Bacterial cell wall

The bacterial (prokaryotic) cell has a cell wall on its surface. All bacteria have a cell wall except mycoplasmas.

Microbiology

The functions of the cell wall are:

- the wall is part of the cellular skeleton;
- the wall gives the cell shape;
- the wall provides mechanical protection to the cell;
- the wall protects the cell from radiation, drying out, chemical damage;
- the wall compensates for the osmotic overpressure inside the cell.

Bacterial wall construction

They differ in structure, but a common feature is the presence of peptidoglycan (murein). Peptidoglycan is formed by layers of polysaccharide chains in which N-acetylglucosamine and N-acetylmuramic acid alternate. The O-glycosidic bond can be disrupted, for example, by lysozyme. N-acetylmuramic acid residues form chain interconnections using short peptides (tetrapeptides). The process of this association is called transpeptidation and is catalyzed by transpeptidases.

Antibiotics such as penicillins and cephalosporins act on the transpeptidation process.

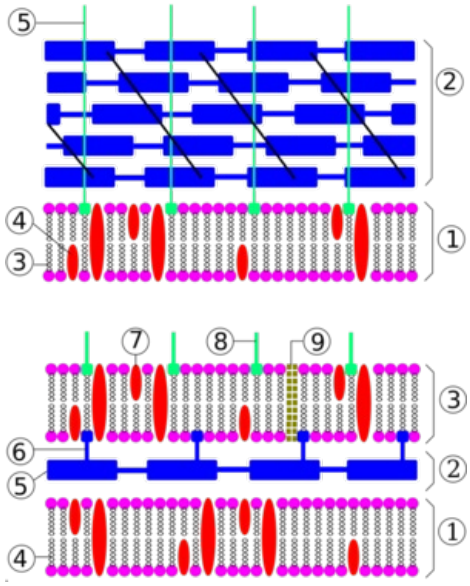
Wall of gram-positive bacteria

Construction easier than G−. The wall thickness is about 20 nm. The wall is formed by a thick layer of peptidoglycan (many layers of peptidoglycan chains). Unlike G− bacteria, in G + almost all N-acetylmuramic acid residues are linked by a peptide bridge (important for antibiotic selection).

Teichoic acid chains, which have the function of the main surface antigen, run through the peptidoglycan layer . It binds cations - Mg^{2+} and Ca^{2+}, which are necessary for the integrity of the wall and membrane. With few exceptions (mycobacteria, corynebacteria, nocardia), it does not contain lipids. It does not contain proteins, except for streptococcus, in which there is a polysaccharide layer between the peptidoglycan and the protein layer and thus forms a microcapsule.

Gram staining bacteria with this cell wall stains crystal violet blue-violet.

Antibiotics: penicillin, cephalosporin. It acts on transpeptidases. It generally binds to PBP = *penicillin binding proteins*. The action results in inhibition of peptidoglycan synthesis.



Above: **Gram-positive bacteria** 1. cytoplasmic membrane, 2. peptidoglycan, 3. phospholipids, 4. membrane proteins, 5. lipoteichoic acid *Below:* **Gram-negative bacteria** 1. cytoplasmic membrane (inner membrane), 2. periplasmic space, 3. outer membrane, 4. phospholipids, 5. peptidoglycan, 6. lipoprotein, 7. proteins, 8. lipopolysaccharides, 9. pore

Wall of gram-negative bacteria

Thinner than the G + wall approx. 15 nm. It consists of: the outer membrane, and the periplasmic space in which a thin layer of peptidoglycan is deposited. The outer membrane consists of a bilayer of phospholipids and proteins. It is attached to the peptidoglycan via lipoproteins. The function of proteins embedded in the membrane is the transport of nutrients into the periplasmic space (see below).

Lipopolysaccharide molecules are present on the outside of the membrane, which are composed of 3 parts:

- lipid A = bacterial endotoxin;
- basic polysaccharide (R-core);
- specific polysaccharide (O-antigen) - linear, carrier of bacterial antigenicity (O-antigen). Antibodies act on the long protruding chains, thus protecting the bacteria and causing virulence (loss of specific polysaccharide = loss of virulence). Provides defense against chemicals and the lytic effects of some substances.

There are excreted metabolites and enzymes in the periplasmic space (eg beta-lactamase, which cleaves penicillin → resistance).

Gram stain with bacteria with this cell wall turns pink.

Wall of acid-resistant bacteria

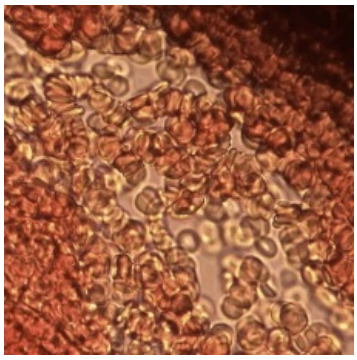
The structure of the cell wall corresponds to gram-positive bacteria. The amount of waxy substances prevents staining - they cannot be stained with normal Gram staining. They can be painted hot, but then resist discoloration.

Special Ziehl-Neelsen dyeing is most often used. *Mycobacterium tuberculosis*, partially nocardia and bacterial spores.

Links

Related articles

- Bacteria
- Prokaryote
- Peptidoglycan



Human Red Blood Cells

References

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- BEDNÁŘ, Marek, et al. *Medical microbiology: bacteriology, virology, parasitology.* 1st edition. Prague: Marvil, 1996. 558 pp. ISBN 8023802976 .