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PROSPECTS FOR THE DEVELOPMENT OF MOLECULAR-BIOCHEMICAL RESEARCH FOR EFFECTIVE METHODS OF CLINICAL-LABORATORY DIAGNOSTICS

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Introduction. Over the past few years, the CRISPR (Clustered regularly interspaced short palindromic repeats) / Cas (Caspase) system has been used in various areas of genetic engineering. CRISPR/Cas system is a powerful gene editing tool derived from the immune system of bacteria, has revolutionized the field of genetic engineering. This technology allows scientists to precisely modify DNA sequences, offering exciting possibilities in various fields, including medicine, agriculture, and biotechnology. With the help of this powerful tool, it is possible to modify the metabolic pathways of industrially important microorganisms, edit the genomes of economically important animals and plants, pests, and carriers of infections. The CRISPR/Cas genome editor is developing as quickly as computers once did. Of course, the greatest expectations are for the use of this technology in medicine.

CRISPR-Cas is an adaptive immune system of microorganisms that uses RNA-directed nucleases to cut out foreign genetic elements. CRISPR-Cas is a method of molecular genetic manipulation developed on the basis of the prokaryotic CRISPR system, which uses a guide RNA (single guide RNA), which directs and activates the second component of the system Cas9 nuclease, the target of which is a specific genetic sequence. The Cas enzyme catalyzes the cleavage of both DNA strands, which are then joined by non-homologous end joining (NHEJ) to form insertions or deletions, or if the repair is provided by the presence of a homologous template, then by homology-directed repair (HDR) of DNA.

This system has high efficiency and specificity of operation and is distinguished by the simplicity of creating genetic constructs. To create a construct that will recognize a specific DNA sequence in the genome, it is enough to place a synthetic DNA fragment of about 20 nucleotides (spacer) in a special vector for transferring guide RNA (sgRNA) and Cas nuclease or another marker into the target cell.

While CRISPR/Cas is primarily known for its gene editing capabilities, its applications extend beyond this. The technology has been adapted for high-precision diagnostics. It can be used as a high-precision diagnostic tool. This technique used to identify two common types of papillomavirus responsible for the development of certain types of cancer in humans. The system, called "DETECTR", copes with its work in about an hour and costs less than a dollar. The accuracy of the technology is from 92 to 100%. Another technology "SHERLOCK" proposed for the identification of viruses and bacteria, as well as for the search for oncogenic mutations in a blood sample.

Future prospects:

CRISPR/Cas technology is still under development, but its potential is immense. The future holds exciting possibilities for its use in:

1) treating genetic diseases: CRISPR/Cas could potentially cure diseases like cystic fibrosis, sickle cell anemia, and Huntington's disease;
2) developing new therapies: CRISPR/Cas could be used to develop new cancer treatments, gene therapies, and personalized medicine approaches;
3) improving agriculture: CRISPR/Cas could be used to develop crops that are more resistant to pests and diseases, and that have higher yields.

Conclusion. Given the above, the relevance of the topic is determined by the prospects that can be realized thanks to research in the field of using CRISPR-Cas systems. Such systems need additional development in order to go beyond scientific laboratories and become part of clinical medicine. The capabilities of CRISPR systems are far from limited to gene editing. CRISPR/Cas technology is a revolutionary tool with vast potential. While research is ongoing, the future of this technology is bright, promising advancements in various fields and improving human health and well-being. The technology is universal, and will probably find wide application in clinical and laboratory practice in the future.

Keywords: CRISPR/CAS systems, genome editing, laboratory diagnostics.