Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 2063 - 2068
Received 05 March 2021; Accepted 01 April 2021.

Molecular Biology and Biotechnology: Prospects of Genetic Engineering

Mahina Azatovna Abduvahabova
PhD, associate professor at the Tashkent State University of oriental studies and Uzbekistan State University of world languages; email: makhina.abduvahabova@gmail.com; ORCID: 0000-0002-9068-3743;

Saodat Artikovna Mannonova
The lecturer of the department of theoretical disciplines 2 under the Uzbekistan State University of world languages; email: saodatmannanova648@gmail.com;

Dilafruz Abdujabbarovna Azimbayeva
Senior lecturer of the department of theoretical disciplines 2 under the Uzbekistan State University of world languages; email: dilafruz.azimbaeva@gmail.ru;

Madina Begizova
The lecturer of the department of theoretical disciplines 2 under the Uzbekistan State University of world languages; email: begizova_madina@gmail.com;

Abstract. The main goal of biology is to solve practical problems of agriculture, medicine and control the evolution of life. The task of the same discipline is to create conditions for a sharp rise in the productivity of plants, animals and microorganisms; in mastering the ways of fighting for health, longevity, long-term adolescence of a person; to develop the methods for managing the genetic processes underlying the evolution of species; to solve problems associated with the widespread use of atomic energy, with the chemicalization of the home economy, with flights of spaceships. Science not only solves the problems posed by the present day, but also prepares the future for technology, medicine, agriculture, interstellar flights, and the conquest of nature. One of the most promising sciences of biology is genetic engineering, which studies the phenomena of heredity and variability of organisms. Heredity is one of the fundamental properties of life; it determines the reproduction of forms in each subsequent generation. And if we want to learn how to manage the development of life forms, the formation of useful ones for us and the elimination of harmful ones, we must understand the essence of heredity and the reasons for the appearance of new hereditary properties in organisms. As for molecular biology, it historically emerged as a branch of biochemistry. This article estimates prospects of genetic engineering in terms of improving strains of biotechnology today that seem almost indivisible and interrelated to one another.

Key words: molecular biology, biotechnology, genetic engineering, genetic diseases, homologous chromosomes, microorganisms, mutagenesis.

INTRODUCTION

April 1953 is considered to be the birth date of molecular biology, when an article by J.D.Watson and F.Crick appeared in the English journal Nature, proposing a spatial model of the DNA molecule. The basis for the construction of this model was the work on X-ray structural analysis, in which M.Wilkinson and R.Franklin also participated (http://mikrobiki.ru/mikrobiologiya). This fundamental discovery was prepared by a long phase of research into the genetics and biochemistry of viruses and bacteria.

In 1928, F.Griffith showed for the first time that an extract of heat-killed pathogenic bacteria could transmit pathogenicity to non-hazardous bacteria (Krishna et.all, 2008). The study of the transformation of bacteria further led to the purification of the pathogenic agent, which, contrary to expectations, turned out to be not a protein, but a nucleic acid. By itself, nucleic acid is not dangerous; it only carries genes that determine the pathogenicity and other properties of the microorganism.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 2063 - 2068
Received 05 March 2021; Accepted 01 April 2021.

In the 50s of the XX century, it was shown that bacteria have a primitive sexual process; they are able to exchange extrachromosomal DNA, plasmids (Pagadala et al., 2017). The discovery of plasmids, like transformation, formed the basis for the plasmid technology widespread in molecular biology. Another important discovery for methodology was the discovery of bacterial viruses and bacteriophages at the beginning of the 20th century. Phages can also transfer genetic material from one bacterial cell to another. Infection of bacteria with phages leads to a change in the composition of bacterial RNA. If, without phages, the composition of RNA is similar to the composition of bacterial DNA, then after infection the RNA becomes more similar to the DNA of a bacteriophage. Thus, it was found that the structure of RNA is determined by the structure of DNA. In turn, the rate of protein synthesis in cells depends on the amount of RNA-protein complexes. This is how the central dogma of molecular biology was formulated: DNA ↔ RNA → protein. The further development of molecular biology was accompanied by both the development of its methodology, in particular, the invention of a method for determining the nucleotide sequence of DNA (Berman, 2000), and new discoveries in the field of studies of the structure and functioning of genes (Rehman et al., 2014). By the beginning of the 21st century, data were obtained on the primary structure of all human DNA and a number of other organisms most important for medicine, agriculture and scientific research, which led to the emergence of several new directions in biology: genomics, bioinformatics, etc.

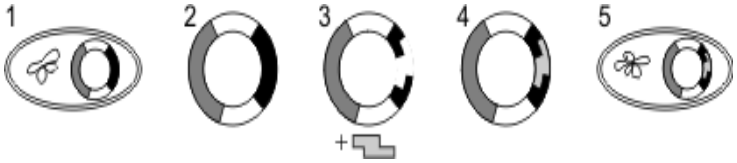
MATERIALS AND METHODS

Traditional selection of microorganisms (mainly bacteria and fungi) is based on experimental mutagenesis and selection of the most productive strains, but here, too, there are some peculiarities. The genome of bacteria is haploid based; any mutations appear already in the first generation. Although the probability of natural occurrence of a mutation in microorganisms is the same as in all other organisms (1 mutation per 1 million individuals for each gene), a very high reproduction rate makes it possible to find a useful mutation for the gene of interest to the researcher. Fungus was increased by more than 1000 times as a result of artificial mutagenesis and selection, the productivity of the strains of the penicillus (Zhao et al., 2006). Microbiological products are used in bakery, brewing, winemaking, and the preparation of many dairy products. Antibiotics, amino acids, proteins, hormones, various enzymes, vitamins and much more are obtained with the help of the microbiological industry. Microorganisms are used for biological wastewater treatment, improving soil quality. At present, methods have been developed for obtaining manganese, copper, chromium in the development of dumps of old mines using bacteria, where conventional mining methods are economically unprofitable.

Biotechnology is the use of living organisms and their biological processes in the production of substances necessary for a person. The objects of biotechnology are bacteria, fungi, cells of plant and animal tissues. They are grown on nutrient environment in special bioreactors. The newest methods of selection of microorganisms, plants and animals are cell, chromosomal and genetic engineering. Genetic engineering is a biotechnology technique that deals with research into the rearrangement of genotypes. A genotype is not just a mechanical sum of genes, but a complex system that has developed in the process of evolution of organisms. Genetic engineering allows the transfer of genetic information from one organism to another through in vitro operations. Gene transfer makes it possible to overcome interspecies barriers and transfer certain hereditary characteristics of some organisms to others. Genetic engineering is a set of techniques that allow us to isolate the desired gene from the genome of one organism and introduce it into the genome of another organism. The carriers of the material bases of genes are chromosomes, which include DNA and proteins. But the genes for education are not chemical, but functional. From a functional point of view, DNA consists of many blocks that store a certain amount of information - genes. The action of a gene is based on its ability to determine protein synthesis through RNA. In the DNA molecule, as it were, information is recorded that determines the chemical structure of protein molecules. A gene is a section of a DNA molecule that contains information about the primary structure of a single protein (one gene - one protein). Since organisms contain tens of thousands of

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 2063 - 2068
Received 05 March 2021; Accepted 01 April 2021.

proteins, there are tens of thousands of genes. The set of all genes of a cell makes up its genome. All cells of the body contain the same set of genes, but each of them implements a different part of the stored information. The restructuring genotypes in performing genetic engineering tasks, represents a qualitative change in genes that are not associated with changes in the structure of chromosomes visible in a microscope. Gene changes are primarily associated with the transformation of the chemical structure of DNA. Information about the structure of a protein, recorded as a sequence of nucleotides, is realized as a sequence of amino acids in a synthesized protein molecule. A change in the sequence of nucleotides in chromosomal DNA, the loss of some and the inclusion of other nucleotides change the composition of the RNA molecule formed on DNA, and this, in turn, determines a new sequence of amino acids during synthesis. As a result, a new protein begins to be synthesized in the cell, which leads to the appearance of new properties in the body. The essence of genetic engineering methods lies in the fact that individual genes or groups of genes are incorporated into or excluded from the genotype of an organism. As a result of the insertion of a previously absent gene into the genotype can force the cell to synthesize proteins has not being previously synthesized. The most common method of genetic engineering is the method of obtaining recombinant, i.e. containing a foreign gene, plasmids. Plasmids are circular double-stranded DNA molecules consisting of several thousand base pairs (Sadovnichy et al., 2017).



Formation of recombinant plasmids:
1 - a cell with the original plasmid; 2 - isolated plasmid; 3 - vector creation; 4 - recombinant plasmid (vector); 5 - a cell with a recombinant plasmid.

Plants and animals, into the genome of which “foreign” genes are introduced, are called transgenic, bacteria and fungi are called transformed ones. The traditional object of genetic engineering is Escherichia coli, a bacterium that lives in the human intestine. It is with its help that the hormone of growth- somatotropin, the hormone insulin is obtained, which was previously obtained from the pancreas of cows and pigs, the interferon protein, which helps to cope with a viral infection. The process of creating transformed bacteria includes the following steps. Restriction is the “excision” of the desired genes. It is carried out with the help of special “genetic scissors”, restriction enzymes (Bolton et al., 2008). Creation of a vector is a special genetic construct, in which the targeted gene will be introduced into the genome of another cell. The vector is based on plasmids. The gene is sewn into the plasmid using another group of enzymes – ligases (Valeur et al., 2001). The vector must contain everything necessary to control the operation of this gene - a promoter, a terminator, an operator gene and a regulator gene, as well as marker genes that give the recipient cell new properties that make it possible to distinguish this cell from the original cells. Transformation is the introduction of a vector into a bacterium. Screening is the selection of those bacteria in which the introduced genes work successfully.

RESULTS AND DISCUSSIONS

The prospects of genetic engineering in terms of improving strains of microorganisms today seem almost unlimited. Undoubtedly, such direction will develop the creation of strains-producers of human proteins, farm animals and plants. This direction is associated not only with medicine and veterinary medicine, but also with the food industry. Work on the creation of a microbiological technology for the production of renin (an enzyme of calf rennet) used in cheese making, sweet protein - taumatin (~ 3000 times sweeter than sugar) and other products. Work is underway to improve yeast strains used in brewing and winemaking. Genes are transferred to these organisms

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 2063 - 2068
Received 05 March 2021; Accepted 01 April 2021.

that can ensure the assimilation of pentoses, the destruction of phenolic compounds, and competitiveness when growing under non-sterile conditions (Foresman et al., 1996).

Work has begun on creating a process for processing starch into ethyl alcohol using bacteria, which significantly speeds up and reduces the cost of its production. The stumbling block is often not the methodology of genetic engineering, but incomplete knowledge of the biochemical pathways for the synthesis of a particular compound leads to the insufficient development of the genetics of many industrial strains. It is for these reasons that no antibiotic-producing strain has yet been created by this method; the number of primary and secondary metabolite-producing strains is very limited.

Certain features of new technologies in the 21st century can lead to greater dangers than existing weapons of mass destruction. First of all, it is the ability to self-replicate. A destructive and avalanche self-reproducing object, specially created or accidentally out of control, can become a means of mass destruction of all. This will not require complex factories, complex organization and large allocations. Knowledge itself will pose a threat: devices invented and manufactured in single copies can contain everything necessary for further reproduction, action, and even further evolution - changing their properties in a given direction. Success in this branch of science will be able to radically raise labor productivity and contribute in solving many existing problems, first of all, raising the standard of living of every person, but, at the same time, and creating new destructive means.

Eukaryotic genes, unlike prokaryotic ones, have a mosaic structure (exons, introns). There is no processing in bacterial cells, and translation in time and space is not separated from transcription. In this regard, it is more efficient to use artificially synthesized genes for transplantation. The template for this synthesis is RNA. With the help of the enzyme reverse transcriptase, a DNA strand is first synthesized on RNA. Then the second strand is completed it with the help of DNA polymerase.

Cellular (chromosome) engineering is the design of cells of a new type based on their cultivation, hybridization and reconstruction. Cells of plants and animals, placed in nutrient media containing all the substances necessary for vital activity are able to divide, forming cell cultures. Plant cells also have the property of totipotency, that is, under certain conditions; they are able to form a full-fledged plant. Therefore, it is possible to propagate plants in test tubes by placing the cells in certain nutrient environment. This is especially true for rare or valuable plants. With the help of cell cultures, valuable biologically active substances can be obtained (ginseng cell culture). The production and study of hybrid cells makes it possible to solve many problems of theoretical biology (mechanisms of cell differentiation, cell reproduction, etc.). The cells obtained as a result of the fusion of protoplasts of somatic cells belonging to different species (potato and tomato, apple and cherry, etc.) are the basis for the creation of new forms of plants. In biotechnology, hybridomas are used to obtain monoclonal antibodies - a hybrid of lymphocytes with cancer cells. Hybridomas develop antibodies, like lymphocytes, and have the ability to multiply indefinitely in culture, like cancer cells. The method of transplanting the nuclei of somatic cells into oocytes makes it possible to obtain a genetic copy of an animal, that is, makes it possible to clone animals. At present, cloned frogs have been obtained, and the first results of mammalian cloning have been obtained. Early embryo fusion makes it possible to create chimeric animals. In this way a chimeric sheep-goat animal, chimeric mice were obtained (fusion of embryos of white and black mice).

Chromosomal engineering is a set of techniques that allow manipulation of chromosomes. One group of methods is based on the introduction into the genotype of a plant organism of a pair of foreign homologous chromosomes that control the development of the desired traits (augmented lines), or the replacement of one pair of homologous chromosomes with another (substituted lines). The haploid method is based on growing haploid plants with subsequent chromosome doubling. For example, maize pollen grains are used to grow haploid plants containing 10 chromosomes (n = 10), then the chromosomes are doubled and diploid (n = 20), completely homozygous plants are obtained in just 2–3 years instead of 6–8 years of inbreeding. Thanks to advances in genetic engineering, humans have the opportunity to discuss concepts such as genetically modified

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 2063 - 2068
Received 05 March 2021; Accepted 01 April 2021.

organisms and gene therapy. At the same time, someone sees the salvation of mankind in genetic engineering. Scientists are actively using the possibility of introducing any modifications into cells, for example, for the synthesis of biologically active substances. Thus, E. coli cells serve as biological factories for the production of human insulin (Ali et al., 2017). Also, modification can be aimed at creating organisms capable of performing certain functions, for example, cleaning the environment. To obtain recombinant vaccines, the genetic material of the pathogen is inserted into the cells of the microorganism, and after cultivation, the desired antigen is isolated from them, purified, and a vaccine is prepared. Changes in the genetic apparatus of human somatic cells are carried out in order to treat various diseases using gene therapy. New genes introduced into transgenic plants make them look perfect, give them the correct shape, uniform size, increase storage, give resistance to harmful insects, drought and soil salinity, reduce the likelihood of poisoning with insecticides and herbicides, and may even be designed to directly improve health ...

FINAL REFLECTION

In the future, genetic engineering will be able to overcome genetic diseases, and human health will rise to a new level. People will get rid of aging, and they will not have to watch their bodies wither. For example, aging is known to be caused by the contraction of telomeres during cell division. Telomeres are located at the ends of chromosomes and carry out the function of protecting DNA. In the late 90s of the twentieth century, scientists introduced a gene into the cell that restores the telomerase protein, which is responsible for the restoration of telomeres. The development of genetic engineering in the future, according to scientists, can bring many benefits for human health and his personal potential. The future poses many problems for humanity that can be effectively dealt with by highly organized, healthy people with great intellectual potential. Thanks to genetic engineering and genetics, it will be possible to cultivate certain positive attributes of people, both in childhood and in adulthood. A person will be able to enhance their mental abilities, immunity and life expectancy due only to the introduction of certain genes into the body. A very tempting prospect, given that many scientists, among whom the discoverers of DNA, say that stupidity is based on genetics and can be curable. Thus, scientists have made the cell immortal. Thus, today genetic engineering has become an integral part of our life, and mistrust of genetically modified organisms in most cases is associated with a banal ignorance of the foundations of biology. In conclusion, it should be noted that genetic engineering is not only a tool for the practical “improvement” of strains, but also a powerful way of understanding the mechanisms of biosynthesis and regulation of the metabolism of microorganisms. Further progress in the design of highly productive strains of microorganisms depends on the joint work of microbiologists, geneticists, biochemists, and genetic engineers.

References

1. Ali, M., Abbasi, B.H., Ahmad, N., Khan, H., Ali, G.S. (2017) Strategies to enhance biologically active-secondary metabolites in cell cultures of Artemisia – current trends. *Crit. Rev. Biotechnol.* 37, 833–851.
2. Berman, H.M. (2000) The Protein Data Bank. *Nucleic Acids Res.* 28, 235–242.
3. Bolton, E.E., Wang, Y., Thiessen, P.A., Bryant, S.H. (2008) PubChem: integrated platform of small molecules and biological activities. In: *Annual Reports in Computational Chemistry*. Elsevier. 4, 217–241.
4. Foresman, J.B., Frisch, A. (1996) *Exploring Chemistry with Electronic Structure Methods.* Sec. Ed. Pittsburgh, PA: Gaussian, Inc.
5. http://mikrobiki.ru/mikrobiologiya/
6. Krishna S., Bustamante, L., Haynes, R.K., Staines, H.M. (2008) Artemisinins: their growing importance in medicine. *Trends Pharmacol. Sci.* 29, 520–527.
7. Pagadala, N.S., Syed, K., Tuszynski J. (2017) Software for molecular docking: a review. *Biophys. Rev.* 9, 91–102.

8. Rehman, S.U., Asghar, S., Fong, S., Sarasvady, S. (2014) DBSCAN: past, present and future. *IEEE*. 232–238.
9. Sadovnichy, V., Tikhonravov, A., Voevodin, V., Opana-senko, V. (2017) "Lomonosov": supercomputing at Moscow State University. In: *Contemp. High Perform. Comput.* Chapman and Hall/CRC. 283–307.
10. Valeur, B., Brochon, J.C. (2001) *New Trends in Fluorescence Spectroscopy: Applications to Chemical and Life Sciences.* Springer, Berlin, Heidelberg.
11. Zhao, H. & Ge, M., Zhang, Z., Wang, W., Wu, G. (2006) Spectroscopic studies on the interaction between riboflavin and albumins. *Spectrochim. Acta A Mol. Biomol. Spectrosc.* 65, 811–817.