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Review Article

Bacteria

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Abstract

Bacteria are common microorganisms that live in a variety of settings and are essential to both human health and world ecosystems. Bacteria are prokaryotic organisms with a diverse range of morphological, metabolic, and ecological features. They lack a well-defined nucleus. Their cellular features such as membranes, cell walls, and different appendages—allow them to adapt to a variety of environments, including soil, water, and the human body. Bacteria are the biological engines that propel vital functions including nitrogen fixation, nutrition cycling, and biodegradation. These functions keep ecological balance and sustain life forms in both land and aquatic environments. As part of the microbiome, helpful bacteria support immunity and digestion in human health, while pathogenic species like Staphylococcus aureus and Salmonella highlight their capacity to cause infectious diseases that can range in severity from moderate to severe. Beyond their significance to medicine and the environment, bacteria find broad applications in biotechnology, driving innovations in fermentation, bioremediation, and pharmaceutical production. However, the emergence of antibiotic-resistant bacteria poses a formidable challenge that requires concerted efforts in antibiotic stewardship and new therapeutic strategies. This overview illuminates the multifaceted functions of bacteria and highlights their profound impact on ecosystems, human health, and industrial processes.

Keywords: prokaryote of bacteria; metabolism of bacteria; antibiotic resistance of bacteria; cell wall of bacteria

Introduction:

Almost every type of ecosystem on Earth has large colonies of bacteria, a class of microscopic single-celled organisms that can be found in the surface, deep marine vents, and human digestive systems (Gautam et al.,2023). Bacteria belong to the prokaryotes class of single-celled organisms since they lack a membrane-enclosed nucleus and other internal characteristics. Because they have been on Earth for perhaps three-quarters of its history and because they can adapt to almost any available biological environment, prokaryotes are the most common living species (Gerald et al.,2015). They can generally consume almost any organic material as well as certain inorganic ones, and they have a remarkably varied metabolic capability. The majority of germs are benign and helpful to the environment, supporting higher forms of life through their metabolic processes, even though some bacteria can cause sickness in humans, animals, or plants. Some bacteria live in symbiotic relationships with plants and invertebrates, performing vital tasks for their hosts like breaking down cellulose and fixing nitrogen (Campbell et al.,2019). Lack of prokaryotes would result in less fertile soil and a slower rate of organic matter breakdown. Many chemicals, medications, and food preparation processes contain some microbes (Gurung et al.,2013). Research on the relationships among different taxa of bacteria continues to provide new understandings of the processes behind evolution and the beginnings of life on Earth. One of two main cell types makes up all life on Earth: prokaryotic cells, which have their genetic material integrated

into the cell membrane, or eukaryotic cells, which have their genetic material enclosed in a nuclear membrane. All prokaryotic cells belonged to the prokaryotic kingdom Monera, which was formerly known as bacteria. However, the classification of prokaryotic cells as Monera, which is classified under the same taxonomy as the other kingdoms, inflated their great genetic and metabolic diversity when compared to eukaryotic cells. Differentiating between prokaryotic (bacteria and archaea) and eukaryotic (other kinds of life) cells is a basic difference (Staley et al.,2017). Prokaryotic cells are distinguished by their significantly simpler architecture in contrast to eukaryotic cells. What distinguishes eukaryotic cells from other types is that they lack internal organelles, which make them simpler. Located in the cytoplasm, organelles are discrete entities encircled by membranes. The nucleus stores, replicates, and expresses genetic information. The mitochondria and chloroplasts transform light or chemical energy into metabolic energy. The lysosome breaks down ingested proteins and releases other nutrients. The endoplasmic reticulum and Golgi apparatus assemble, modify, and export the proteins that the cell synthesizes and releases All of the tasks carried out by organelles are also completed by bacteria, albeit without the assistance of specific structures. Prokaryotic cells are also often somewhat smaller than eukaryotic ones. Bacteria can grow and divide swiftly, are small, have a straightforward structure, and engage in a variety of metabolic processes. Additionally, they adapt to practically any habitat. Other differences between prokaryotic and eukaryotic cells include their lipid content, the structure of important metabolic enzymes, how they react to toxins and antibiotics, and how their genes are expressed. Several linear chromosomes in eukaryotic organisms contain genes that are substantially larger than those needed to code for the synthesis of proteins. After the genetic information (deoxyribonucleic acid, or DNA) is translated into protein, the messenger RNA (mRNA) that is left over is drastically changed, and major portions of the RNA copy of the genetic information are lost. In contrast, bacteria have a single circular chromosome that contains all of their genetic material, and the mRNAs in them are exact replicas of their genes (Dorman et al.,2020)

Prokaryote of bacteria

Prokaryotes are unicellular organisms that belong to the kingdoms of Bacteria and Archaea. Prokaryotic cells lack organelles and have a lower size than eukaryotic cells. They also lack a nucleus. Every prokaryotic cell is enveloped and shielded by its cell wall (Koonin et al.,2008)

Metabolism of bacteria

Bacteria get their energy from carbohydrates. They store this energy as ATP and use it for anaerobic fermentation or aerobic glucose oxidation. Both anabolic and catabolic intracellular processes are a part of bacterial metabolism (Fulco et al.,1983)

Antibiotic Resistance of bacteria

Bacteria that are resistant to drugs can neither be controlled nor eradicated. Under the influence of an antibiotic, they can endure and even proliferate. Most pathogenic bacteria have the ability to develop resistance to at least some drugs. (Martinez et al.,2014)

Cell Wall of bacteria

Peptidoglycan, commonly known as murein, is the substance that makes up bacterial cell walls. It is composed of polysaccharide chains that have been cross-linked by peculiar peptides that include D-amino acids. (Seltmann et al.,2002)

Conclusion

Bacteria are ubiquitous and diverse organisms that are found throughout the entire earth, from the highest mountains to the lowest ocean depths. Its enormous influence on human health and the planet's ecosystems belies its minuscule size. Bacteria are vital to the balance of nature because they recycle nutrients and act as decomposers. They substantially shape the environment by facilitating activities ranging from digestion to nitrogen fixation in symbiosis with plants and animals. Bacteria are essential to biotechnology because they generate enzymes, antibiotics, and genetic models in addition to their ecological roles.

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