GOLD NUGGET

Prokaryota – Bacteria

Proteobacteria

Proteobacteria is the largest and most diverse bacterial phylum. It contains about 30 % of the total number of bacterial species. Proteobacteria comes from the name of the Greek god *Proteus*, which could take various forms, thus reflecting the enormous diversity of morphological and physiological characteristics observed in this bacterial phylum. Proteobacteria comprises the majority of Gram-negative bacteria of medical (e.g. *Helicobacter*), veterinary (e.g. *Acinetobacter*), industrial (e.g. *Campylobacter*) and agricultural interest (e.g. *Bradyrhizobium*). It also comprises bacteria involved in carbon, sulphur and nitrogen cycles (including N2 fixers), phototrophic (i.e. organisms that obtain energy from light) and non-phototrophic, aerobic and anaerobic bacteria.

Firmicutes

The most representative genera in Firmicutes are *Bacillus* and *Clostridium*, which are obligate and facultative anaerobic bacteria, respectively. These genera include important species of human and animal pathogens that produce resistant cell structures called endospores. Spores tolerate different types of stresses. For example, they are more resistant to heat than normal cells by a factor greater or equal to 105. Furthermore, they are 100 times or more resistant to ultraviolet radiation, and more tolerant to drought, antibiotics and disinfectants. Most *Bacillus* species, such as *B. cereus*, which causes contamination of food, are soil inhabitants. Due to their pathogenicity on some soil insects, some *Bacillus* species, including *B. popilliae*, *B. lentimorbus* and *B. thuringiensis*, have been successfully used in agriculture to control pests. *Bacillus* may also be dangerous: *Bacillus anthracis* is considered the most lethal biological weapon for human beings because it is the origin of anthrax. Another Firmicute genus, *Paenibacillus*, includes important soil-living nitrogen fixers. Nitrogen-fixing bacteria are also present in both *Bacillus* and *Clostridium* genera.

Endospores, what are they?

• Endospores can survive environmental assaults that would normally kill the bacterium. These stresses include high temperatures, high UV irradiation, desiccation and chemical damages. The extraordinary resistance properties of endospores make them of particular importance because they are not readily killed by many antimicrobial treatments.
• When favoured nutrients are exhausted, some Gram-positive bacteria may develop an extreme survival strategy: the formation of endospores.
• This complex development allows the bacterium to produce a highly resistant cell to preserve the cell's genetic material in times of extreme stress.
• The resilience of an endospore can be explained in part by its unique cellular structure. The outer coat surrounding the spore provides much of the chemical resistance. Beneath the coat there is a very thick layer called the cortex. Proper cortex formation is needed for dehydration of the spore core, which aids in resistance to high temperature. A germ cell wall is found under the cortex. This layer will become the cell wall of the bacterium after the endospore germinates. The inner membrane, under the germ cell wall, is a major permeability barrier against several potentially damaging chemicals. The centre of the endospore, the core, exists in a very dehydrated state and houses the cell's DNA.
• The process of forming an endospore is complex and requires several hours to complete.

Bacteria as workers

• Many compounds are produced in large amounts by bacteria to be used for various purposes in industry and medicine. They can be a part of silk, cotton and rubber manufacturing. Bacteria also synthesise certain antibiotics, such as bacitracin and polymyxin.
• Bacteria are able to degrade complex compounds. For example, they break down the woody and tough tissues of jute, coconut, hemp and flax. They can also degrade hydrocarbons and clean up oil spills.

Farming Secrets says: Bacteria Can Be Both Useful and Damaging.

Ref: *Global Soil Biodiversity Atlas p**34***