RAMA UNIVERSITY

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FACULTY OF ENGINEERING &TECHNOLOGY

DEPARTMENT OF BIOTECHNOLOGY

Cell wall

❖The cell wall of the bacterial cell is a complex, semi rigid structure that surrounds the cytoplasmic membrane and gives shape to the cell.

❖The major function of the cell wall is to prevent bacterial cells from rupturing when the water pressure inside the cell is greater than that outside the cell and serves as point of anchorage for flagella.

Composition and characteristics

❖The bacterial cell wall is composed of a macromolecular network called **peptidoglycan** (also known as *murein*), which is present either alone or in combination with other substances.

❖Peptidoglycan consists of a repeating disaccharide connected by polypeptides to form a lattice that surrounds and protects the entire cell.

❖The disaccharide portion is made up of monosaccharides called N-acetylglucosamine (NAG) and N-acetylmuramic acid (NAM) (from *murus*, meaning wall), which are related to glucose.

❖Alternating NAM and NAG molecules are linked in rows of 10 to 65 sugars to form a carbohydrate “backbone” (the glycan portion of peptidoglycan).

❖Adjacent rows are linked by **polypeptides** (the peptide portion of peptidoglycan). Although the structure of the polypeptide link varies, it always includes *tetrapeptide side chains*, which consist of four amino acids attached to NAMs in the backbone.

❖The amino acids occur in an alternating pattern of D and L forms.

❖This is unique because the amino acids found in other proteins are L forms.

❖The significance of D-amino acids are that they protects bacterial cell wall against attack by most peptidases.

❖ Parallel tetrapeptide side chains may be directly bonded to each other or linked by a *peptide cross-bridge*, consisting of a short chain of amino acids.

Gram Positive cell wall:

Gram positive bacterial cell walls have much greater amount of peptidoglycan than gram negative cell wall.

In most gram-positive bacteria, the cell wall consists of many layers of peptidoglycan, forming a thick, rigid structure whereas gram negative bacteria cell wall has thin peptidoglycan layer.

The space between the cell wall and plasma membrane of gram-positive bacteria is the periplasmic space.

It contains the granular layer, which is composed of lipoteichoic acid.

In addition, the cell walls of gram positive bacteria contain *teichoic acids*, which consist primarily of an alcohol (such as glycerol or ribitol) and phosphate.

Teichoic acid regulates movements of ions and protects cell wall from thermal injury.

Further Teichoic acids provide much of the wall's antigenic specificity and thus make it possible to identify gram-positive bacteria by certain laboratory tests.

Gram negative cell wall:

Gram negative bacterial cell wall is more complex than Gram Positive cell wall.

It is consists of one or a very few layers of peptidoglycan and an outer membrane that surrounds the thin underlying layer of peptidoglycan.

The peptidoglycan is bonded to lipoproteins in the outer membrane and is in the *periplasm*, a gel-like fluid in the periplasmic space of gram negative bacteria, the region between the outer membrane and the plasma membrane.

The periplasm contains a high concentration of degradative enzymes and transport proteins.

Gram-negative cell walls do not contain teichoic acids.

Because the cell walls of gram negative bacteria contain only a small amount of peptidoglycan, they are more susceptible to mechanical breakage.

The outer membrane also serves as barriers to various external enzymes that may damage bacterial cell wall.

❖The *outer membrane* of the gram-negative cell consists of lipopolysaccharides (LPS), lipoproteins, and phospholipid.

❖ The outer membrane has several specialized functions.

❖Its strong negative charge is an important factor in evading phagocytosis and the actions of complement (lyses cells and promotes phagocytosis), two components of the defenses of the host.

❖The outer membrane also provides a barrier to detergents, heavy metals, bile salts, certain dyes, antibiotics (for example, penicillin), and digestive enzymes such as lysozyme.

The **lipopolysaccharide (LPS)** of the outer membrane is a large, complex molecule that contains lipids and carbohydrates and consists of three components:
(1) lipid A,
(2) a core polysaccharide, and
(3) an O polysaccharide.

Lipid A is the lipid portion of the LPS and is embedded in the top layer of the outer membrane. Lipid A functions as endotoxins and is responsible for symptoms shown by gram negative bacteria.

The **core polysaccharide** is attached to lipid A and contains unusual sugars. Its role is structural—to provide stability. T

he **O polysaccharide** extends outward from the core polysaccharide and is composed of sugar molecules. The O polysaccharide functions as an antigen and is useful for distinguishing serovars of gram-negative bacteria. The bacterial cell wall also showed presence of special channels for passage of small molecules, such as nucleotides, oligosaccharide, mono saccharides, and amino acids but restricts the passage of larger molecules. These channels are formed from special proteins called porins, and span the whole membrane.

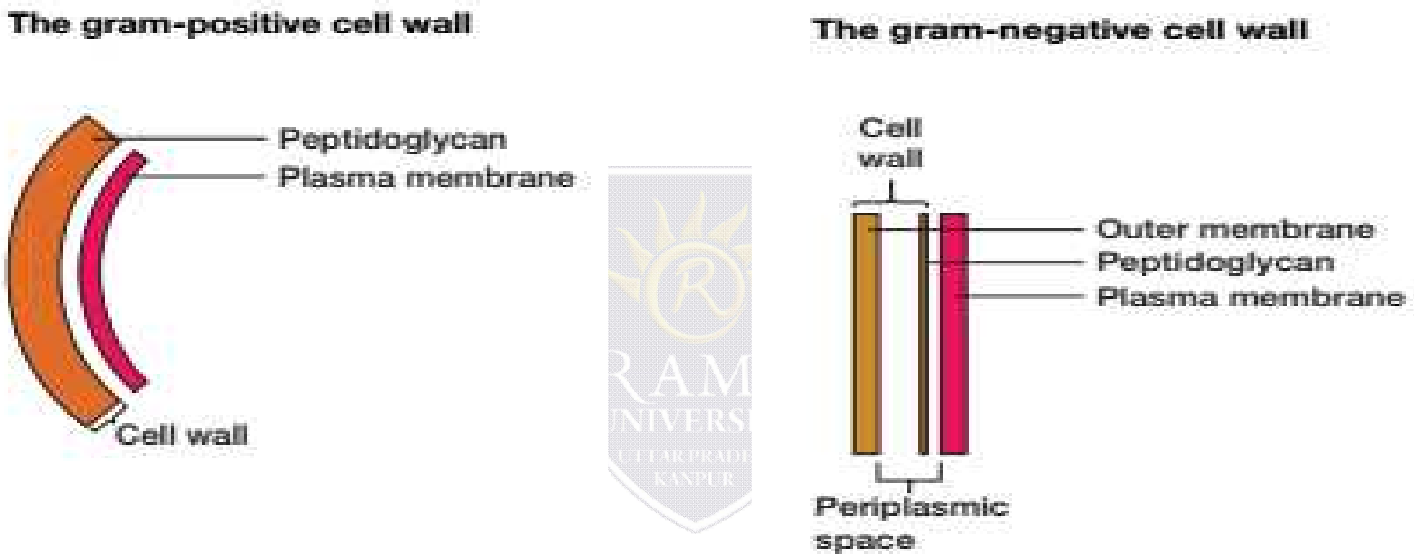

Figure : Gram +ive cell wall and Gram −ive cell wall of bacteria

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