

## BACTERIA: THE POWERFUL CREATURES: A MINI REVIEW

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**Abstract:** *Bacteria through evolution suffered a lot and therefore they have adopted for their survival to live in extreme environmental conditions. From Free living to they became commensal, symbiotic, parasitic and pathogenic too. During their adaptation their properties also change, some are extremely beneficial to other organisms in various ways. But some became hostile to mankind. With the development of data storing knowledge in DNA, bacterial DNA was also used for this purpose and now we are in the era of making Biocomputers using bacteria as a source for storing information.*

**Key words:** Bacteria

### INTRODUCTION

Bacteria are minute organisms that are found in almost every ecosystem on earth as free living, and can also associate with other groups of living things [1]. They can either be harmless and necessary in biological processes of the host, or they can be highly dangerous. Over the period, due to evolutionary constrains, gene mutations, changes in micro- and mega- environment bacteria change their morphological features and now they are found in various shapes and sizes. Some scientists even conjecture their presence on other planets and even in space because of their property that they can grow at high temperature without even photosynthesis [2,3].

Bacteria are the best example to adapt and survive in hostile environment [4]. The only living creatures, those extend life at upper and lower limits of temperature. In addition to temperature they can tolerate elevated hydrostatic pressures too [5,6].

Unlike other organisms, bacteria are a little more sophisticated in the fact that they can actually manufacture their own food like plants, but they are quite different than plants [3].

Skin micro-organisms also produce compounds that influence animal physiology, such as in traspecific behaviour modifying pheromones [8] and volatile organic compounds that contribute to body odour. All external surfaces are loaded with millions of bacteria including human skin. On the surfaces where they get favourable conditions and enough nutrition different types of bacteria grow in forms of colonies. Generally bacteria are free living, but due various requirements and associations they adopted to commensalism or mutualitism. The friendly bacteria which are residing on skin or hair do not allow the pathogenic bacteria to make their home, thus preventing the trouble to the host; this is the best example of commensalism [7-11].

They live in human and many other organism's body;

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on surface as well inside the internal organs. 30% people suffer from the infection with *Staphylococcus aureus*. In some people, it is a part of the normal group of bacteria that inhabit the body and may be found in areas such as the skin and the nasal cavities. MRSA strain of *Staphylococcus aureus* is deadly pathogenic. They infect human skin and blood cells, and are responsible for brain and heart diseases too. For their iron requirement they infect RBCs and produce haemolysis [12].

**Responsible for heart disease:** Staph bacteria prefer human blood over that of animal blood. These bacteria favour the iron which is contained within the oxygen-carrying protein haemoglobin found within red blood cells. They are responsible for lysing the RBCs; thus, they cause low haemoglobin counts. *Staphylococcus aureus* bacteria break open blood cells to obtain the iron within the cells. It is believed that genetic variations in haemoglobin may make some human haemoglobin more desirable to staph bacteria than others.

A large number of bacteria reside in the gums of a human mouth and causes the most common form of gingivitis, inflammation of the gum tissue. Studies have shown that there is a close connexion amongst gum and heart diseases. Now researchers have found a specific link between the two that centres on stress proteins. These proteins are produced when cells experience various types of stressful conditions; bacteria on the attack by the human immune cells and immune cell produce stress proteins to eliminate foreign invasion.

The problem lies in the fact that the white blood cells cannot distinguish between stress proteins produced by bacteria, and those produced by the body. As a result, the immune system cells also attack the stress proteins that are produced by the body. It is this assault that causes a build-up of white blood cells in the arteries which leads to atherosclerosis. Atherosclerosis is a major contributor to heart disease and poor cardiovascular health [13].

**Acne fighting bacteria:** *Propionibacterium acnes* bacteria are found deep in the hair follicles and pores of the skin, where they usually cause no problems. However, if there is an over-production of sebaceous oil, they grow, producing enzymes that damage the skin and cause acne.

Researchers have discovered that some strains of acne bacteria may actually help to prevent acne. The bacterium, *Propionibacterium acnes*, that causes acne, dwells in the pores of the skin. When these bacteria induce an immune response, the area swells and produces acne bumps. Some strains of the acne bacteria however, have been found to be less likely to cause acne. These strains may be the reason why people with healthy skin rarely get acne.

While examining the genes of *Propionibacterium acnes* strains, gathered from people with acne and people with healthy skin, the researchers identified a strain that was common in those with clear skin and rare in the presence of acne. Future studies will include the attempt to develop a drug that only kills the acne producing strains of this bacteria [14].

### **Recently discovered some extra ordinary “works” done by certain types of bacteria**

**1. Neuron growth resulting in increased levels of serotonin:** Some soil bacteria stimulate brain neuron growth and increase learning capacity. Dorothy Matthews conducted interesting research using mice which were fed live the soil bacterium *Mycobacterium vaccae*. The results showed that bacteria fed mice were able to navigate amaze much faster and with less anxiety than the controlled group of mice who were not fed the bacteria. The study suggests that *M. vaccae* does play a role in the improved learning of new tasks and decreased levels of anxiety. So far the mechanism of this happening is not clear however, it is postulated that *Mycobacterium vaccae* is thought to increase learning by stimulating brain neuron growth resulting in increased levels of serotonin and decreased anxiety [15].

**2. Bacteria power machines:** *Bacillus subtilis* have the ability to turn very small gears. These when placed in a solution with the microgears, the bacteria swim into the spokes of the gears and cause them to turn in a specific direction in a coordinated way. It takes a few hundred bacteria working in unison to turn the gears.

It was also discovered that the bacteria can turn gears that are connected at the spokes, similar to the gears of a clock. These can bacteria control the speed of the gears by the amount of oxygen in the solution.

Decreasing the amount of oxygen caused the bacteria to slow down. Removing the oxygen caused them to stop moving completely [16], really intelligent enough.

**3. Rain-making bacteria:** Bacteria *Pseudomonas syringae* in the atmosphere may play role in the production of rain by precipitation of water vapours present in the atmosphere. This process begins as bacteria on plants are swept into the atmosphere by wind. As they rise higher, ice forms around them and they begin to grow larger. Once the frozen bacteria reach a certain threshold, the ice begins to melt and returns to the ground as rain. These bacteria produce a special protein in their cell membranes that allows them to bind water in a unique fashion that helps to promote ice crystal formation [17,18].

**4. Data can be stored in bacteria (Bio computers):** Imagine that tiny creatures being able to store data and sensitive information in their DNA! These microscopic organisms are most commonly known for causing disease, but scientists have managed to genetically engineer bacteria that can store encrypted data. The data is stored in bacterial DNA. Information such as text, images, music, and even video can be compressed and distributed between different bacterial cells. By mapping the bacterial DNA, scientists can easily locate and retrieve the information. One gram of bacteria is capable of storing the same amount of data as can be stored in 450 hard disks with 2,000 gigabytes of storage space each

Bacteria are good candidates for biostorage (Bio computers) because they replicate quickly, they have the capacity to store huge volumes of information, and they are resilient. Under optimal conditions, a single bacterial cell can produce as many as one hundred million bacteria in only one hour since they replicate by binary fission at an astounding rate. Considering this, data stored in bacteria could be copied millions of times ensuring the preservation of information. There are many advantages of Bio computers over conventional silico chip computers

1. Because bacteria are so small, they have the potential to store large quantities of information without taking up much space.
2. It has been estimated that 1 gram of bacteria contains around 10 million cells.
3. Bacteria are also resilient organisms. They can survive and adapt to changing environmental conditions [4].

4. Bacteria can survive extreme conditions, whereas hard drives and other computer storage devices cannot [19].

**5. Bacteria can identify any person:** Researchers from the University of Colorado at Boulder (USA) have shown that bacteria found on the skin can be used to identify individuals. The bacteria that reside on hands are unique to individuals. Even identical twins have unique skin bacteria. When we touch something, we leave behind our skin bacteria on the item. Through bacterial DNA analysis, specific bacteria on surfaces can be matched to the hands of the person from which they came. Because bacteria are unique and remain unchanged for several weeks, they can be used as a type of fingerprint [12].

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