positive and gram negative bacteria.

Types of bacterial cell envelopes

1. Gram-positive cell wall: The gram-positive cell wall is characterized by the presence of a highly dense peptidoglycan layer, which is responsible for the storage of crystal violet dyes during the Gram contamination process. It is found only in living organisms that are part of Actinomycetota and Bacillota. Bacteria within the Deinococcota group may also show how to make gram-positive spots but contain other common cell wall structures of non-gram-positive organisms. It is embedded in a wall of gram-positive polyalcohol cells called teichoic acids, some of which are attached to lipid to form lipoteichoic acids. Because lipoteichoic acids interact jointly with lipids within the cytoplasmic membrane they are responsible for binding peptidoglycan

to the cytoplasmic membrane. Teichoic acids give the gram-positive cell wall a negative side effect due to the presence of phosphodiester bonds among teichoic acid monomers.

2. Gram-negative cell envelope: The gram-negative cell wall consists of a thin layer of peptidoglycan adjacent to the cytoplasmic membrane than the gram-positive wall, which is responsible for the cell wall's inability to retain crystal violet color in ethanol removal during Gram contamination. In addition to the peptidoglycan layer the gram-negative cell wall also contains extra outer membranes composed of phospholipids and lipopolysaccharides. The highly charged nature of lipopolysaccharides provides a total negative charge on the gram-negative cell wall.

Cell envelope construction: Bacteria within the Chlamydiaceae family are different in their morphology as they do not have the available peptidoglycan levels in the cell wall of their infectious species. Instead, extracellular forms of these gram-negative bacteria maintain their structural integrity by relying on a layer of disulfide bond rich cysteine-rich proteins, found between the cytoplasmic membrane and the outer layer in a manner similar to a peptidoglycan layer in other gram-negative viruses. In the intracellular species of the bacterium there is no cross-linking of disulfide, which makes this form mechanically weak.

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Functions of cell envelope

- The bacterial cell wall not only keeps the cell from bursting and prevents it from exploding or crumbling but, as noted in the case of moving bacteria, forms filamentous extensions called flagella.
- The cell membrane also controls the transport of substances inside and outside the cell.

- A special structure known as the mesosome is formed by the expansion of the plasma membrane into the cell wall. These extensions are usually in the form of vesicles, tubules, and lamellae. They help the cell to perform various functions, such as cell wall fusion, DNA replication, and the distribution of daughter cells, respiration, fluid, and so on.