

Opinion Article

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The Features and Cell Division of Mycobacterium Tuberculosis

Xang Chen*

Department of Cell Biology, Lanzhou University, Lanzhou, China

*Corresponding Author: Xang Chen, Department of Cell Biology, Lanzhou University, Lanzhou, China; E-mail: chen23@xang.cn

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Description

Cell division is a fundamental process that allows organisms to grow and reproduce. Among the diverse organisms in the microbial world, mycobacteria, a group of bacteria that includes the notorious Mycobacterium tuberculosis, possess a unique and complex mechanism of cell division. This study will delve into the intricacies of mycobacterial cell division.

Features of mycobacteria

Mycobacteria stand out among other bacteria due to their distinctive features. These rod-shaped bacteria possess a unique cell wall structure composed of a thick, lipid-rich layer called the mycolic acid layer. The presence of this complex cell wall poses challenges for cell division. Unlike most bacteria that divide through binary fission, mycobacteria employ a more complex process called polar growth, where cell elongation occurs at the poles rather than in the middle of the cell.

The two main pathogenic species of the genus Mycobacterium, M. tuberculosis and *M. leprae*, respectively, are the causes of two of the oldest diseases in the world: tuberculosis and leprosy. One-third of the world's population is considered to be latently infected with M. tuberculosis, which kills about two million people annually. Its capacity to produce dormant inside a person for decades before reactivating into active tuberculosis is one of the nonsporulating M. tuberculosis' most impressive traits. Controlling cell division is therefore an essential component of the illness.

Initiation of cell division

A conventional plasma membrane made of lipid and protein surrounds a complicated cell wall made of glucose and lipid in the mycobacterial cell envelope. A "capsule" layer surrounds the cell wall in pathogenic organisms like Mycobacterium TB.

The initiation of mycobacterial cell division involves the formation of a septum, a transverse wall that divides the cell into two daughter cells. This process begins with the assembly of a protein complex known as the divisome at the future site of cell division. The divisome consists of various proteins, including FtsZ, a tubulin-like protein that forms a ring-like structure, and FtsI, an enzyme involved in cell wall synthesis.

Assembly of the divisome

The assembly of the divisome is a highly regulated and coordinated process. FtsZ proteins polymerize and form a ring structure, known as the Z-ring, at the site of cell division. The Z-ring serves as a scaffold for recruiting other divisome proteins, such as FtsI and FtsW, which are involved in cell wall synthesis. The mycobacterial divisome also contains additional proteins, including FtsK, FtsQ, and FtsE, which aid in the proper formation and functioning of the divisome complex.

Cell wall remodeling

One of the unique challenges of mycobacterial cell division is the presence of the mycolic acid layer in the cell wall. During cell division, mycobacteria must remodel their complex cell wall to allow for septum formation and the subsequent separation of daughter cells. Enzymes involved in cell wall synthesis, such as FtsI and FtsW, play a crucial role in this process. They coordinate the synthesis and remodeling of the peptidoglycan layer, allowing the cell to divide while maintaining the integrity of the mycolic acid layer.

Regulation and coordination

The process of mycobacterial cell division is tightly regulated to ensure accurate and synchronized division. Regulatory proteins, such as DivL, DivK, and DivJ, control the formation and activity of the divisome complex. These proteins sense environmental cues and coordinate the timing of cell division, ensuring that it occurs under optimal conditions. Additionally, the cell cycle of mycobacteria is coordinated with DNA replication and segregation to maintain genome integrity during division.

Conclusion

The cell division process in mycobacteria is a fascinating and complex phenomenon. Understanding the unique mechanisms employed by these bacteria can provide valuable insights into their pathogenicity and potentially lead to the development of novel therapeutic strategies to combat mycobacterial infections, including tuberculosis. Further research in this area is necessary to know the complexities of mycobacterial cell division fully and to discover potential targets for intervention in the fight against these formidable pathogens.

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