

UDC 504.06: 575.856(476)(047.31)
AGRIS S01

<https://doi.org/10.33619/2414-2948/111/18>

THE IMPACT OF GENETICALLY MODIFIED ORGANISMS ON HUMAN HEALTH

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ВЛИЯНИЕ ГЕНЕТИЧЕСКИ МОДИФИЦИРОВАННЫХ ОРГАНИЗМОВ НА ЗДОРОВЬЕ ЧЕЛОВЕКА

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Abstract. Investigates the impact of genetically modified organisms (GMOs) on human health. It is noted that the use of GMOs is increasing yearly worldwide. While gene technology, which has entered our lives through the creation of genetically modified organisms, shows benefits, it also presents certain challenges. These challenges include negative impacts on distribution and balance, toxic effects on plants, difficulties in fighting pathogens due to the development of antibiotic-resistant genes, gene transfers, and an increased risk of allergic reactions due to GMOs, all of which raise relevant questions about genetically modified organisms. It is highlighted that in recent years, biotechnology and the use of genetically modified organisms (GMOs) developed through biotechnological research methods are among the topics of most interest worldwide. Based on the information obtained from the research, the article explores the potential benefits, harms, and risks of genetically modified organisms, their effects on biodiversity, socioeconomic and legal dimensions, as well as consumer perspectives. In conclusion, it is stated that since the opinions of scientists around the world about the benefits and harms of GMO products are not unanimous, it would be more appropriate to consider the favorable natural conditions in our country for the cultivation of agricultural products and use ecologically clean food products.

Аннотация. Исследуется влияние генетически модифицированных организмов (ГМО) на здоровье человека. Отмечается, что использование ГМО с каждым годом увеличивается во всем мире. Хотя генная технология, вошедшая в нашу жизнь благодаря созданию генетически модифицированных организмов, демонстрирует определённые преимущества, она также вызывает определённые проблемы. Эти проблемы включают в себя негативное влияние на распространение и баланс экосистем, токсические эффекты на растения, трудности в борьбе с патогенами из-за развития генов, устойчивых к антибиотикам, генетические трансферы, а также повышение риска аллергических реакций, что вызывает важные вопросы относительно ГМО. Отмечается, что в последние годы биотехнологии и использование генетически модифицированных организмов (ГМО), созданных с помощью методов биотехнологических исследований, стали одной из наиболее актуальных тем по всему миру. На основе информации, полученной в ходе исследований, в статье рассматриваются потенциальные преимущества, вред и риски генетически модифицированных организмов, их влияние на биоразнообразие, социально-экономические и правовые аспекты, а также отношение потребителей. В заключение отмечается, что,

поскольку мнения учёных во всем мире о пользе и вреде продуктов с ГМО не являются однозначными, было бы более целесообразно учитывать благоприятные природные условия в нашей стране для выращивания сельскохозяйственных продуктов и использовать экологически чистые продукты питания.

Keywords: genetically modified organisms, transgenic plants, transgenic animals, biodiversity, food diversity.

Ключевые слова: генетически модифицированные организмы, трансгенные растения, трансгенные животные, биоразнообразие, пищевая диверсификация.

For millennia, reproductive methods have been used to selectively alter organisms for desirable traits. Plants and animals have been selectively bred over generations to achieve desired characteristics. In recent years, modern advancements in biotechnology have allowed scientists to directly alter the DNA of microorganisms, plants, and animals.

The traditional methods of altering plant and animal genes, such as selective breeding and crossbreeding, were time-consuming and often produced mixed results, with undesirable traits appearing alongside desired ones. However, in recent years, biotechnology has allowed scientists to avoid this problem by creating targeted modifications of DNA, improving the genetic makeup of organisms without undesirable traits [1].

The most striking result of the rapidly developing gene technology is genetically modified organisms. Genetically modified organisms (GMOs) are organisms whose genetic material has been altered using biotechnological methods to manipulate gene sequences and thereby change their existing characteristics. These products are also referred to as “transgenic products” in simplified terms. Genetically modified organisms allow for the creation of plants, animals, and microorganisms with desired traits through technological methods, and they can modify certain characteristics through the transfer of genes from other species. For example, it is possible to create plant varieties that are more resistant to drought and pests, enrich foods with vitamins, or create special foods for people suffering from genetic diseases.

Most genetically modified animals are produced for use in laboratory research. These animals are used as “models” to study the function of specific genes and how genes are related to health and disease. However, some GMO animals are produced for human consumption. For example, genetically modified salmon have been engineered to grow faster, and the U.S. Food and Drug Administration has declared these fish safe to eat [2].

As the world population grows, the development of gene technology has accelerated to meet the basic needs. Biotechnology has made it possible to achieve greater efficiency from agricultural products in a shorter time, enrich products by enhancing their nutritional value, and prevent the development of diseases. Examples of such technological advancements include “golden” rice developed to address vitamin A deficiency, genetically modified bacteria that produce effective insulin for diabetics, crops enriched with higher yields or nutrient content to combat hunger, and increased growth hormones for higher meat and milk production.

Materials and Methods

This research uses data from scientific and public literature, both printed and electronic, as well as other sources of information on the risks and development prospects of biotechnology and biotechnological research methods.

Discussion of Results

Scientific knowledge about genetically modified organisms emerged in the 1970s. The first GMO was created in the U.S. by transferring genes from Salmonella into E.coli bacteria. The first transgenic plant was developed in 1983, and the first transgenic animal in 1987. The main GMO-producing countries include the U.S., Canada, Argentina, China, and India. Large companies such as Monsanto, Syngenta Seeds, Bayer Crop Science, and others are key producers of GMOs. The first genetically modified plants intended for human consumption were introduced in the mid-1990s. Today, approximately 90% of the corn and soybeans on the market are GMOs [3].

Genetically modified crops offer higher yields, longer shelf life, and resistance to diseases and pests. These are advantages for both farmers and consumers. For example, higher productivity and longer shelf life result in lower prices for consumers, while pest-resistant crops reduce farmers' need for pesticides, which can lead to more eco-friendly and cheaper GMO crops compared to conventionally grown plants [4].

In agriculture, the use of GMOs is referred to as “green gene technology,” while in medicine it is known as “red gene technology.” It is clear that biotechnological methods, especially molecular techniques, which have significantly advanced in recent years, offer considerable advantages in the intensive growth of agricultural production. The rapid growth of the world population and the need to supply this population with food are bringing GMO food production to the forefront. Meeting the demand involves increasing the cultivation of highly productive GMO crops [2].

The primary advantages of genetically modified organisms for farmers include resistance to pests, herbicides, diseases, cold, drought, and salinity, eliminating the allergenic properties of some foods, and generally reducing costs and making products more accessible. With green gene techniques, the natural programs of plants can be altered by manipulating their genomes (the complete set of genes that make up a plant), and a desirable trait from a foreign gene can be introduced into the plant.

The European Union has enacted legislation on genetically modified foods to ensure the protection of human and animal health, the environment, and the internal market. Information on GMOs permitted for cultivation and sale in the European Union can be found in the European Commission's GMO register. All licenses for GMO food and feed production are issued by the European Food Safety Authority (EFSA) following risk assessments conducted by the EU member states [5].

In Article 13 of the Law of the Republic of Azerbaijan "On Food Safety," requirements for genetically modified organisms and feed products are outlined. As stated in the law, the production, processing, and circulation of genetically modified organisms and feed products are allowed only after registration by the relevant executive authority (institution). Production, circulation, processing, and initial production of GMOs and feed products without registration are prohibited. These products must meet the following requirements for registration:

- Must not be harmful to life and health
- Must not deceive consumers regarding their properties
- Must contain the necessary ingredients required for animal nutrition, replacing traditional products (https://base.spinform.ru/show_doc.fwx?rgn=142360).

Despite the existence of scientific studies that claim GMOs are safe, there are also research findings that suggest they pose a threat to human and animal health. Scientific studies have revealed that GMOs, while appearing to offer advantages, carry potential risks. The presence of GMOs and GMO products in food may cause changes in food quality, lead to antibiotic resistance, disrupt natural biodiversity, and result in the formation of new viruses and toxins due to gene transfer to non-target organisms. These products also pose a threat to genetic diversity. Scientific research on

the harmful effects of genetically modified organisms suggests that these products have detrimental effects not only on human health but also on the environment, water sources, and biodiversity. In some cases, such products may even lead to changes in the entire ecosystem [6].

One of the most common adverse effects of GMOs on humans is allergic reactions. Food allergies are primarily observed in the immune system. Allergic reactions can cause swelling in the mouth, tongue, and lips, itching, eczema, rashes, redness, and edema in the eyes. Gastrointestinal symptoms such as abdominal cramps, diarrhea, and vomiting may also occur. The main allergenic foods are peanuts, milk, eggs, fish, and wheat. Even small changes in the protein sequence of consumed foods can cause allergic reactions. The body does not recognize these proteins when consumed for the first time, leading to different immune system responses and allergic reactions.

In India, allergic reactions have been observed among people working in the cotton industry, which uses Bt (*Bacillus thuringiensis*) toxin-producing cotton. The allergic symptoms are mostly eye and skin reactions, as well as respiratory difficulties in the lungs.

Another issue caused by GMOs in living organisms is the development of resistance to antibiotics. The genetic material in GMO foods can lead to antibiotic resistance when it reaches bacteria in the digestive system. These genetic materials can transfer to the bacteria in living organisms, making them resistant to antibiotics. However, such transfer has not been experimentally proven. In 2004, the World Health Organization adopted a decision regarding the transfer of genetic material, proposing the addition of marker genes to cells. However, it has been determined that biotechnology partners did not comply with this decision, and antibiotic-resistant genes are still being used.

One of the problems caused by GMOs in living organisms is their toxic effects. These toxic effects include new gene products transferred to organisms and secondary products resulting from these genes. Lethal genes present in GMO plants accumulate in the cells and tissue systems of organisms, leading to toxic effects. During gene transfer, significant metabolic events occur in the cells, and one of the most important is the alteration of enzyme and protein production in the cells of organisms.

A Japanese company used the essential amino acid tryptophan, which is involved in serotonin production in the body, by extracting it from bacteria and applying it to the production of GMO foods. These GMO products were then introduced to the U.S. market in various forms. People who consumed these products experienced nervous system disorders and muscle complaints within a few months. Research revealed that the cause was an increase in tryptophan production in the genetically modified bacteria. This rise in tryptophan production led to an increase in the volume of products that accumulated toxic substances [7].

A group of researchers in the U.S. studied the Lonapo potato variety used in the production of chips and discovered the presence of solanine toxin, resulting in its removal from the market. The primary goal of GMO food production is to protect these foods from drought, insects, and similar pests. However, scientists opposed to GMO products argue that they contain pesticides, raising concerns about potential adverse effects for people consuming GMO corn. In recent years, the increase in GMO food production and consumption has coincided with a rise in cancer rates and the risk of early onset cancer.

Research indicates that the consumption of GMO foods may have toxic effects on society, leading to an increase in allergic reactions. Additionally, GMO products are thought to raise the risk of cancer, which has driven scientists worldwide to intensify research in this area.

However, it is important to note that the opinions of scientists on GMOs are not unanimous. Some believe that GMO foods can be beneficial in biomedical research and play a significant role in both nutrition and the development of pharmaceutical products. These conflicting views reduce

consumer resistance to such products. The broader impact of using genetically modified products on human development is still unclear, and scientists continue to express contradictory opinions regarding their effects on human health. In summary, it is difficult to objectively assess the impact of GMOs on human health and the environment in a short period of time. While some see potential benefits, the long-term effects are still under study, and caution is advised when it comes to widespread use.

Conclusion

GMO foods are an important issue in terms of healthy nutrition both in our country and around the world. The significant increase in the use of GMO foods has sparked discussions. Some studies indicate that consuming GMO foods may have toxic effects on society, increase the frequency of allergic reactions, and even lead to a rise in cancer cases. On the other hand, all these studies and results pave the way for new research and scientific approaches. Today, scientists continue to conduct intensive research on GMOs. As a result, it can be said that there is no unified scientific consensus yet regarding the consumption of GMO foods [7-9].

In the coming years, it appears that biotechnological products will play a significant role not only in agricultural production but also in our entire lives. Despite the ongoing research on GMOs, it is currently impossible to make a definitive decision about their benefits or harms due to a lack of sufficient experimental evidence. In this context, immediate precautionary measures should be taken to minimize the potential effects and risks to our environment and future generations.

Relevant surveys show that consumers want to know whether the product they are purchasing contains GMOs. For this reason, it is considered extremely important to have "GMO" labels on products and to complete legal regulations on this matter immediately so that consumers can make informed choices. It is also crucial to inform the public about GMOs and provide training on this subject.

Despite all these conflicting views, considering the broad opportunities to achieve the intensive development of agricultural products in our country, we must make efficient use of these natural resources. In the name of protecting our health, we should strive to choose eco-friendly food products, avoiding products that look similar, appear attractive, have no taste or aroma, and don't spoil for days. Instead, we should give preference to products that naturally attract us with their purity and quality.

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*Работа поступила
в редакцию 29.12.2024 г.*

*Принята к публикации
12.01.2025 г.*

Ссылка для цитирования:

Mammadov H., Gulamova A. The Impact of Genetically Modified Organisms on Human Health // Бюллетень науки и практики. 2025. Т. 11. №2. С. 145-150. <https://doi.org/10.33619/2414-2948/111/18>

Cite as (APA):

Mammadov, H., & Gulamova, A. (2025). Impact of Genetically Modified Organisms on Human Health. *Bulletin of Science and Practice*, 11(2), 145-150. <https://doi.org/10.33619/2414-2948/111/18>