Bacillus megaterium

Description and significance

Bacillus megaterium is a Gram-positive, rod shaped Endospore-forming Bacteria. It is considered Aerobic, but, it is also capable of growing under anaerobic conditions when necessary. One of the largest Eubacteria found in soil, and hence the name "mega" means "relatively big" is a common soil saprophyte. A saprophyte is an organism, especially a fungus or bacterium, that lives on and gets its nourishment from dead organisms or decaying organic material. Saprophytes recycle organic material in the soil, breaking it down into in simpler compounds that can be taken up by other organisms. Bacillus Megaterium are also found in chains where the cells are joined together by polysaccharides on the cell walls and synthesizes a capsule composed of both polypeptide and polysaccharide. Bacillus Megaterium is also able to survive in extreme conditions such as desert environments due to the spores it forms.

Genome structure

Bacillus megaterium has been studied since the 1940's because it was one of the only species to have 100% of a culture sporulate as well as the ability to germinate at the same rate. It is about two times greater in volume compared to that of an E. coli. The larger size has allowed several proteins to be successfully studied, along with further membrane research. Such research include that of Cell division, DNA-protein, protein-protein and protein-RNA interactions, protein transport, secretion, and recycling. The size comparison to most other Bacilli would be very interesting to study from a Genomic perspective.

Here is an image showing us the structure of a Bacillus Megaterium:

The single strain has been used for many studies on various aspects of spore physiology and cell wall structure. Some of the uses in the environmental and industrial applications are:

* glucose dehydrogenase
* penicillin aminidase
* vitamin B12
* oxetanocin
* P450 cytochromes
* biodegradation enzymes

Here is an image showing us the different uses/ advances for our environmental and industrials needs:

Cell structure and metabolism

Bacillus Megaterium is a prokaryotic cell, lacking membrane-bound organelles. It is a Gram-positive, rod-shaped and found with other bacillus megaterium organisms. It is motile, with the use of its flagella. The cell wall, has large amounts of peptidoglycan. The flow of energy in cellular respiration is considered aerobic, but may undergo anaerobic conditions. They are like most Gram-positive bacteria, that have the surface of Bacillus Megaterium, which is complex and is combined with their properties of resistance in extreme conditions, due to formation of spores. The cell surface is a laminated structure that consists of a capsule, a proteinaceous surface layer (S-layer), several layers of peptidoglycan sheeting, and the proteins on the outer surface of the plasma membrane. Also, plasmid content and cloning such as connecting many plasmids, rolling circle vectors that are stable, and efficient for secretion, and lacking extracellular alkaline proteases. However, large plasmids may be involved in horizontal gene transfer, such as integrase, recombinase, transposases, mobilization, and relaxase genes.

Ecology

Due to the resistance of their endospores to environmental stress, as well as their long-term survival under adverse conditions, most aerobic sporeformers can be isolated from a wide variety of sources. In the soil environment the bacteria become metabolically-active when substrates for their growth are available, and form spores when their nutrients become exhausted. This is a strategy used by other microbes in the soil habitat, including the filamentous fungi and the actinomycetes, which also predominate in the aerobic soil habitat. These groups of microbes live in the soil, and produce antibiotics in association with their sporulation processes. Since many endospore forming species can effectively degrade a series of biopolymers (proteins, starch, pectin), they are assumed to play a significant role in the biological cycles of carbon and nitrogen. From soil, by direct contact or air-borne dust, endospores can contaminate just about anything that is not maintained in a sterile environment. They may play a big role in whatever they contaminate, and they may be agents of unwanted decomposition and decay.

-Endospores- Endospores have proven to be the most durable type of cell found in nature, and in their cryptobiotic state. Cryptobiotic is a state where mature spores have no detectable metabolism and remain viable for extremely long periods of time. Endospores are formed by vegetative cells in response to environmental signals that indicate a limiting factor for vegetative growth. They germinate and become vegetative cells when the environmental stress is relieved. Endospore-formation is a mechanism of survival rather than a mechanism of reproduction.

-Ecophysiological Groups- An artificial, and convenient way to organize aerobic spore-formers for this purpose is to place them into Ecophysiological groups. The two groups that

Bacillus Megaterium fall into are:**Psychrophiles or psychrotrophs:** two species will grow and form spores at 0oC **and Pathogens of Animals:** which have been occasionally isolated from human infections. According to human health, Bacillus Megaterium is considered non-pathogenic.

Pathology

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Application to Biotechnology

There is an example of a special compound produced by Bacillus Megaterium, which is known as amylases. These have been found in many species of bacteria, streptomyces, yeasts, and moulds. There are many species that appear to be active in bacteria, and one of them is b-amylase for bacillus megaterium.

Current Research

There are many research being done on Bacillus Megaterium, all around the world, in the United States, Europe, and many parts of Asia. I have found a few recent and current research being done on this organism.

a) **Heat-stable toxin production by strains of Bacillus megaterium:**

Department of Biological and Biomedical Sciences, School of Life Sciences, Glasgow Caledonian University, Cowcaddens Road, Glasgow, Scotland G4 0BA, UK

-This experiment is done by combining different strains of Bacillus Megaterium, and to study the development of high levels of toxicity. Bacillus megaterium is one of those organisms, out of a few in the bacillus group that produce high levels of toxicity.

b) **Effect of different carbon sources on central metabolic fluxes and the recombinant production of a hydrolase from Thermobifida** fusca in Bacillus megaterium:

Technical University Braunschweig/HZI-Helmholtz Zentrum for Infektionsforschung, Institute of Biochemical Engineering, Inhoffenstrasse 7, D-38124 Braunschweig, Germany

- This research is conducted by Thermobifida fusca(TFH) which was detected for glucose-dependent growth. Also, the pyruvate was identified as a great condition for production and secretion of recombinant TFH using B. megaterium as production host.

c)**Distribution of Bacillus megaterium plasmids among other Bacillus megaterium strains and Bacillus species**:

- Since bacillus megaterium is considered non-pathogenic, researchers are also looking into the further study of bacillus megaterium combined with other strains of bacillus megaterium, and appearing from the data that even though some plasmids carry genes suggesting horizontal transfer, their replicons seem to be unique to Bacillus megaterium, and each carry a unique sequence and trait of its strains.