Peptidoglycan Encyclopedia Article

Peptidoglycan

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Peptidoglycan

Peptidoglycan is the skeleton of **bacteria**. Present in both Gram-positive and Gram-negative bacteria, the peptidoglycan is the rigid sac that enables the bacterium to maintain its shape.

This rigid layer is a network of two sugars that are cross-linked together by amino acid bridges. The sugars are N-acetyl glucosamine and N-acetyl muramic acid. The latter sugar is unique to the peptidoglycan, and is found no where else in nature.

The peptidoglycan in Gram-negative bacteria is only a single layer thick, and appears somewhat like the criss-cross network of strings on a tennis racket. The layer lies between the two membranes that are part of the cell wall of Gram-negative bacteria, and comprises only about twenty percent of the weight of the cell wall. In Gram-positive bacteria, the peptidoglycan is much thicker, some 40 sugars thick, comprising up to ninety percent of the weight of the cell wall. The cross bridging is three-dimensional in this network. The peptidoglycan layer is external to the single membrane, and together they comprise the cell wall of Gram-positive bacteria.

Research has demonstrated that the growth of the peptidoglycan occurs at sites all over a bacterium, rather than at a single site. Newly made peptidoglycan must be inserted into the existing network in such a way that the strength of the peptidoglycan sheet is maintained. Otherwise, the inner and outer pressures acting on the bacterium would burst the cell. This problem can be thought of as similar to trying to incorporate material into an inflated balloon without bursting the balloon. This delicate process is accomplished by the coordinate action of **enzymes** that snip open the peptidoglycan, insert new material, and bind the old and new regions together. This process is also coordinated with the rate of **bacterial growth**. The faster a bacterium is growing, the more quickly peptidoglycan is made and the faster the peptidoglycan sac is enlarged.

Certain **antibiotics** can inhibit the growth and proper linkage of peptidoglycan. An example is the beta-lactam class of antibiotics (such as **penicillin**). Also, the enzyme called lysozyme, which is found in the saliva and the tears of humans, attacks peptidoglycan by breaking the connection between the sugar molecules. This activity is one of the important bacterial defense mechanisms of the human body.