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# **MODERN SCIENCE: INNOVATIONS AND PROSPECTS**



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# **MODERN SCIENCE: INNOVATIONS AND PROSPECTS**

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# GENETICALLY MODIFIED ORGANISMS IN THE FOOD INDUSTRY

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Genetically modified plants were first commercialized in 1996, and since then the area of their cultivation has been growing every year. In 2006, genetically modified plants were grown in 22 countries on an area of more than 100 million hectares

What are these products? How and when did they appear? Why are they needed and are they needed at all? Are genetically modified products dangerous for health and what products on our table can be modified? These are not all the questions that arise in a person who cares about his health, and very few of them can be answered. Based on the above, it seems useful and even necessary to consider the issue of genetically modified foods in more detail: the history and reasons for their appearance, methods of their creation and research and, of course, the danger to the body. Thus, genetically modified products in various forms have been consumed in the last 10-12 years by hundreds of millions of people in different, including the most developed, countries. In the last few years, the area of GMO plants cultivation has been gradually increasing in the EU countries, which are often cited as an example of resistance to the spread of GMOs. In fact, in the EU in the period from 1999 to 2004 there was a temporary ban on the cultivation of GM plants, but there was no ban on the use of products derived from transgenic plants as human food and animal feed.

As of today, about 140 species of different plants have been transformed. At the same time, only a relatively small number of them have been commercialized (permitted for cultivation in open systems for industrial purposes, for use as food or animal feed).

In reality, only genetically modified lines of soybeans, corn, rapeseed, cotton, alfalfa, papaya and pumpkin have been present on the commercial market in recent years.

The main introduced trait inherent in most commercialized GMO plants is herbicide resistance and pest resistance.

Now it is known for sure that the use of GMO products can lead to allergic reactions. For example, in the USA, where GM products are freely consumed, about 70% of the population suffer from allergies. In Sweden, where such products are

banned, only 7%. It is hardly a coincidence.

The consequence of eating foods with transgenes is a violation of the structure of the gastric mucosa, the emergence of antibiotic-resistant intestinal microflora. The consequence may be the inability to treat many infectious diseases.

Another consequence may be a decrease in the immunity of the whole body (70% of human immunity is in the intestines), as well as metabolic disorders.

GMO products can cause cancer. Transgenes have the ability to be embedded in the genetic apparatus of intestinal microorganisms, and this is a mutation. As you know, it is cell mutations that lead to the development of cancer cells.

Since the possibility of certain changes in plant metabolism can theoretically be foreseen, the need for a thorough assessment of these products for biosafety is recognized worldwide.

There are three directions for conducting a comprehensive sanitary and epidemiological examination of food products derived from GMOs: assessment of medical and genetic, medical and biological and assessment of technological parameters. *Medical genetic evaluation* (based on polymerase chain reaction - PCR) includes the analysis of gene sequence, marker genes, promoters, terminators, stability and expression level of introduced genes. *Medical and biological evaluation* consists of several blocks of studies: compositional equivalence, chronic toxicity, special studies (allergenic properties, effect on immune status, reproductive function, mutagenicity, carcinogenicity, neuro- and genotoxicity). *Technological evaluation* determines organoleptic and physicochemical properties, as well as the impact of genetic modification on the technological parameters of products.

Bacteria were the first organisms to be genetically modified in the laboratory. Today they are used to produce a large number of human proteins that can be used in medicine. For example, genetically modified bacteria are used to produce insulin. Bacteria are also used to produce blood clotting factors for the treatment of hemophilia.

The main purpose of GM plants is to create new varieties with specific traits that are not inherent in plants of this species. Examples of such traits may be resistance to various kinds of herbicides, pests, resistance to adverse environmental conditions or the acquisition of new qualities of nutritional value.

To date, 5 methods are used to create transgenic animals:

- 1) introduction of DNA into the egg;
- 2) introduction of DNA into stem cells;
- 3) introduction of DNA using virus-based vectors;
- 4) transfection;
- 5) introduction of DNA using liposomes.

Genetically modified food is food derived from genetically modified

organisms. Genetically modified organisms acquire certain qualities through the transfer of individual genes into the genome of theoretically any organism (in the case of transgenesis) or from the genome of related species (cisgenesis).

Proponents of GMOs believe that GM inserts are completely broken down in the human gastrointestinal tract. They argue that the presence of recombinant DNA in food and feed in itself does not pose a health hazard, any DNA consists of nucleotide bases, and genetic modification leaves their chemical structure unchanged and does not increase the total content of genetic material. A person daily consumes DNA and RNA with food in the amount from 0.1 to 1.0 g depending on the type of food consumed and the degree of their technological processing.

Nowadays it is widely accepted to divide GM products into three categories. The *first* one is products that are compositionally absolutely similar to traditional ones (in terms of molecular and phenotypic characteristics, levels of key nutrients, anti-nutritional, toxic substances and allergens characteristic of this type of product or determined by the properties of transferable genes). They, like the analogue, are safe and, accordingly, like the analogue, do not require any additional research. Most GM plants currently grown for commercial purposes belong to the first group. The *second* is GM products that have certain differences associated with the introduction of a new gene, the synthesis of a new protein. In this case, research focuses on this protein, on the characteristics of its properties. *Third* - in the future there may be products with deliberately changed compositional chemical composition (vitamin, protein), then, of course, other studies will be needed.

Proponents of GMOs believe that GM inserts are completely broken down in the human gastrointestinal tract. They argue that the presence of recombinant DNA in food and feed in itself does not pose a danger to human and animal health, compared to traditional products, because any DNA consists of nucleotide bases, and genetic modification leaves their chemical structure unchanged and does not increase the total content of genetic material. Every day a person consumes DNA and RNA with food in the amount from 0.1 to 1.0 g depending on the type of food consumed and the degree of their technological processing.

In this regard, the law "On the State System of Biosafety in the Creation, Testing, Transportation and Use of Genetically Modified Organisms" was adopted, which obliges manufacturers to label food products for the presence or absence of GMOs.

Advantages of GM food. Transgenic plants (TP) contribute to productivity growth due to their resistance to herbicides, pests, diseases. This allows you to save the part of the crop that was previously lost due to biotic stress factors and ineffective protection.

TP can be given useful properties. For example, British scientists have



developed a new variety of rice - "golden rice" - genetically improved with betacarotene, which is converted into vitamin A in the human body.

Improved corn, soybeans and rapeseed produce vegetable oil with a reduced amount of saturated fat.

Transgenic varieties of potatoes and corn have more starch and less water. When frying such potatoes, little oil is needed and it is easier to digest by the stomach. Modified tomatoes, pumpkins and potatoes retain vitamins C, E and betacarotene better.

TP can be used for pharmacological purposes as biofactories for the production of interleukin proteins, stimulating the protective properties of humans (in particular carrots, bananas, etc.).

Summarizing the above, it can be concluded that the use of TP:

- increases the productivity of agricultural crops;
- allows to increase agricultural production without expanding arable land;
- reduces environmental damage from the use of pesticides;
- allows to obtain economic benefits by reducing labor costs and saving energy resources.

Disadvantages of using GM food. Scientists and experts associate the potential danger of transgenic organisms with the following possible negative consequences;

Displacement of natural organisms from their ecological niches with subsequent disruption of ecological balance. These risks are associated primarily with the emergence of superweeds, the formation of new, resistant to poisons, insect populations, genetic contamination and irreversible loss of traditional varieties of the most important crops, as well as with the growth of chemical pollution of the environment by pesticides.

Reduction of biodiversity. GMOs pose a risk to biodiversity (including genetic biodiversity) because they interact in nature with all living things around them. Scientists have identified several problem areas - the emergence of new pests, super weeds, genetic contamination, cross-pollination of GM crops and conventional crops, the emergence of new viruses, as well as other private "weaknesses" depending on the type of GMO.

Uncontrolled transfer of foreign genes from transgenic organisms to natural ones, which is likely to lead to the activation of previously known or the formation of new pathogens. Transgenic constructs have the ability to move into other plants, related or of the same type. Genetically modified material is transferred in pollen by, say, wind to neighboring fields.

Conventionally, the risks associated with the use of GM food can be divided by the object of action:

- environmental

- medical; and
- socio-economic.

Medical risks deserve a detailed consideration, since the impact of such products on health is in the first place for consumers.

Transgenes can cause:

- increased allergenicity;
- possible toxicity.

Genetically modified manipulations endow plants or animals with uncharacteristic properties. At the same time, a problem arises: it is almost impossible to stop or predict the process of functioning of the combined gene, so there is no certainty that genetically modified plants that we eat will not produce new toxins;

- resistance to antibiotics.

Thus, completely new products with improved or modified nutritional value, resistant to climatic factors, soil salinity, as well as having a longer shelf life and improved taste, characterized by the absence of allergens, will continue to be created. The more distant future is plants that produce certain chemical compounds, vaccines and so on. And this is not a fantasy. Laboratory developments show the effectiveness of this direction.

And in the future, the cultures of the third generation (since about 2015). In addition to the above qualities, they will be characterized by a change in plant architecture, for example, stunting as a factor of stability in windy areas. Or a change in flowering and fruiting time - then it will be possible to grow tropical fruits in the middle lane. Or a change in the size, shape and number of fruits. Or the growth of photosynthesis efficiency - this will lead to an increase in oxygen content in the air. Or the production of nutrients with an increased level of assimilation, which are better absorbed by the body.

It will take 40-50 years to prove all the consequences of consuming GMO products. Therefore, in order not to get problems and diseases, it will not be superfluous to be careful when choosing food.