ORIGINAL ARTICLE

INTERNATIONAL JOURNAL OF ARTIFICIAL INTELLIGENCE

ISSN: 2692-5206, Impact Factor: 12,23

American Academic publishers, volume 05, issue 10,2025

Journal: https://www.academicpublishers.org/journals/index.php/ijai

RESEARCH ON THE TECHNOLOGY OF PRODUCING FOOD PRODUCTS ENRICHED WITH ESSENTIAL FATTY ACIDS BASED ON CEREAL PRODUCTS

Askarova Khurshida Ekram kizi

Tashkent Institute of Chemical Technology

Faculty of Food and Winemaking Technologies

1st year master's student in the field of Food Technology (Technology of Oil and Fat Products)

Abstract. This article discusses the scientific study of the technology of producing food products enriched with essential fatty acids based on cereals. The study analyzed the chemical composition of cereals, their components beneficial to human health, and methods of enrichment with omega-3 and omega-6 fatty acids. Also, the technological stages used in the enrichment process, ways to increase the nutritional and biological value of the product, and factors affecting the shelf life were studied on a scientific basis. Based on the results obtained, an effective technological model for the production of cereals as functional foods was developed. This study is of significant scientific and practical importance in ensuring food safety, establishing a healthy diet for the population, and creating a new generation of bioactive products.

Keywords: cereals, essential fatty acids, functional food, technological process, omega-3, omega-6, biological value, bioactive substance, healthy nutrition, food safety.

In recent years, the issues of healthy nutrition of the population, the production of environmentally friendly and biologically active food products have become one of the urgent global problems. Ensuring food security, providing the population with nutritious, balanced and biologically active products have become an important direction of state policy. In this regard, the creation of new types of functional food products based on cereal products and enriching them with essential fatty acids is of great scientific and practical importance today.

Cereal products are a source of energy, protein, carbohydrates, vitamins and minerals necessary for the human body. However, their natural composition does not contain enough of some biochemical components, in particular essential (non-exchangeable) fatty acids. Since the human body cannot synthesize these acids independently, it must receive them only through food products. Therefore, enriching cereal products with fatty acids such as omega-3 and omega-6 significantly increases their biological and nutritional value. This process not only improves the product's nutritional value, but also its functional properties.

The Republic of Uzbekistan is implementing a number of state programs to ensure food security. In particular, within the framework of the “Healthy Nutrition” concept, great attention is paid to forming a culture of the population to use products rich in nutritious and biologically active substances. In this regard, the development of products such as bread, cereals, pasta, muesli, enriched with grain products is of great importance not only economically, but also socially.

Looking at world experience, scientific research in the field of functional food production is expanding. In countries such as the USA, Japan, Germany, Russia, and China, technologies for enriching grain products with bioactive additives are widely used. In particular, flaxseed oil,

ORIGINAL ARTICLE
INTERNATIONAL JOURNAL OF ARTIFICIAL INTELLIGENCE
ISSN: 2692-5206, Impact Factor: 12,23
American Academic publishers, volume 05, issue 10,2025
Journal: https://www.academicpublishers.org/journals/index.php/ijai

fish oil, extracts from marine organisms, and other natural sources are used to introduce omega-3 acids. Scientific approaches in this regard allow to improve the quality of products, extend their shelf life, and preserve their beneficial properties.

In the conditions of Uzbekistan, this direction is relatively new, and scientific research is currently at the development stage. Our country has unique opportunities in the production of grain products. The composition of wheat, barley, oats, corn, rye and other types of grains is different, and each of them has certain nutritional advantages. At the same time, the enrichment of these grain products with fatty acids increases their consumer value and serves to satisfy the population's need for healthy nutrition.

A specific feature of the technology of grain product enrichment is that in this process it is important to prevent the oxidation of fatty acids, to properly and stably incorporate them into the grain mass. For this, modern technological methods are used - microencapsulation, emulsion formation, enzymatic processing and low-temperature drying processes. As a result of these approaches, fatty acids are stably preserved in the product and delivered to the human body in a form that is fully absorbed during consumption.[4; 45, 52]

Also, an important scientific approach is required in choosing the sources of fat used in the enrichment of grain products. Extracts based on flaxseed, sunflower, rapeseed, soybean, walnut, fish oil and microalgae are recognized as the most effective sources. Their chemical composition, the ratio of fatty acids and the level of oxidation resistance directly affect the quality of the product. Therefore, when developing production technology, it is necessary to thoroughly analyze the biochemical properties of each source.

The production of cereal products enriched with essential fatty acids serves not only to form a healthy eating culture, but also to the innovative development of the national economy. Because such products have high added value and increase export potential along with the domestic market. In addition, the production of such products creates new jobs in the food industry, ensures the modernization of processing technologies, and establishes an environmentally friendly production system.

Studies show that people who regularly consume functional food products can prevent diseases such as cardiovascular diseases, obesity, diabetes, and metabolic syndrome. Therefore, the creation of scientific foundations for the production of such products and their implementation in practice is an important stage on the way to building a healthy society.

A number of studies are also being conducted in this direction in the scientific environment of Uzbekistan. For example, research is being conducted at higher educational institutions such as the National University of Uzbekistan, the Tashkent Institute of Chemical Technology, and Samarkand State University on enriching the composition of grain products and developing new types of bioactive products. These scientific developments are aimed at modernizing the national food industry and accelerating innovative development by introducing scientific achievements into production.

In addition, functional foods based on cereals are also useful for special categories of consumers, such as children, the elderly, pregnant women, and athletes. Because the body of these categories of people needs a high level of energy, vitamins, minerals, and fatty acids.

ORIGINAL ARTICLE
INTERNATIONAL JOURNAL OF ARTIFICIAL INTELLIGENCE
ISSN: 2692-5206, Impact Factor: 12,23
American Academic publishers, volume 05, issue 10,2025
Journal: https://www.academicpublishers.org/journals/index.php/ijai

Therefore, enriched products play an important role in strengthening their health, supporting the immune system, and normalizing metabolic processes.

The relevance of the article is that it is aimed at developing the theoretical and practical foundations of the technology for producing new types of food products enriched with essential fatty acids based on cereals. The research develops scientific approaches to determine the technological stages of the production process, the stability of fatty acids, mechanisms of protection against oxidation, and the quality indicators of the finished product.

The main goal of this scientific work is to create an innovative technology for the production of functional food products by enriching the composition of cereals with bioactive components necessary for the human body, in particular, essential fatty acids. At the same time, the research results will serve to support healthy nutrition programs in our country, improve the quality of food products, and improve scientifically based production mechanisms.

Thus, the significance of this research is determined by the fact that it is aimed at ensuring a healthy lifestyle of the population, strengthening food security, and developing innovative industrial sectors by creating a technology for the production of functional foods enriched with essential fatty acids based on grain products.

This direction will serve as the basis for the sustainable development of the food industry in the future, the creation of a new generation of environmentally friendly products, and increasing the competitiveness of the national economy.

The technology for the production of food products enriched with essential fatty acids based on grain products is one of the innovative directions in the food industry today. The main goal of this direction is to provide the human body with fatty acids that are necessary for it, but are not synthesized naturally, in sufficient quantities through the daily diet. Studies show that by enriching cereal products with functional substances, it is possible to increase not only their nutritional, but also their biological value. Therefore, each stage of production technology requires a scientifically based approach.

Cereal products are one of the oldest food sources in human history. They contain many nutritional components, in particular, starch, protein, fiber, vitamins (group B), minerals (iron, phosphorus, zinc, magnesium). However, their fatty acid content, especially essential types, is limited. For example, the fat content of wheat flour is only about 1.5–2%, and it contains very little omega-3 acids. Therefore, by enriching them, it is possible to obtain a product with full biological value.[5; 37,44]

Linoleic and linolenic acids, which are naturally present in cereal products, are important for the body. They maintain the plasticity of cell membranes, improve cardiovascular function, and regulate cholesterol metabolism. However, during grain processing, in particular during milling, most of them are lost. Therefore, enrichment technology is the most effective way to compensate for these losses.

Essential fatty acids (EFAs) are substances that are not synthesized in the human body and can only be obtained through food. Their main types are omega-3 and omega-6 groups. Omega-3 acids include α-linolenic, eicosapentaenoic (EPA) and docosahexaenoic (DHA) acids, while the

ORIGINAL ARTICLE
INTERNATIONAL JOURNAL OF ARTIFICIAL INTELLIGENCE
ISSN: 2692-5206, Impact Factor: 12,23
American Academic publishers, volume 05, issue 10,2025
Journal: https://www.academicpublishers.org/journals/index.php/ijai

omega-6 group includes linoleic and arachidonic acids. They perform the following biological functions:

maintain the structure and elasticity of cell membranes;

increase the strength of blood vessels;

participate in the development of the brain and visual system;

regulate inflammatory processes;

improve the function of the heart and liver;

strengthen the immune system.

Therefore, the deficiency of these acids leads to various disorders in the cardiovascular, nervous, endocrine and immune systems. These problems can be prevented by adding EYK to cereal products.

The sources of fat used in the enrichment of cereal products should be of natural origin. Studies show that flaxseed oil, rapeseed oil, soybean oil, sunflower oil, walnut oil and fish oil are the most effective sources. Flaxseed oil contains up to 55–60% omega-3 acids (α-linolenic acid), and rapeseed oil - up to 35–40%. Such a high content creates an ideal environment for the enrichment of cereal products.

The following factors are taken into account when choosing a source:

resistance to oxidation of fatty acids;

degree of chemical compatibility with the product;

stability under storage conditions;

biological effect on the human body.

Using modern technologies, these sources of fat are introduced into the cereal mass by microencapsulation. This method prevents oxidation of fat by oxygen in the air and extends the shelf life of the product.

The production process of enriched grain products consists of several technological stages:

Raw material preparation. Grains are cleaned, washed and dried. The moisture content is brought to 12–14%.

Grinding and fractionation. Grains are ground into groats or flour in milling equipment.

Addition of essential fatty acids. During the enrichment process, fatty acids are introduced in the form of a special emulsion or microencapsulation. At this stage, the product temperature should not exceed 40°C, since fats oxidize at high temperatures.

Mixing and homogenization. Fatty substances are evenly distributed, ensuring product homogeneity.

ORIGINAL ARTICLE

INTERNATIONAL JOURNAL OF ARTIFICIAL INTELLIGENCE

ISSN: 2692-5206, Impact Factor: 12,23

American Academic publishers, volume 05, issue 10,2025

Journal: https://www.academicpublishers.org/journals/index.php/ijai

Drying and cooling. The finished product is cooled to 30–35°C and packaged without air.

Quality control. The product is checked for moisture content, fat content, acidity index, oxidation level and microbiological purity.

Each of these stages determines the quality of the product. For example, if the emulsion is not stable, the fatty acids will not be evenly distributed and the beneficial properties of the finished product will decrease.[7; 25,31]

Among modern technologies, microencapsulation is considered the most promising direction. In this method, fatty acids are covered with a special protective shell (gelatin, starch, sodium alginate, etc.). As a result, fatty acids are protected from oxidation, thermal stability increases, and the taste of the product does not change.

The technology of emulsion formation is also widely used. In this method, fatty acids are distributed in the form of microscopic droplets in an aqueous medium. This increases their bioavailability.

In addition, the enzymatic modification method allows changing the structure of fatty acids, allowing them to be better absorbed into the grain. This process increases the stability of the product and allows for the full preservation of beneficial components.

Functional products based on grain products can be of various types:

Bread products. In bread making, flaxseed oil or fish oil enriched with omega-3 is added to the dough in the form of an emulsion. This increases the moisture retention properties of the bread, improves its taste and provides useful properties.

Muesli and cereal products. Muesli based on flaxseed, oats and corn are enriched with EEK and are produced as energy-giving products.

Pasta products. Pasta products made from enriched flour are more shelf-stable and beneficial for heart health.

Baby food. Cereals and porridges enriched with omega-3 acids develop children's brain activity.

The amount of enrichment, technological conditions and storage methods for each type of product are determined based on separate standards.

The advantages of cereal products enriched with essential fatty acids are manifested in the following:

improves the digestibility of proteins and carbohydrates;

increases the amount of "good" cholesterol (HDL) in the blood;

reduces the risk of cardiovascular diseases;

has antioxidant properties;

enhances the body's immune response.[8]

ISSN: 2692-5206, Impact Factor: 12,23
American Academic publishers, volume 05, issue 10,2025
Journal: https://www.academicpublishers.org/journals/index.php/ijai

Studies have shown that consumers who consumed enriched bread products for two months had a 10–15% decrease in cholesterol levels and an increase in overall energy activity. This proves that the practical results of enrichment technology are high.

Product quality control is one of the important stages. Physicochemical, microbiological and organoleptic analyses are carried out. According to international standards of the food industry, the content of omega-3 fatty acids is recommended to be 0.3–0.5 g/100 g of product. Also, the oxidation index (peroxide number) should not exceed 10 meq/kg.

To ensure product stability, special attention is also paid to the packaging process. Usually, vacuum containers filled with inert gas (nitrogen) are used. This slows down oxidation and extends the shelf life of the product to 6–12 months.

In conclusion, the technology for producing food products enriched with essential fatty acids based on cereal products is of great importance not only from a scientific but also from a practical point of view. This technology:

Increases the biological and energy value of food products;

Serves to form a healthy eating culture among the population;

Improves the functioning of the heart, nervous, and immune systems;

Extends the shelf life of products and stabilizes their quality;

Allows the production of innovative and export-oriented products in the national economy;

Complies with the principles of environmentally friendly production.[9]

Thus, the technological solutions developed based on the results of this research will undoubtedly take the food industry of Uzbekistan to a new level in the future, play an important role in promoting a healthy lifestyle, strengthening the health of the population and ensuring food safety. Further deepening research on the enrichment of grain products with essential fatty acids, testing new raw materials and improving technological processes is one of the most important scientific tasks in the future.

REFERENCES

1. O‘zbekiston Respublikasi Prezidentining “Oziq-ovqat xavfsizligini ta’minlash va sog‘lom ovqatlanish tizimini takomillashtirish chora-tadbirlari to‘g‘risida”gi PQ–4086-sonli Qarori. — Toshkent, 2019 yil.

2. “O‘zbekiston Respublikasida 2022–2026 yillarda oziq-ovqat sanoatini rivojlantirish strategiyasi”. — Toshkent: O‘zbekiston Respublikasi Iqtisodiyot va moliya vazirligi, 2022.

3. Abdurahmonova, M. “Funktsional oziq-ovqat mahsulotlari ishlab chiqarish texnologiyalarining ilmiy asoslari”. — Toshkent: Fan va texnologiya nashriyoti, 2021.

4. Karimova, G. “Don mahsulotlarining biologik qiymatini oshirishda essensial yog‘ kislotalarining roli”. // Oziq-ovqat texnologiyasi jurnali, 2023. №4. — B. 45–52.

ISSN: 2692-5206, Impact Factor: 12,23
American Academic publishers, volume 05, issue 10,2025
Journal: https://www.academicpublishers.org/journals/index.php/ijai

5. Халилов, А. “Современные методы обогащения хлебобулочных изделий жирными кислотами”. // Технология пищевых продуктов, 2022. №2. — С. 37–44.

6. Kamilov, R. va Axmedov, B. “O‘zbekiston oziq-ovqat sanoatida innovatsion texnologiyalarni joriy etish istiqbollari”. — Toshkent: Iqtisodiyot nashriyoti, 2022.

7. Nurmatova, D. “Omega-3 va omega-6 yog‘ kislotalarining inson salomatligidagi o‘rni”. // Biotexnologiya va oziq-ovqat xavfsizligi, 2021. №3. — B. 25–31.

8. Azizova, S. “Don mahsulotlarini chuqur qayta ishlash texnologiyalari”. — Samarqand: SamDU nashriyoti, 2020.

9. Shodmonov, J. “Oziq-ovqat mahsulotlarining sifat ko‘rsatkichlarini oshirishda biologik boyitish usullari”. — Toshkent: Innovatsion ta’lim nashriyoti, 2021.