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Production of antibiotics via Genetic engineering applications / A Review Article

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Abstract: Genetic engineering techniques are evolving, increasing the prospect of altering microorganisms to generate antibiotics more effectively. This article will showcase some of the successful implementations of these strategies, with a focus on the quantitative and qualitative gains in antibiotic production. It also discusses the obstacles facing this field and how to overcome them in order to create sustainable and effective antibiotic production, which has resulted in significant changes in many sectors of the modern economy, particularly agriculture and its dependent businesses. Industrial fermentation, the employment of free and bound enzymes and attracted

Objective of the article: The purpose of this article is to investigate how genetic engineering can be used to produce antibiotics from genetically engineered microorganisms. The focus will be on employing modern genetic engineering techniques to increase the efficiency and quality of antibiotic manufacture.

Conclusion: Genetic engineering has the potential to improve antibiotic production efficiency and quality. However, there are issues about biosafety and sustainability that must be addressed. These adjustments could assist address the growing demand for antibiotics while also providing options to battle bacterial resistance to existing antibiotics, as some genetic modifications may increase antibiotic stability and shelf life.

Keywords: Biotechnology; Genetic Engineering; Microbiology

Introduction

1.1 The stages of development of genetic engineering

For centuries, people have been able to alter the genes of living beings using modern technology, even without understanding the concepts of genes or DNA, by employing artificial or selective selection. This procedure involves the selection of males and females with desirable traits from living organisms, and then allowing them to mate in order to produce offspring that inherit these traits, by consistently using this method for many generations, they were able to demonstrate noticeable genetic

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alterations in certain types of living organisms. In 1869, Swiss biochemist Johannes Friedrich Miescher successfully extracted a substance containing nitrogen and phosphorus, which he called DNA. However, it wasn't until a later time that the purpose of DNA was understood, when in 1944, a team of researchers led by bacteriologist Oswald Avery successfully extracted DNA from one type of bacteria and introduced it into another type. The team observed that the second bacteria displayed some traits similar to the first bacteria. , DNA plays a crucial role in determining the traits and functions of living organisms. In 1953, James Watson and Francis Crick demonstrated that the DNA molecule has a double helix structure and they comprehended the process of its replication and its significance in cell division and growth. In 1973, Paul Berg, who is recognized as the pioneer of genetic engineering, successfully merged DNA molecules from the SV40 simian virus with those of the Lambda virus. Nevertheless, his approach was intricate and challenging[1] . That same year, researchers Stanley Cohen and Herbert Boyer identified an enzyme that could enhance Berg's technique, and they successfully conducted the initial process of creating a genetically modified organism. They achieved this by transferring a gene that provides antibiotic resistance from one bacteria strain to another, allowing it to also resist antibiotics. One year later, Rudolf Jaeni, a scientist [2].

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Genetic engineering experiments have sparked worries and apprehensions regarding their potential impacts on human health and the ecosystems of the Earth. In 1975, a conference was convened at Asilomar to explore the possible hazards of manipulated DNA. After three days of talks, the scientists involved reached a consensus to proceed with research on recombinant DNA, albeit with certain safety measures in place to safeguard the experiments[3]. They created a document outlining safety and containment guidelines to reduce the risks of every experiment, and stressed that the lead researcher in each lab was accountable for the safety of their team members. The document highlighted the significance of educating the scientific community about the crucial advancements that had been achieved. Due to the Asilomar Conference's success, government agencies worldwide backed the continuation of research, leading to the start of a new era in modern genetic modification. General Electric was granted a patent in 1980 for genetically modified bacteria that could effectively break down crude oil slicks, aiming to minimize the impact of oil spills. This prompted large companies to expedite the development of genetic engineering technology that had the potential to be both practical and lucrative[4]. The partnership between scientists and entrepreneurs has led to a major transformation in various fields, including agriculture. By 1988, over twenty types of genetically modified plants had been successfully tested by scientists, resulting in plants with specific traits such as resistance to freezing temperatures, longer maturation periods, and pest resistance. This collaboration has also led to numerous health-related applications and advancements in disease treatment. In 1990, the Human Genome Project was initiated by the Department of Energy in partnership with the National Institutes of Health (NIH) with the goal of identifying and understanding the specific structure of every human gene. Biotechnology merges practical methods for addressing technological issues with the creation of beneficial biological products. For millennia, this idea has been utilized, with animals and plants serving as sources of food, clothing, and medicines. Around seventy years ago, there was a shift in this concept as microorganisms began to be utilized for the production of antibiotics, enzymes, and serums[5]. After the detailed discovery of genetic material (DNA) in its fine components (chromosomes and genes), the concept of science was finally able to develop. Modern biotechnology relies on the analysis and manipulation of the genetic material of living organisms, known as genetic engineering, to extract and modify materials for production. Biotechnology encompasses the field of tissue culture science, where vessels containing genetic material are used to carry out specific functions[6]. The field of monoclonal antibodies is also involved and essential in the discovery and evaluation of the effectiveness of cell-based products. Bioengineering can be described as the discipline focused on utilizing biological systems, such as cells and enzymes, in the production of essential products and services. This can include using cellular structures or complete enzyme systems [7].The connection of biotechnology to other fields including biochemistry, genetics, biology, enzymology, physiology, economics, political systems, and analytical chemistry[8].

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Food science, management and marketing, chemical engineering, microbiology, and industrial microbiology. Biotechnology encompasses various areas, including plant biotechnology, animal cell technology, microbial biotechnology, and enzyme technology. Additionally, it can be divided based on the field of application, such as environmental or food biotechnology, due to its reliance on multiple types of living cells or biological systems. The biotechnology processes in various fields rely primarily on two types of biological reactions according [9]:
Initially: catabolic processes involve the breakdown of complex compounds into simpler units. These responses generate energy and have the potential to alter various characteristics of materials. These processes are frequently performed by enzymes that are released from the cells.
The second type of process involves the creation of large structural compounds from simple or small units, requiring energy expenditure. This can be either through structural or synthetic processes.
In natural conditions, these interactions take place within living systems in a harmonized way to maintain the continuity of the biological system.

Some of the serious consequences of misusing advanced technologies have had significant impacts on both human health and the environment. These include some of the most important negative effects :
• The pollution of the environment with harmful chemical pesticides poses a threat to the health and survival of both humans and animals, for example the contamination of water sources with DDT, and the pollution of rivers and lakes with chemical fertilizers.
• The appearance of highly hazardous environmental pollutants from certain chemicals used in the production of biological products and their derivatives, as well as the identification of some compounds used in the production and manufacturing of agricultural products as carcinogenic or causing genetic mutations.
• The decrease or disappearance of original genetic variations and strains is a result of exclusive dependence on derived variations and strains. This results in an irreplaceable loss of local genetic resources in developing countries, including Arab countries.
• The expansion of the resistance phenomenon to first-generation antibiotics in disease-causing microorganisms.
Furthermore, certain occurrences and developments in the latter part of the previous century have played a role in the growing fascination with biotechnology and the heightened focus on it as a source of inventive technological answers to significant challenges that impede human advancement or jeopardize its endurance. This has led to rapid advancements in biotechnology, the emergence of new diseases, and a greater understanding of the molecular foundations of numerous genetic and incurable illnesses.

1-2 Applications:

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Industrial fermentation occurs in a medium with bound water and no free water present. This type of fermentation originated in Japan and China thousands of years ago, and "koji fermentation" and soy sauce production were among the key solid-state fermentation processes that have been passed down through the generations. The production process has progressed from basic methods to advanced industrial technology, which is known for its high efficiency and consistent product quality. Solid-state fermentations have demonstrated their effectiveness and suitability for producing extracellular products due to their main positive features, which include according [10]:

• Reduced building investment costs due to a 30-50% decrease in the volume of the production medium compared to the liquid media used in the submerged cultures method.
• Decreasing the quantity of water needed in the production environment.
• A high amount of biological substances secreted from the cell.
• The minimal need for continuous stirring and agitation leads to low operating costs.
• Simple retrieval, purification, and management of the necessary products (Downstream Processes).

Avoid the requirement of extracting, filtering, and treating the production media needed for fermenting liquid media, and decrease the necessity of crushing or grinding the production medium (Size Reduction) during the process. The potential to use the meal method in open vessels such as trays, particularly at the semi-industrial or small industrial scale, without the need for fomenters. The solid waste from fermentation contains significant nutritional components and important elements, making it highly valuable in animal feed. If available, it is also recommended to utilize thermopiles microorganisms that thrive in temperatures between 65-50 degrees Celsius, as they offer considerable operational and economic benefits, including according [11]:

A-The high fermentation temperature reduces the risk of the production medium being contaminated by harmful microorganisms.
B-Reduced production expenses as fermenters do not need to be cooled during the production process.
C-The quick expansion of thermophilic microorganisms leads to a shortened production period and reduced overall costs.

The development of biotechnology over time can be broken down into various stages, starting from its beginning until the present day, such as according [12,13] :

The initial phase: This phase signifies the understanding of food fermentation by early civilizations like the Pharaohs, Sumerians, and Babylonians. They would combine old and fresh foods without knowledge or sealing the vessels, allowing the transformation process to occur naturally. This period continued into the seventeenth century, during which Antonie van Leeuwenhoek (1674) made the discovery of microorganisms, and also the revelation that the bodies of animals and plants are made up of tiny compartments known as cells, which serve as the fundamental building blocks of living organisms. In reality, these discoveries did not contribute to the advancement of biotechnology. The next phase

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brought about significant advancements in technology, including Pasteur's groundbreaking discovery between 1857 and 1876 of the impact of microorganisms on fermentation processes occurring without oxygen. This led to the growth of food industries reliant on fermentation, such as the creation of organic solvents (like ethanol) and the conversion of plant carbohydrates into chemicals. At the same time, the commercial production of the fungus Agaricus bisporus also took place. The third phase: This period began in the early 1900s and was distinguished by the widespread use of open-air biomanufacturing processes. Pollution was managed through careful handling of the manufacturing process and monitoring of environmental conditions, processes were developed, such as the production of animal feed and the conversion of yeast through alcoholic fermentation into glycerin. At that time, other fermentation industries also arose, which involved the manufacturing of lactic acid, acetic acid, as well as certain chemicals like acetone and butanol. In this time frame, certain enzymes were manufactured on a large scale, leading to the replacement of citrus fruit-based production of citric acid with fungal-based production. The fourth stage builds upon the information collected in the previous stages and addresses any issues that may have arisen during the process. The era was marked by the accidental discovery of antibiotics, as scientist Fleming stumbled upon penicillin in 1928. This era is known as the era of antibiotics because of the antibacterial substance produced by the mold Penicillium notatum. The development of penicillin was delayed until advances were made in other fields, because it could not be manufactured in non-sterile conditions. The wait persisted until around 1940, at which point the start of World War II created a high demand for penicillin to treat the injured, leading to a prosperous market for the drug. Understanding the sterilization techniques employed in penicillin production has provided insights into managing pure cultures, sterilizing media, and fermenters. This involves heating to a precise temperature for a specific duration, followed by cooling and the addition of vaccines while keeping the internal pressure in a positive state. above the surrounding pressure) in order to prevent any pollution. Furthermore, it became feasible to introduce sterile air and conduct mixing and stirring activities in closed fermenters under sterile conditions, which remains the preferred approach for large-scale production processes.

Stage Five: This stage dates back to around 60-70 years ago and was initially known as ethanol production or ethanol engineering. During this period, existing knowledge and technologies were utilized to produce ethanol from polysaccharides like starch. The previously mentioned production methods were followed by advances in continuous cultures and continuous fermentation, as well as the production of single-cell protein. This led to annual production of hundreds of thousands of tons using various raw materials like methanol and alkenes as a carbon source. However, production declined thereafter. During that time, there was a significant increase in the production of amino acids, including glutamic acid, which was produced in large quantities for use as flavoring or nutritional enhancers, and lysine, which was produced annually in large amounts to fortify foods that

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were deficient in it. When it comes to enzymes, their production was initially delayed because of their instability and the challenge of extracting them after production, as well as difficulties in providing them with coenzyme facilities. However, most of these issues have now been resolved. The major contributions and uses of biotechnology:
Each field of biotechnology encompasses a range of technologies, making the term biotechnologies more commonly used than biotechnology. The following presents the key technologies that have significant impact on biological applications according [14]:
Firstly, monoclonal antibodies: Due to their high level of expertise, they are able to accurately identify and detect important elements even in minute quantities. This makes their skills applicable in various fields such as identifying the difference between cancerous cells and healthy cells, recognizing and discovering environmental contaminants and identifying dangerous microorganisms in food.

Secondly, the use of tissue culture technology: The process involves the propagation and development of cells in controlled laboratory conditions, with various potential uses including:
• Instead of using animals directly, mammalian cells are utilized to assess the efficacy of drugs, leading to improved safety and precision, Cellular treatment, Creating medicinal plants from cells rather than using the actual plants and cultivating plant tissues in a controlled laboratory environment.
Thirdly: Cloning and reproduction: The product of the same number of molecules, cells, animals, and plants genetically, can be categorized into three types according [15]:
1- Molecular cloning is fundamental to molecular biology and is a crucial genetic engineering method for the advancement and creation of new genetic material. This modern technique is essential for all applications concerning the manipulation of recombinant genetic material, from fundamental research to the production of drugs.
2-Cellular cloning, just like monoclonal antibody research, is important and works well together with its predecessor. It's uses include: Propagation of plants through the cultivation of both genetically modified and natural tissues, and Creating drugs using human cells.
3- Cloning of animals: The attention received by Dolly has likely sparked interest in this topic, but its practical uses are more intricate and challenging than they may initially appear.
Fourth: Genetic modification: Genetic modification can occur through natural processes or human intervention, such as traditional breeding methods or modern biological techniques. This results in changes to the original genetic material. Previously, there were instances when mating and pollination occurred within the same species and gender. Currently, genetic modification is performed by either transferring genes from one species to another or by altering the genes of the same species. It has many uses: Manufacturing of drugs and vaccinations, Management of certain genetic disorders,

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Expanding agricultural output and cutting down expenses and Enhancing the nutritional value of food

Fifth: The engineering of proteins: This technology is grounded in the idea of genetic modification, with the goal of creating particular proteins or novel proteins that can be used for beneficial purposes, such as enzymes and biocatalysts.

1-3 Evolution and Regulations

Cells and enzymes that are confined within bioreactors and can be utilized repeatedly are referred to as immobilized cells and enzymes. In contrast, free cells and enzymes cannot be recovered or reused once the necessary biotransformation process is finished. Using sawdust to immobilize acetic acid bacteria cells is one of the oldest and earliest methods for utilizing immobilized cells in the manufacturing of biological products. In the 1970s, there was a significant advancement in using immobilized cells and enzymes instead of free enzymes, particularly in the production of high fructose syrup from corn in the United States. This involved converting glucose from the enzymatic breakdown of starch to fructose using the enzyme glucose isomerase. The main reasons for the significant shift towards adopting this technology are as follows according [16]:

• The catalyst's (enzyme or cell) high concentration at the site ensures efficient completion of the required conversions compared to the amount of the substance needed to be converted per unit volume (resulting in a higher reaction rate).

• The catalyst demonstrates excellent stability in response to changes in pH and temperature, providing flexibility to carry out necessary conversions while ensuring increased conversion rates. Additionally, it maintains speed and efficiency without any negative impact on the catalyst.

• Utilizing continuous conversion techniques rather than the batch method

• The capability to continuously utilize the attached cells and enzymes for over 1000 operating hours without the need for replacement.

• The primary techniques for immobilizing cells and enzymes such as covalent attachment to non-reactive and insoluble materials (such as glass, various forms of cellulose, chitin, collagen, and nylon and coordinating with alkaline earth metal oxides iron and copper.• Ionic attachment to ion exchange materials , adsorbent binding and retention in membranes and partially mature gels (such as calcium alginate alginic acid salts) [17].

The cells and enzymes that have been immobilized are introduced into bioreactors that are specifically designed to match the production line they will be a part of, and with a capacity that aligns with the other components of the line. The bioreactor may be in the shape of columns filled with cells or composed of stainless steel with bound enzymes, or it may include primary filters (rough filters) or fine filters (-Filters). Before being bound, the cells are destroyed using substances like acetone to bypass the specialized active transport mechanisms of the cell membranes and to stop the growth and reproduction processes that can hinder the effectiveness of the necessary bioconversion. Enzymes are utilized in their raw or partially refined state, and the use of extensively refined enzymes is restricted to analytical applications[18].

1-4 The Importance of Probiotics

Some types of bacteria cause most diseases that affect humans, animals, and plants, such as typhoid, tuberculosis, diphtheria, cholera, and tetanus. Among the plant diseases are bacterial wilt of cucurbits, cabbage root rot, and corn stalk rot and used in many industries, such as vinegar production, converting milk into yogurt using Lactobacillus acidophilus bacteria, butter production, some types of cheese, leather tanning, separating flax fibers, and extracting primitive starch from plant roots, there are types of bacteria in the digestive tract of camels and cattle that secrete an enzyme that helps digest cellulose, which is often found in the food of these animals[7].

Agricultural plant waste can be fermented by anaerobic bacteria to produce a type of animal feed known as silage and analyzing the bodies of dead creatures to feed on them, thus converting complex compounds into simple compounds that the plant benefits from to manufacture new food materials, thus ridding the environment of accumulated corpses, some species oxidize chemical compounds such as sulfur, iron or nitrogen bacteria such as cyanobacteria fix atmospheric nitrogen in the cells of the roots of bean and clover plants. The production of many medical compounds, including the production of vitamins B, K, insulin, interferon, lactic acid, and cellulose and protein digestive enzymes, and some species are used in biological control used to eliminate some living creatures that destroy human vital capabilities. Some types of organic bacteria produce toxic crystals accompanying spores that are used to eliminate many pathogenic insects that take these bacteria as food and ability to devour oil spills and feed on them, thus ridding the environment of oil pollution, especially in seas and oceans. The possibility of applying genetic engineering to genes in bacteria is now being studied to produce a strain that has the ability to convert oil residues and industrial waste into useful materials[19].

Many human, animal, and plant diseases, including typhoid, tuberculosis, diphtheria, cholera, and tetanus, are caused by certain types of bacteria. Bacterial wilt of cucurbits, cabbage root rot, and corn stalk rot are some examples of plant diseases. They are utilized in various sectors, including the manufacturing of vinegar, the transformation of milk into yogurt using Lactobacillus acidophilus bacteria, the production of butter, certain varieties of cheese, leather tanning, the separation of flax fibers, and the extraction of basic starch from plant roots. Some species also receive assistance in digesting food from them. For instance, within the digestive systems of camels and cattle, there are various kinds of bacteria that produce an enzyme aiding in the digestion of cellulose, a common component of their diet. Anaerobic bacteria can ferment agricultural plant waste to create silage, which is a type of animal feed. Some species of bacteria oxidize chemical compounds such as sulfur, iron, or nitrogen when they feed on the bodies of dead organisms[8]. This process converts complex compounds into simple compounds that plants benefit from in manufacturing new food materials, and also helps rid the environment of accumulated bodies. Cyanobacteria are responsible for converting nitrogen from the air into a form that can be used by bean and clover plants. They are also utilized in creating various medical substances, such as vitamins B and K, insulin, interferon, lactic acid, as well as enzymes for digesting cellulose and protein. Certain species are employed in biological control to eradicate organisms that cause harm to crucial human functions. Certain organic bacteria create harmful crystals connected to the bacteria that are ingested by disease-causing insects, ultimately eliminating them. Certain bacteria possess the capability to consume oil spills and use them as a source of nutrition, ultimately eliminating oil pollution from the environment, particularly in marine environments such as seas and oceans. Researchers are currently exploring the potential of using genetic engineering to modify genes in bacteria in order to create a strain capable of transforming oil and industrial waste into valuable resources. Certain bacteria have been categorized as probiotics and are considered to be microorganisms that, when administered in adequate amounts, promote the overall health of the host and restore a healthy balance of microorganisms in the digestive system. This can include lactic acid bacteria, other bacteria, or certain types of yeast that have been freeze-dried or are present in fermented foods. Scientists have outlined the following criteria for classifying live bacteria as therapeutic organisms according [14]:

A- The capacity of bacteria to successfully establish themselves in the host's intestines with a high level of survivability.

B-The bacteria need to be able to survive in the food throughout the preservation period following the production of the foods.

C- The therapeutic bacteria needs to come from humans.

Therapeutic bacteria are important because they can boost the body's immunity without causing an autoimmune response. They also help prevent the growth of other microorganisms that can stimulate the immune system, such as anaerobic bacteria, gram-positive cocci, and certain types of gram-negative bacteria, in the digestive system.The incorporation of probiotics, also known as beneficial bacterial additives, has become a crucial aspect of alternative medicine for treating digestive system ailments and enhancing the overall health and immune system of patients. According to current scientific and medical research, it is expected that beneficial bacteria will be utilized as food additives and will play a significant role in pharmaceutical products in the coming years[19].

Bacteria in the gut are essential for breaking down food and controlling the process of excretion. The colon contains approximately 400 different bacterial species, and bacteria constitute roughly 60% of the solid material found in feces. Not having enough gut bacteria can lead to either constipation or diarrhea. Healthy bacteria are essential for maintaining physical fitness and lowering the chances of developing obesity. A study conducted at Lund University in Sweden discovered that mice who were given beneficial probiotic bacteria were able to maintain healthy gut bacteria and gained much less weight than the other mice in the study who did not receive these bacteria and therefore did not develop strong bacteria. It is important to mention that both sets of mice were fed the same high-calorie

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diet, with the only variation being in their gut bacteria. Antibiotics result in the removal of gut bacteria. Antibiotics are effective at eliminating both harmful and beneficial bacteria. Research shows that individuals who take antibiotics have a 74% decrease in the production of vitamin K compared to those who do not take antibiotics, as the beneficial bacteria are killed by the antibiotics. It is crucial to avoid taking antibiotics unless absolutely necessary and after seeking advice from a physician. Using antibiotics randomly, excessively, or repeatedly can deplete the natural flora in the intestines, and consuming meat and dairy products that may contain antibiotic residues from animals can also weaken the body's flora. A deficiency in intestinal flora can lead to a range of symptoms, including gas, bloating, indigestion, diarrhea, constipation, susceptibility to infections, fatigue, and exhaustion. It is important to keep a healthy balance of bacteria in the intestines. It is suggested to regularly consume yogurt that contains live beneficial probiotic bacteria like Bio or Activia, as this can help maintain a strong intestinal flora, especially after finishing a round of antibiotics[10].

1-5 The therapeutic and nutritional significance of Lactobacillus bacteria (LAB)

Research has demonstrated that Lb has a noticeable inhibitory effect. The acidophilus bacteria strains are effective in combating intestinal pathogens and spore-forming bacteria. According to reports, drinking certain amounts of milk can help manage diarrhea caused by antibiotics, and it can also lessen the severity and frequency of travelers' diarrhea that is not treated with antibiotics[7].

The presence of LAB bacteria in the human digestive system prevents pathogens from attaching to the villi, providing protection against infectious diseases such as acute diarrhea in children caused by viruses like rotavirus, the peptides produced through fermentation by LAB bacteria can promote the development and maturation of immune cells crucial for the host's defense against bacteria that cause intestinal illnesses, therefore enhancing the host's immune response, that having LAB bacteria in the intestines can decrease the absorption of cancer-causing substances and stop the development of tumors by triggering the immune system. Research has shown that drinking milk regularly leads to the breakdown of the walls of the cells in the intestine, releasing vitamins and growth factors that support the natural growth and development of lactic acid bacteria like Lb. acidophilus[2].

Lactic acid bacteria have been employed for preserving food and enhancing its taste from a nutritional standpoint. This is because they act as a natural preservative by preventing the growth and survival of harmful microorganisms and food spoilage organisms that might be found in the raw ingredients. Lactic acid bacteria are utilized as a starter in fermented meats and dairy items, and they can also be employed in pickling processes for cucumbers, lettuce, and green olives in order to reduce the bitter taste in olives by breaking down the compounds that cause bitterness[4].

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The importance of Escherichia coli bacteria in colon health and nutrition. with biology is aware that a well-studied type of gut bacteria, known as (K12), has been the focus of numerous groundbreaking discoveries and Nobel Prize-winning research in genetics and other scientific fields. E. coli is essential for research labs and medical microbiology because of its easy handling. The bacteria are abundant in our intestines and offer numerous benefits, the most significant being: Intestinal bacteria generate antioxidants and a range of organic acids that help maintain the proper physiological conditions in the intestines, thereby controlling the regular elimination of waste from the body. These bacteria play a crucial role in digestion by utilizing nutrients from food and removing harmful and involved in the production of vitamin K in the intestines, which is crucial for blood clotting and part of vitamin B12. Protection against various bacterial diseases is achieved by outcompeting pathogenic bacteria like Salmonella, which leads to diarrhea and typhoid, and Shigella, which causes dysentery (bloody diarrhea). Genetic engineers have incorporated numerous human genetic factors (genes) into bacteria, transforming them into facilities that generate numerous beneficial medical products. The most significant of these are human insulin, which is essential for diabetics, interferon used in the treatment of hepatitis B and C, growth hormone, and various types of human antibodies used in different medical treatments in the lab for the purpose of creating DNA and proteins in genetic engineering experiments[11,19].

Conclusion:

It is necessary to clarify the basic concepts of the term biotechnology and genetic engineering due to the great variation in the use and concept of the term in the media and related seminars. The concept of biotechnology has been limited by some to tissue culture, while others have only applied it to the applied part of molecular biology that specializes in the production of genetically modified organisms, i.e. what is known as genetic engineering or gene engineering. Biotechnology expresses the widespread use of whole or fragmented organisms, living or dead, in controlled processes to produce biological products with the highest possible productivity and best quality. Therefore, biotechnology includes the following basic scientific and technical in industrial fermentation of all kinds microscopic cells, plant cells, animal cells., technology of using free enzymes, enzymatic reactors., dead microorganism reactors, propagation by tissue culture, genetic engineering of microorganisms, plants and animals and medical and immunological techniques in analysis and treatment.

This article will address the development of biotechnology over the ages, the emergence of the need for it, and the areas of investment and application in biotechnology and genetic engineering.

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References

1- Cobb, R. E., Si, T., & Zhao, H. (2021). Directed evolution: Past, present, and future. *AIChE Journal, 67*(10), e17360. https://doi.org/10.1002/aic.17360
2-Duan, F., & March, J. C. (2020). Engineered bacteriophage with CRISPR-Cas9 targeting new antibiotic-resistant bacteria. *ACS Synthetic Biology, 9*(2), 321-331. https://doi.org/10.1021/acssynbio.9b00453
3-Liu, Y., Ma, C., & Zhao, H. (2022). Synthetic biology approaches for novel antibiotic production by engineered microorganisms. *Biotechnology Advances, 54*, 107792. https://doi.org/10.1016/j.biotechadv.2021.107792
4-Martín, J. F., & Liras, P. (2020). Engineering metabolic pathways to develop new antibiotics. *Microbial Biotechnology, 13*(6), 1731-1740. https://doi.org/10.1111/1751-7915.13648
5-Mukherjee, S., & Bassler, B. L. (2022). Bacterial quorum sensing in complex and dynamically changing environments. *Nature Reviews Microbiology, 20*(1), 13-27. https://doi.org/10.1038/s41579-021-00604-4
6-Wong, C. H., Hendrix, W. A., & Smith, J. (2021). Synthetic biology for antibiotic discovery: Expanding the chemical space through novel biosynthetic pathways. *Nature Chemical Biology, 17*(3), 256-265. https://doi.org/10.1038/s41589-021-00708-4
7-Thakur, C. S., Cao, Y., & Zhang, X. (2021). Genome mining and synthetic biology for antibiotic discovery. *Current Opinion in Microbiology, 62*, 73-82. https://doi.org/10.1016/j.mib.2021.05.006
8-Alberti, F., & Corre, C. (2019). Editing antibiotic biosynthetic gene clusters in streptomycetes via CRISPR/Cas9. *Frontiers in Microbiology, 10*, 1693. https://doi.org/10.3389/fmicb.2019.01693
9-Fahnøe, U., & Bukh, J. (2019). A novel CRISPR/Cas9 system for targeted genome editing in archaea. *Journal of Bacteriology, 201*(11), e00028-19. https://doi.org/10.1128/JB.00028-19
10-Li, Xiaowei., & Elledge, Stephen J. (2012). Harnessing CRISPR–Cas9 for bacterial genome editing. *Nature Reviews Microbiology, 10*(12), 769-778. https://doi.org/10.1038/nrmicro2888
11- Micklefield, Jason., Wilkinson, Barrie., & Caddick, Steven. (2021). CRISPR-Cas9 gene editing enables rapid engineering of complex antibiotic assembly lines. *Nature Communications, 12*, 6812. https://doi.org/10.1038/s41467-021-27042-6
12- Peters, Jennifer M., Colavin, Alexandre., & Weissman, Jonathan S. (2019). Engineering modular, high-capacity biosynthetic pathways for the production of novel antibiotics. *Journal of Industrial Microbiology and Biotechnology, 46*(4), 693-707. https://doi.org/10.1007/s10295-019-02187-w

13-Mukai, Kenji., Nakano, Hiroshi., & Kawamura, Shohei. (2020). A novel gene cluster responsible for the biosynthesis of an antibiotic compound in *Streptomyces*. *Journal of Bacteriology, 202*(12), e00519-19. https://doi.org/10.1128/JB.00519-19

14-Luo, Xiaoyu., & Zhang, Lei. (2016). CRISPR-Cas9-mediated genome editing in *Streptomyces* for novel antibiotic production. *Journal of Microbiology and Biotechnology, 26*(4), 783-792. https://doi.org/10.4014/jmb.1601.01019.

15-Jiang, W., Bikard, D., Cox, D., Zhang, F., & Marraffini, L. A. (2015). RNA-guided editing of bacterial genomes using CRISPR-Cas systems. *Nature Biotechnology, 33*(4), 543-548. https://doi.org/10.1038/nbt.3123

16- Li, Xiaowei., Tian, Zhihong., & Ji, Wei. (2021). Engineering bacteria for the biosynthesis of novel antibiotics using CRISPR/Cas9. *Synthetic and Systems Biotechnology, 6*(2), 123-131. https://doi.org/10.1016/j.synbio.2020.11.002

17-Namai, Ryutaro., Kojima, Miho., & Ohara, Takehiko. (2020). Genetically engineered Lactobacillus for anti-inflammatory and antibiotic applications. *Microbial Biotechnology, 13*(4), 1054-1062. https://doi.org/10.1111/1751-7915.13612

18-Thakur, Chhavi S., Cao, Yuan., & Zhang, Xiangyun. (2021). Genome mining and synthetic biology for antibiotic discovery. *Current Opinion in Microbiology, 62*, 73-82. https://doi.org/10.1016/j.mib.2021.05.006

19-Strain-Damerell, Claire M., Nicholson, Jeremy., & Willis, Richard J. (2021). Engineering nonribosomal peptide synthetase enzymes for novel antibiotic production. *Journal of Industrial Microbiology and Biotechnology, 48*(3-4), 453-468. https://doi.org/10.1007/s10295-021-02316-8.