Objects of modern biotechnology in food industry and agriculture

Zalina Mayrbekovna Ibragimova[1,*], *Elmira Faylovna* Amirova[2,3], and *Olga Mikhailovna* Shvets[4]

[1]Kadyrov Chechen State University, Grozny, Russia
[2]Kazan Federal University, Kazan, Russia
[3]Kazan State Agrarian University, Kazan, Russia
[4]Kursk State Agrarian University named after. I.I.Ivanova, Kursk, Russia

Abstract. This article analyzes the purpose of modern biotechnology in the food industry and agriculture. The concept, characteristics, and role of biotechnology are examined. Trends and main stages of biotechnology production are identified. The purpose and main directions of biotechnology in the food industry and agriculture are presented, its characteristics and benefits are discussed. Promising directions of biotechnology in the food industry and agriculture are described.

1 Introduction

The role of scientific and technological progress in modern economic development is becoming noticeably more important. This increased role can be attributed to the continuous transformation of science into a direct productive force. By implementing the practical results of scientific and technical endeavors, humanity acquires the ability to conserve raw materials, increase labor productivity, improve the quality of manufactured goods, and increase the efficiency of capital investments.

Biotechnology as a whole represents a rapidly developing area of science that is firmly entrenched in the field of scientific research, with applications in the food industry and agriculture. Food biotechnology is primarily concerned with building the theoretical and applied foundations for innovating new food sources and forms. It involves the study of various functional and technological aspects of food systems and explores their biological effects on the human body. The practical potential of biotechnology in the food industry and agriculture emphasizes the importance of examining its core nature and potential applications.

The purpose of the present study is to investigate the reality of modern biotechnology in the food industry and agriculture. To achieve this purpose, analytical and synthetic methods were used by analyzing scientific publications and literary materials related to the topic. Biotechnology encompasses all modes of human activity related to the production of products from raw materials using living organisms [3]. Biotechnology research encompasses a wide range of topics, especially molecular and genetic engineering,

*Corresponding author: iibragimovazlina@mail.ru

systematic and analytical biotechnology, energy, food, environmental biotechnology, and animal and plant biotechnology.

The efficiency and prospects of utilizing biotechnology processes in various domains are supported by their simultaneous large-scale and small-scale nature, increased productivity, and labor mechanization. This provides opportunities for control, regulation, and automation [4]. Unlike chemical processes, biotechnology processes occur under "mild" conditions characterized by low environmental temperatures and standard pressures. This reduces environmental pollution from waste and secondary products, reduces dependence on weather and climatic conditions, eliminates the need for external environmental factors, and removes the requirement for significant land area.

Modern biotechnology uses biological systems at all levels to create entirely new biological systems. These newly formed systems, together with non-biological components such as materials, technological devices, control systems, power supplies, and monitoring systems, form functional systems [5]. The main branches of modern biotechnology consist of microbial synthesis, which utilizes microorganisms to produce various materials, and cellular and genetic engineering, which entails the engineering of genetically modified organisms.

The main trajectory of biotechnology manufacturing advancement revolves around increasing productivity and intensifying all processes [6]. To achieve these goals, the integration of high-yielding producers and the adoption of highly efficient technologies are practiced. The development of biotechnology production is a relatively complex procedure involving subsequent steps:

- Select an organism, which can be a microorganism or an isolated cell, and obtain a pure culture of it.
- Select a suitable substrate.
- Design a technological device.
- Optimize cultivation conditions.
- Implement automated process control.
- Develop methods to isolate and purify the final product.

2 Research Methodology

Materials used in food biotechnology encompass a wide range of prokaryotic and eukaryotic organisms and represent a wide diversity in terms of biological properties and structural composition [7]. These biotechnological entities include.

- Bacteria and cyanobacteria;
- Viruses;
- Lichens;
- -Algae;
- Aquatic plants;
- -Fungi;
- Cells of plants and animals.

The category of lower plants includes a wide range of organisms, including microscopic unicellular and multicellular entities as well as much larger organisms. They share common features such as various methods of reproduction and the absence of body differentiation into trophic structures. Various important applications in the food industry and agriculture utilize these biotechnological entities. One such application involves the development of biological agents that rely on living rhizosphere microorganisms as an environmentally friendly alternative to pesticides commonly used in agriculture [8]. These biological agents serve a variety of functions.

– Improve the quality and yield of agricultural products.
– Protect plants from pathogenic fungi, viruses, bacteria, nematode larvae, and pests.
– Thanks to bacterial antagonists in biological preparations, the composition of pesticides is maintained. When these organisms inhabit the rhizosphere and phylosphere, they acquire the status of natural components, which ensures a long-lasting impact.
– Strengthens the immunity of crops.
– Promotes plant development and growth through the ability of rhizosphere microorganisms to nourish beneficial biota through symbiosis with root exudates.
– Absorb atmospheric nitrogen and convert potassium, phosphorus, essential minerals and trace elements in the soil into compounds accessible to plants.
– Produce vitamins, growth promoters, and plant phytohormones such as auxins, gibberellins, ethylene, cytokinins, etc.
– Synthesize essential vitamins, amino acids, and plant biostimulants.
– Restore soil fertility, improving soil structure and increasing biodiversity.

The widespread use of biologicals can be attributed to their environmentally friendly properties, lack of resistance problems, high specificity, cost-effectiveness, and ability to be applied at different growth stages [9].

3 Results and Discussions

An emerging and actively developing area of biotechnology research includes the development of products with probiotic and prebiotic properties [10]. More than half of the developments in this area are related to functional foods, about 40% to food and feed additives, and about 10% to pharmaceutical formulations. Interest in probiotics stems from their biological safety, ability to enhance immune responsiveness, and ability to normalize digestion without developing resistance in pathogenic microorganisms. In animal agriculture, probiotics offer the opportunity to eliminate the use of antibiotics in animal feed, improving digestion and reducing overall disease incidence. The most well-known probiotics are those based on organisms found in the normal intestinal biota, such as lactic acid bacteria and bifidobacteria. However, these microorganisms are highly sensitive to environmental factors, so products derived from them are less stable than those produced by spore-forming bacteria. Several promising directions in biotechnology for the food industry and agriculture can be outlined [11].

– Identify and analyze genes responsible for enzymatic protein synthesis and study the regulatory mechanisms that control their expression.
– Selection and subsequent genetic engineering of microorganisms that act as competitive enzyme producers.
– Development of a new generation of biosensors that incorporate nanomaterials into bio-receptor elements.
– Utilizing live yeasts and their biologically active metabolites to create feed products with multi-faceted impacts.
– Establishing innovative import substitution biotechnology for the food industry and agriculture.

4 Conclusions

Biotechnology offers great potential as a developmental tool that affects all aspects of human life. Its application in the food industry and agriculture plays an important role in shaping the bioeconomy and biosociety, which reflect the emergence of modern innovation-driven civilization. When carrying out practical planning for the development

and integration of industrial innovations, it is important to describe the unique characteristics of biotechnologies. It is essential to obtain a holistic understanding of all economic and environmental processes involved in their implementation, preceded by a thorough theoretical review of how they are used.planet.

Modern biotechnology is a pivotal force driving progress within the food industry and agriculture. The expanding array of biotechnology entities encompassing microorganisms, genetically modified organisms, and various biological systems play a central role in improving product quality, increasing yields, and reducing harmful ecological impacts.

Microscopic beings such as bacteria, viruses, and fungi occupy an integral place in biotechnology investigation and manufacturing; they find utility in the manufacture of biologics, probiotics, antagonists against pathogenic microorganisms, and other goods that amplify crop productivity and actively contribute to fostering plant well-being.

The field of genetically modified organisms (GMOs) offers new prospects for enhancing the characteristics of cultivated plants and making them more resilient to diseases, pests, and adverse environmental conditions.

One important aspect of biotechnology's progress in these areas is the constant search for sustainable and environmentally friendly solutions: biotechnology plays a role in facilitating the development of products with a reduced ecological footprint, which in turn reduces the need for chemical fertilizers and pesticides.

Nevertheless, despite the significant milestones achieved, it is essential to perform due diligence in addressing the ethical and social aspects of biotechnology applications. Balancing the potential benefits of biotechnology utilization with the preservation of biodiversity, human health, and environmental stability is paramount.

In summary, modern biotechnology appears to be an innovative and auspicious mechanism for increasing productivity and improving product quality in the food industry and agriculture. The development and skillful implementation of biotechnological elements in these sectors constitutes a fundamental step towards the establishment of a sustainable and harmonious food production system for the collective society.

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