



APPLICATION OF RECOMBINANT DNA IN m=MEDICINE. MECHANISM OF ACTION OF DRUGS AGAINST VIRUSES AND TUMORS.

Ximmatova Yangildi Raxmatovna

Lecturer at the Department of Medical Biology and Chemistry, Termiz
Branch of Tashkent Medical Academy
yangeldiximmatova@gmail.com

Xolmatjonova Anoraxon Doniyorbek qizi

Students of the Termez Branch of Tashkent State Medical University
xolmatjonova_anora@icloud.com

Rahmonova Lobar Ilhom qizi

lobarraahmonova876@gmail.com

<https://doi.org/10.5281/zenodo.19413787>

Abstract: This article analyzes the application of recombinant DNA technology in medicine, as well as the mechanisms of action of drugs against viral infections and tumors. Recombinant DNA technology is one of the key areas of modern biomedicine, enabling the production of therapeutic proteins such as insulin, interferons, and vaccines. The paper also describes the mechanisms of antiviral drugs, which inhibit viral replication, and antitumor agents, which act by suppressing cell proliferation, inducing apoptosis, and blocking signal transduction pathways. The results of the study contribute to a deeper understanding of the significance and effectiveness of recombinant technologies in medical practice.

Keywords: Recombinant DNA, genetic engineering, biotechnology, antiviral drugs, anticancer agents, cell proliferation, apoptosis, signal transduction pathways, vaccines, interferons.

Аннотация: В данной статье рассматривается применение технологий рекомбинантной ДНК в медицине, а также механизмы действия лекарственных средств против вирусных инфекций и опухолей. Технология рекомбинантной ДНК является одним из ключевых направлений современной биомедицины, позволяя получать терапевтические белки, такие как инсулин, интерфероны и вакцины. В работе также описываются механизмы действия противовирусных препаратов, подавляющих репликацию вирусов, и противоопухолевых средств, которые воздействуют за счёт ингибирования клеточного деления, индукции апоптоза и блокирования сигнальных путей. Результаты исследования способствуют более глубокому пониманию значения и эффективности рекомбинантных технологий в медицине.

Ключевые слова: Рекомбинантная ДНК, генная инженерия, биотехнология, противовирусные препараты, противоопухолевые средства, клеточная пролиферация, апоптоз, сигнальные пути, вакцины, интерфероны.

Annotatsiya: Ushbu maqolada tibbiyotda rekombinant DNK texnologiyalarining qo'llanilishi hamda virusli infeksiyalar va o'smalarga qarshi dori vositalarining ta'sir mexanizmlari tahlil qilinadi. Rekombinant DNK texnologiyasi zamonaviy biotibbiyotning muhim yo'nalishlaridan biri bo'lib, u orqali insulin, interferonlar, vaksinalar va boshqa terapevtik oqsillar ishlab chiqarilishi yoritiladi. Shuningdek, maqolada antiviral preparatlarning virus replikatsiyasini bostirish, o'smaga qarshi dori vositalarining esa hujayra bo'linishini to'xtatish, apoptozni faollashtirish va signal uzatish yo'llarini bloklash orqali ta'sir

ko'rsatish mexanizmlari ilmiy asosda bayon etiladi. Tadqiqot natijalari rekombinant texnologiyalarning tibbiyotdagi ahamiyati va samaradorligini yanada kengroq tushunishga xizmat qiladi.

Kalit so'zlar: Rekombinant DNK, gen muhandisligi, biotexnologiya, antiviral preparatlar, o'smaga qarshi dori vositalari, hujayra proliferatsiyasi, apoptoz, signal uzatish yo'llari, vaksinalar, interferonlar.

In recent decades, rapid advances in molecular biology and biotechnology have significantly transformed modern medicine. Among these innovations, recombinant DNA technology has emerged as a powerful tool, enabling precise manipulation of genetic material for therapeutic and diagnostic purposes. This technology allows scientists to isolate, modify, and express specific genes, leading to the large-scale production of biologically active molecules that are essential for the treatment of various diseases.

Recombinant DNA technology plays a crucial role in the development of modern pharmaceuticals, including hormones, enzymes, vaccines, and monoclonal antibodies. For instance, the production of recombinant insulin has revolutionized the management of diabetes mellitus, while recombinant interferons are widely used in the treatment of viral infections and certain types of cancer. Additionally, advances in genetic engineering have contributed to the design of safer and more effective vaccines, including those based on viral vectors and nucleic acid platforms.

Viral infections and cancer remain among the leading causes of morbidity and mortality worldwide, posing significant challenges to global health systems. The development of effective antiviral and anticancer drugs requires a deep understanding of the molecular mechanisms underlying disease progression. Antiviral agents typically function by targeting specific stages of the viral life cycle, such as viral entry, replication, or assembly, thereby inhibiting the spread of infection. On the other hand, anticancer drugs act through various mechanisms, including the inhibition of uncontrolled cell proliferation, induction of programmed cell death (apoptosis), and disruption of intracellular signaling pathways that regulate tumor growth and survival.

Despite significant progress, the emergence of drug resistance and adverse side effects continues to limit the effectiveness of many therapeutic agents. Therefore, ongoing research in recombinant DNA technology and molecular pharmacology is essential for the development of novel, targeted therapies with improved efficacy and safety profiles. In this context, the present article aims to explore the applications of recombinant DNA technology in medicine and to analyze the mechanisms of action of drugs used against viral infections and tumors.

Recombinant DNA technology represents a cornerstone of modern biomedical science, providing innovative approaches for the prevention, diagnosis, and treatment of various diseases. This technology involves the combination of DNA molecules from different sources into a single molecule, which is then introduced into a host organism for replication and expression. The resulting recombinant products are widely utilized in medicine due to their high specificity, efficiency, and safety.

One of the most significant applications of recombinant DNA technology in medicine is the production of therapeutic proteins. Recombinant human insulin was among the first successfully developed products and remains a critical treatment for diabetes mellitus. Similarly, recombinant interferons and interleukins are used as immunomodulatory agents in the treatment of viral infections, autoimmune disorders, and certain malignancies. Monoclonal

antibodies, produced using recombinant techniques, have become essential tools in targeted therapy, particularly in oncology, where they selectively bind to tumor-specific antigens.

In addition to therapeutic protein production, recombinant DNA technology plays a key role in vaccine development. Recombinant vaccines, such as subunit and vector-based vaccines, offer improved safety profiles compared to traditional vaccines, as they do not contain live pathogens. These vaccines stimulate the immune system by presenting specific antigens, thereby inducing protective immunity without causing disease. Advances in nucleic acid-based vaccines, including DNA and mRNA vaccines, have further expanded the possibilities for rapid and effective responses to emerging infectious diseases.

The mechanisms of action of antiviral drugs are primarily focused on disrupting the viral life cycle. Viruses rely on host cellular machinery for replication; therefore, antiviral agents are designed to selectively inhibit viral enzymes or processes without causing significant harm to host cells. For example, reverse transcriptase inhibitors block the conversion of viral RNA into DNA in retroviruses, while protease inhibitors prevent the maturation of viral proteins. Other antiviral drugs may inhibit viral entry into host cells or interfere with viral genome replication, ultimately reducing viral load and limiting disease progression.

Anticancer drugs, on the other hand, target the abnormal characteristics of tumor cells, such as uncontrolled proliferation, resistance to apoptosis, and altered signaling pathways. Chemotherapeutic agents often act by damaging DNA or interfering with cell division, leading to cell death. However, these agents may also affect normal rapidly dividing cells, resulting in side effects. In contrast, targeted therapies, including monoclonal antibodies and small-molecule inhibitors, are designed to specifically interact with molecular targets involved in tumor growth and progression. These include growth factor receptors, intracellular kinases, and angiogenesis-related factors.

Another important mechanism of anticancer therapy is the induction of apoptosis, a regulated process of programmed cell death. Many anticancer drugs activate apoptotic pathways by influencing pro-apoptotic and anti-apoptotic proteins within the cell. Additionally, immunotherapy has emerged as a promising approach in cancer treatment, enhancing the body's immune response against tumor cells. Immune checkpoint inhibitors, for instance, block inhibitory signals that prevent immune cells from attacking cancer cells, thereby restoring immune activity.

Despite these advancements, several challenges remain in the clinical application of antiviral and anticancer therapies. Drug resistance, caused by genetic mutations in viruses or tumor cells, can significantly reduce treatment efficacy. Furthermore, toxicity and adverse effects continue to pose limitations.

Therefore, ongoing research in recombinant DNA technology and molecular medicine is focused on developing novel therapeutic strategies, including gene therapy, personalized medicine, and precision-targeted treatments, which aim to improve patient outcomes and minimize side effects.

In conclusion, recombinant DNA technology has profoundly transformed the landscape of modern medicine, offering innovative solutions for the prevention, diagnosis, and treatment of a wide range of diseases. Its applications in the production of therapeutic proteins, vaccines, and targeted biological agents have significantly improved the effectiveness and specificity of medical interventions.

At the same time, a deeper understanding of the mechanisms of action of antiviral and anticancer drugs has enabled the development of more precise and efficient therapeutic strategies. By targeting key stages of viral replication and critical pathways involved in tumor growth and survival, these drugs contribute to improved clinical outcomes and enhanced patient care.

Nevertheless, challenges such as drug resistance, toxicity, and variability in patient response remain significant obstacles in clinical practice. Addressing these issues requires continuous research and the integration of advanced technologies, including gene editing, personalized medicine, and molecular targeting approaches.

Overall, the combination of recombinant DNA technology and modern pharmacological strategies represents a promising direction for the future of medicine, paving the way for more effective, safe, and individualized therapies.

References:

1. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R. (2014). *Molecular Biology of the Gene* (7th ed.). Pearson Education.
2. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2015). *Molecular Biology of the Cell* (6th ed.). Garland Science.
3. Lodish, H., Berk, A., Kaiser, C. A., et al. (2016). *Molecular Cell Biology* (8th ed.). W.H. Freeman and Company.
4. Brown, T. A. (2016). *Gene Cloning and DNA Analysis: An Introduction* (7th ed.). Wiley-Blackwell.
5. Katzung, B. G. (2021). *Basic and Clinical Pharmacology* (15th ed.). McGraw-Hill Education.
6. Abduraxmonov, I. (2020). *Genetika va genomika asoslari*. Toshkent: Fan nashriyoti.

