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Impact of Functional Foods on Improving the Health of the Kazakh Population

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Abstract

Background: This study investigates the influence of functional foods (FFs) on the health of the Kazakh population and their potential in preventing diseases associated with inadequate and unbalanced nutrition.

Methods: The research is based on an unstructured telephone interview conducted with experts in the production, sale, and consumption of functional foods in Kazakhstan. The experts provided insights into current trends in the Kazakh functional food market, factors driving the demand for FFs, and the preferences of the Kazakh population concerning functional foods.

Result: The analysis revealed significant factors contributing to the growth in demand for FFs among the Kazakh population. These factors include an increasing interest in healthy lifestyles, marketing strategies promoting FFs, and the endorsement of biologically active supplements by medical professionals. The study also identified the most favored FFs among Kazakh consumers, with a particular preference for various pro- and synbiotic dairy products, prebiotic grain-based foods, sweetened foods, and vitamin-enriched products.

Conclusion: The findings highlight the potential of FFs in positively impacting the health of the Kazakh population and promoting preventive nutrition practices. The study emphasizes the importance of considering the general nutritional status and disease incidence in developing the range structure of FFs in Kazakhstan. The research underscores the need for a well-informed and targeted approach to meet the specific dietary requirements and preferences of the Kazakh population, thereby contributing to improved overall health and well-being.

Introduction

Nutrition is one of the most important environmental factors [1] which directly affects the human body throughout life. Biological components of food, being transformed during metabolism into structural and functional elements of cells of a living organism, ensure its physical and mental performance, adaptive capabilities, immune status, determining the state of human health, life expectancy, social and individual activity. Therefore, one of the defining features in the current stage of social development is that the problem of maintaining the health of the population, increasing the life expectancy of each individual has ceased to be the focus of only biology and medicine and has taken a significant place in the development of the latest food technologies, determining their direction and priorities.

The global food market is developing according to trends in the global economy; therefore, the market mainly reflects its inherent patterns. The development of the modern food market is influenced by the following circumstances: the need to increase production efficiency through increased competition [2]; increasing the level of awareness and education of the population on nutrition issues [3]; a gradual change in consumer preferences and requirements [4]; production of high quality products at the lowest cost [5], mandatory guarantees of food quality and safety at all stages of distribution [6].

The problem of improving the structure of nutrition and the quality and safety of food products as the basis of human life is today one of the most crucial for increasing the sustainable development of society [7,8]. At the same time, the accumulated global practices show that it is almost impossible to solve this problem of rapid adjustment of the nutritional structure by simply increasing production volumes and expanding the range of traditional food products [9]. Based on this, food manufacturers very often view the food market as a combination of individual segments with different preferences, differentiated demand, and purchasing power [10].

Research [11,12] shows that in modern society, only traditional nutrition inevitably leads to certain types of nutritional deficiencies, the causes of which are protein deficiency, lack of vitamins and other macro- and micronutrients, consumption of refined foods, widespread use of a variety of food additives [13] that have no biological value. The search for alternative ways to solve this important problem led scientists and practitioners to the idea of the need to develop and implement new, much more advanced technologies to produce foods the compositional breakdown of which is adequate to the needs of the modern person.

We believe that by meeting the body's need for the necessary substances to the maximum, it is possible to improve the quality of human life, give strength and energy for a comfortable existence in any period of life. This function is best fulfilled by functional foods (FFs), that is, those that contain active ingredients. Due to their balanced composition, the use of FFs is one of the best ways to provide a person with the opportunity to adapt to the physiological changes taking place in the body and guarantee its resistance to external factors [14].The creation of FFs is aimed at enriching diets with a sufficient amount of effective components that improve the functioning of human organs and systems [15]. The specific nature of preventive nutrition lies in the targeted need to reduce the number of risks, namely: impact of environmental factors on the body; the development of diseases by increasing the protective functions of the physiological barriers of the human body and regulating the biotransformation of foreign compounds with their removal from the human body; deficiency of essential nutrients and increase the overall resistance of the human body [16].

In 1999, the European Commission Concerted Action on Functional Food Science in Europe (FUFOSE) was established [17]. The work of the commission was aimed at developing and validating a science-based approach to the development of food production that can positively influence certain physiological functions, as well as improve health and well-being and reduce the risk of disease [18]. This gave impetus to the practical implementation of the concept of functional nutrition in Europe and the introduction of the term "FFs", by which it is proposed to understand products that a) ensure one or more target functions of the body after adequate nutritional effects by the way that is appropriate for any improvement in health and well-being and reducing the risk of disease; b) are not tablets, capsules or other forms of dietary supplements; c) are consumed as part of a normal diet [19].For FFs there is a special procedure for introduction into production and promotion on the market. Researchers [20] explain such caution by the fact that among innovative food products there are products that contain products of microbiological synthesis, algae, or genetically modified raw materials. It should be noted that the FF group is at the initial stage of introduction into the practice of food safety and quality control. Basically, international practices are focused on creating a list of permitted prescription components with guaranteed safety of consumption. An exception is Japan, where there are clearly defined groups of FFs, and in the FOSHU (Food of Special Health Using) system there is a classification by two directions [21]:

- by groups of goods: dairy products; confectionery; drinks, including dairy; vitamin

drinks; sugar-free products; semi-finished products, ready-to-eat meals; nutritional supplements; products for weight loss; organic foods (those that do not contain artificial or technologically processed components);

- by functional components, products containing: prebiotics (xylooligosaccharides, fructooligosaccharides, etc.); probiotics (live cultures of bifidobacteria, lactic acid bacteria, etc.); mineral substances over the daily norm; dietary fiber (polydextrin, bran, etc.); nutrients that regulate blood pressure (oligopeptides, lactopeptides, etc.); nutrients that regulate cholesterol in the body (soy protein isolate, alginic acid salts, etc.).

Japanese researchers [21] identified three conditions that determine the functions of food products: 1) food products prepared from natural ingredients; 2) foods that are constantly consumed as part of the daily diet; 3) when consumed, these products have a certain effect, regulating certain processes in the body, for example, strengthening the biological defense mechanism, preventing a certain disease, controlling the physical and mental state, slowing down the aging process. Scientists [22] identify a distinction between FFs and "nutraceuticals" – the form of manufacture. Nutraceuticals are pharmaceuticals or dietary supplements, while FFs are common food products with a clear physiological effect.

Our analysis of studies on the FFs, published over the past 20 years, led to the conclusion that there are both broad (detailed) and narrow interpretations of the essence of the term "FF". Thus, in our opinion, the essence of a FF is narrowly, although quite accurately, described in [10], where it is proposed to define it as a product that:

- has been altered or enriched with natural substances with a specific physiological preventive and/or healing effect;
- is part of the normal daily intake of food/liquid by a certain individual.

A more detailed interpretation is given by A.A. Kochetkova [16] who believes that FFs are products of natural or artificial origin intended for systematic daily use and having a regulatory effect on physiological functions, biochemical reactions, and psychosocial behavior of a person due to the normalization of the microecological status of their body. Even more comprehensive and broad definition from a practical point of view was given by E.L. O'Connor and K.M. White [23] who believe that the FF group should include, first, natural, unmodified food products; second, food products where one of the components is enhanced with the help of special conditions for its growth, creation or biotechnological means; third, food products in which it is necessary to add components to ensure the desired effect; fourth, food products in which the component has been moved by technological or biotechnological means in such a way as to provide an effect that is otherwise impossible to obtain; fifth, foods in which one component has been replaced by an alternative component with favorable properties; sixth, food products in which the component has been modified by enzymatic, chemical or technological means to provide the desired effect; seventh, food products that combine any of the above.

Based on the above, we propose to define FFs as a variety of health-improving food products that have been enriched with substances with a specific physiological preventive or health-related effect (including enriched by introducing various biologically active supplements into the food production technology) and/or modified by enzymatic, chemical or technological means or in which the component has been moved by technological or biotechnological means and which can be consumed regularly as part of the daily diet, helping to reduce the risk of disease, improve physiological processes in the body and restore health (primarily by compensating for the deficiency of biologically active components and maintaining the normal functional activity of all organs and systems of the human body). At the present stage of the economic development of the food market, seven main types of functional ingredients are efficiently used, among them – dietary fiber, vitamins (A, B, D, etc.), minerals (calcium, iron, iodine, selenium, etc.), polyunsaturated fatty acids, antioxidants (P-carotene, ascorbic acid, a-tocopherol, etc.), prebiotics (inulin, fructooligosaccharide, lactic acid, etc.), probiotics (bifidus- and lactobacteria, yeast, higher fungi) [24].Naturally, for a significant socio-economic effect, it is necessary to apply an integrated approach to solving the problem of forming the consumer properties of products and the development of their range structure. For example, in 2015, 78% of American consumers opted for fortified foods. Compared to 2014, their number has increased by 35% [25]. In general, the analysis of the US FF market and its trends indicate that beverages and grain-based products will remain the main group in the structure of FFs. The rest of the products are ready-made breakfasts, snacks, and dairy products [26]. The Kazakhstan FF market is gradually filled with domestic products as part of import substitution, which includes fermented milk products, various drinks enriched with vitamins, minerals, and soluble dietary fiber. There are also baked goods, ready-made breakfast meals, and confectionery. There are now fatty products with an improved fatty acid

composition due to their enrichment with sources of polyunsaturated fatty acids, fortified [27].FFs are by far the fastest-growing segment of the food industry in the global market. According to [28], Germany, the United States, Japan, India, China, and Kazakhstan are among the main consuming countries of FFs due to increased demand from millennials and a surge in marketing activity. The growth of the FF market is fostering improved distribution channels and increased public awareness of the benefits of FFs and their availability, as well as an increase in the number of applications. The purpose of the study was to determine current trends in the market of FFs and their impact on improving the health of the population, preventing diseases caused by malnutrition and unbalanced nutrition, and nutritional status.

The hypothesis of the study: the strategy for developing the range of the market of FFs should be aimed at improving the quality of life of the population and depends on the factors causing the growth in demand for FFs, as well as preferences regarding the range of FFs. According to the goal and the stated hypothesis, the following research objectives were formulated:

1. Determine the factors of growth in demand for FFs in the developed countries of the world;
2. Determine the preferences of Kazakhstani regarding the FFs;
3. Determine the factors for the development of the FFs range structure in Kazakhstan

Methods

To achieve the purpose of the study and understand the current trends in the Functional Foods (FFs) market, a methodological framework based on empirical data was employed.

Design and Participants of the research

The study was conducted between September and October 2021. It involved a diverse group of 81 experts, each with valuable insights in the field of FFs. Among the participants, 39 experts were employees of Kazakhstani companies actively involved in the FF market (business), while the remaining 42 experts were renowned nutritionists and researchers specializing in healthy nutrition (science).

To ensure the validity and reliability of the data collected through the unstructured telephone interviews, participants' experience and expertise were taken into account. Each expert had substantial experience in the field, with a track record of over 10 years or a significant number of published articles (at least three in reputable scientific journals such as Scopus and Web of Science).

Data Collection Method

The study utilized unstructured telephone interviews to gather relevant insights. The interview questions were designed to align with the study's objectives, aiming to understand the experts' perspectives on various aspects. The topics covered included the factors influencing the growth in demand for FFs in developed countries, the preferences of Kazakhstanis regarding FFs, and the factors contributing to the development of FFs' range structure in Kazakhstan. Each interview consisted of 9 questions (including clarifying ones if necessary) and took 30-40 minutes.

1. What, in your opinion, are the key factors contributing to the growth in demand for Functional Foods (FFs) in developed countries?
2. How do you perceive the preferences of the Kazakhstanis population regarding the range of FFs?
3. Are there any specific trends or preferences that you have observed?
4. From your perspective, what are the major factors influencing the development of the range structure of FFs in Kazakhstan?
5. Can you identify any particular challenges or obstacles faced by the FF market in meeting consumer demands and expectations?
6. Are there any unique opportunities or untapped segments within the FF market that you think have the potential for significant growth?
7. Do you believe that FFs can significantly contribute to improving the health and well-being of consumers?
8. What national opportunities exist in Kazakhstan that could improve the functional food segment?
9. Will the development of public health policy help increase the public's interest in functional food?

The opinions of experts in relation to various aspects and problems of the FF market were assigned a rank on a scale from one (the least important criterion) to five (the most significant).

Correlation Analysis

To enhance the reliability of the results, a correlation analysis was performed using Spearman's rank correlation coefficient.

Results

Among the factors that determine the growth in demand for FFs in the developed countries of the world, experts identify the following (Table 1).

Factors of price growth for FFs	Total sample, N = 81	Field of work	
		Business N = 39	Science N = 42
aging of the population	3.21	2.88	3.44
increased interest in a healthy lifestyle	4.27	4.13	4.38
increasing drug prices and focusing on disease prevention	3.48	3.63	3.32
interest in alternative treatment methods	2.32	2.23	2.42
positive attitude of medical professionals to the use of biologically active supplements	3.79	3.71	3.88
use of marketing tools to promote FFs	3.75	4.25	3.22

source: Compiled by authors based on the experiment

Table 1: Factors that determine the growth in demand for FFs in the developed countries.

Analyzing the results presented in Table 1, we can conclude that the most significant factors in the growth in demand for FFs in the developed world are an increase in interest in a healthy lifestyle (4.27) and the use of marketing tools to promote FFs (3.75). On the other hand, the least important factor, according to the respondents, is the interest in alternative treatment methods [2,32]. The results of the correlation analysis showed that there were close links between such factors of growth in demand for FFs in the developed countries of the world as "increased interest in a healthy lifestyle", on the one hand, and " increasing drug prices and focusing on disease prevention" (r_s = 0.637), as well as "use of marketing tools to promote FFs" (r_s = 0.595), on the other hand. At the same time, the share of health-improving and preventive products, according to experts, is reduced by a wide range of dietary supplements. Meanwhile, experts believe that most consumers prefer foods with a reduced calorie content and foods that contain an increased amount of dietary fiber, which allows them to prevent cancer. As for the European practice, the analysis of consumer preferences regarding the directions of development of the FF range showed that health-improving and low-calorie food products were determined to be the most significant [24]. Thus, among the many products, consumers prefer products for treatment and prevention. The results of a study of modern trends in the FF market also showed [23] that the European market is experiencing a "rejuvenation" of the average consumer. According to the study, in recent years, about 36% of FFs are consumed by young people under the age of 30, although this group makes up about (20-22%) of the total population of European countries. According to experts, the Kazakhstan FF market shows a diverse range of presented products, is dynamically growing and expanding. However, since this process is supported only by an aggressive marketing policy (Table 2), and not by the study of consumer demand, development occurs haphazardly. Usually, the range policy of the Kazakhstanis market differs significantly from the range of FFs in the EU and the USA. Experts believe that Kazakhstan population prefer the following FFs (Table 2).

Preferences	Total sample, N = 81	Field of work	
		Business N = 39	Science N = 42
variety of pro- and symbiotic dairy products	3.77	3.85	3.71
prebiotic food products from grain raw materials	3.54	3.63	3.45
sweetened foods	3.23	3.12	3.31
vitamin products	3.18	3.11	3.24

source: Compiled by authors based on the experiment

Table 2: Preferences of Kazakhstanis in terms of FFs

Analyzing the results presented in Table 2, we can conclude that, according to expert opinion, various pro- and synbiotic dairy products are the most in-demand on the Kazakhstanis market for FFs (3.77). The technology of their production, according to experts, is easily adjustable and makes it possible to introduce new physiologically functional ingredients – vitamins, minerals, plant extracts, the consumption of which allows maintaining or improving human health. These drinks often have a therapeutic effect. The results of the correlation analysis show that there is a close relationship between such preferences of Kazakhstanis regarding FFs as "various pro- and synbiotic dairy products" and "vitamin products" (r_s = 0.614). Important directions in the development of the structure of the FFs range can also include distribution by age and physiological state. Therefore, one of the priorities of the state policy should be the development of the production of foods enriched with irreplaceable components, specialized FFs, dietary (therapeutic and preventive) foods. For instance, there is the potential to pursue a national policy aimed at advancing the production of domestic products, such as mare's milk. Mare's milk includes essential minerals like iron, copper, and magnesium [30]. Moreover, it exhibits elevated levels of zinc and potassium. Of significant importance is its abundant lactose content, vital amino acids, and retinol, all of which play a crucial role in regulating the function of diverse organs and tissues.

Furthermore, mare's milk contains immunoglobulins, which are antibodies that contribute to the neutralization of bacteria and viruses [31]. The consumption of mare's milk offers numerous therapeutic benefits. It enhances the immune system, aids in the recovery of a debilitated body, reduces cholesterol levels, combats fatigue during periods of heightened stress, regulates metabolism, and facilitates the detoxification of the body from harmful toxins [32]. Based on the above problems, the experts note that the urgent task is the further development of the range structure of FFs in Kazakhstan, which should take into account the following factors (Table 3). Analyzing the results presented in Table 3, one can conclude that the most significant factors in the development of the

range structure of FFs in Kazakhstan are the general nutritional status of the population (3.88) and disease incidence (3.59). At the same time, the least important factor, according to the respondents, is the age structure of the population (2.44).

Factors of the development of range structure of FFs in Kazakhstan	Total sample, N = 81	Field of work	
		Business N = 39	Science N = 42
general nutritional status of the population	3.88	3.63	4.11
age structure	2.44	2.12	2.74
coverage of the main classification groups and types of food products	3.26	3.41	3.09
psychophysiological profile of target consumer groups	2.94	3.52	2.33
disease incidence	3.59	3.32	3.85

source: Compiled by authors based on the experiment

Table 3: Factors of the development of range structure of FFs in Kazakhstan

The results of the correlation analysis show that there are close links between such factors of growth in demand for FFs in the developed countries of the world as the "general nutritional status of the population", on the one hand, and the "disease incidence" (r_s = 0.652), as well as the "psycho-physiological profile of target consumer groups" (r_s = 0.612), on the other hand. At the same time, the correlation analysis also showed the relationship between the preferences of Kazakhstanis regarding the FFs and the factors in the development of the range structure of the FFs in Kazakhstan. Thus, close correlations were found between the preferences of Kazakhstan population regarding a variety of pro- and synbiotic dairy products and prebiotic food products from grain raw materials, on the one hand, and disease incidence, on the other hand (r_s = 0.711, r_s = 0.684, respectively).

Discussion

In light of the concept of "optimal nutrition" proposed by V. Tutelian [33, 34], this study opens up promising avenues for the development of Functional Foods (FFs). The concept underscores the significance of an integrated approach to address nutrient deficiencies and maintain a high level of public health [35]. By preserving natural and high-quality food products in the diet and enriching them with macro- and micronutrients that are deficient in specific regions, this approach seeks to optimize the nutritional intake of the population [36].The emphasis on introducing new genetically modified ingredients with enhanced nutrient content further adds to the potential of FFs in addressing nutritional challenges. By leveraging innovative biotechnological advancements, FFs can provide essential nutrients to individuals, contributing to their overall health and well-being. According to research [37], the nutrition of most of the Kazakhstan population does not comply with the principles of healthy eating. In the diet of Kazakhstanis, there are still excesses of high-calorie foods with a significant amount of animal fat and simple carbohydrates. The greatest deficiency of micronutrients are vitamins (C, B1, B2, B6, beta-carotene, A, D, PP), dietary fiber, macro - and microelements (Ca, K, I, Fe, Zn, etc.) [26]. Now the diet of Kazakhstanis is characterized by a deficiency of dietary fiber, which results in cardiovascular diseases (increased risk from 60% to 70%), obesity, type 2 diabetes, atherosclerosis, cholelithiasis, varicose veins, colon dyskinesia, etc. [38]. One promising avenue to address these deficiencies is through the utilization of mare's milk as a functional food. The advancement of combined mare's milk products presents not only an opportunity to conserve animal raw materials but also to judiciously integrate vegetable raw materials. This novel approach in protein production involves combining mare's milk with plant-based protein raw materials from different sources, mutually enriching their composition, enhancing functional properties, elevating biological value, and reducing production costs [39; 40]. The biochemical and medicinal properties of mare's milk are determined, first of all, by its qualitative composition [41]. Mare's milk is rich in essential nutrients, vitamins, and minerals that can contribute significantly to meeting the nutritional requirements of individuals. It contains vitamins C, B1, B2, B6, beta-carotene, A, D, and PP, which are essential for various physiological processes and overall well-being. Additionally, mare's milk is a natural source of vital minerals such as calcium (Ca), potassium (K), iodine (I), iron (Fe), zinc (Zn), and others, which play crucial roles in maintaining proper organ function and supporting the body's immune system. All in all, it should be noted that FFs are used in many areas of medicine, as well as in the everyday life of people. Thanks to them, it is possible to feed newborns with formula, the composition of which is as close as possible to the composition of mother's milk, and also, in case of insufficient breast milk, to use FFs as a safe and healthy supplemental feeding means. In people with chronic diseases, there is often a need for the external administration of biologically active nutrients: in case such nutrients are not synthesized sufficiently in the body, FFs can also be used [42]. FFs are also indispensable for the parenteral nutrition of seriously ill patients since FFs can support the functioning of vital organs and systems. FFs become an important component of the diet when people stay in extreme conditions, under the influence of high or low temperatures, with extreme physical exertion (in this case, drinks enriched with vitamins and plant extracts can be particularly efficient). Athletes and people whose work requires physical endurance actively use

FFs. Most residents of large cities and towns in Kazakhstan today live and work at an accelerated pace, devoting most of their time to work [43]. At the same time, the rules of a healthy diet, the need for proper sleep and rest are neglected. Under such conditions, functional nutrition can be used as a tonic and health-improving component of the diet, as well as to prevent the development of overtiredness and exhaustion of the body. Even with intensive mental work, when there is a risk of mental overstrain, FFs can significantly increase efficiency and relieve fatigue. As one can see, there are a lot of situations in which functional nutrition is appropriate, and in each of them, the corresponding FFs can be used. Therefore, knowing the composition of a particular product, a person can enrich their diet with the necessary nutrients. The study found that FFs play a very important role in the nutrition of the modern person. The inclusion of FFs in diets is primarily aimed at optimizing the chemical composition of these diets and, as a result, at reducing the risk of disease and promoting the restoration of health of various categories of the population. Among the factors that determine the growth in demand for FFs in the developed countries of the world, we have identified: the aging of the population; increased interest in a healthy lifestyle; increasing prices for medicines and focusing on disease prevention; interest in alternative treatment methods; positive attitude of medical professionals to the use of biologically active supplements; use of marketing means to promote functional products. The Kazakhstanis FF market features a diverse range of products, it is dynamically growing and expanding. Kazakh population prefers a variety of pro- and synbiotic dairy products, prebiotic grain-based foods, foods with sweeteners, and vitamin foods. At the same time, the factors in the development of the FFs range structure in Kazakhstan are the general nutritional status of the population, its age structure; coverage of the main classification groups and types of food products; psychophysiological profile of target consumer groups; disease incidence. The results of the study confirmed the hypothesis that the strategy for developing the range of the market of functional products should be aimed at improving the living standards of the population and depends on the factors causing the growth in demand for FFs as well as preferences regarding the range of FFs. Further research could focus on exploring the nutritional and bioactive properties of dried mare's milk in depth. Its bioavailability, thermal stability, immunomodulatory effects, health effects, and anti-inflammatory properties need to be investigated. Consumer safety and palatability change must also be explored to unlock the full potential in improving the health and quality of life of various population groups in Kazakhstan.

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Author Contributions

All authors of this article contributed equally to the conception, design, data collection, analysis, interpretation, and writing of the manuscript. All authors have read and approved the final version of the article for submission.

Conflicts of interest

The authors declare no conflict of interest.

References

1. Polukhin AA, Panarina VI, Klimova SP. Quality management in the food market for sustainable development based on industrial and manufacturing engineering in the age of digital economy. International Journal for Quality Research, (2021); 15(4): 1159-1178.
2. Mark-Herbert C. Innovation of a new product category - Functional foods. Technovation, (2004); 24(9): 713-719.
3. Ares G, Gimenez A, Gambaro A. Influence of nutritional knowledge on perceived healthiness and willingness to try functional foods. Appetite, (2008); 51(3): 663-668.
4. Karashchuk O, Mayorova E, Nikishin A, Pankina T. Factors hindering retail development in Russia: Proceedings of the 34th International-Business-Information-Management-Association (IBIMA) conference. Vision 2025: Education excellence and management of innovations through sustainable economic competitive advantage. 2019; 7819-7824. International Business Information Management Association (IBIMA).
5. Bimbetov B, Zhangabylov A, Aitbaeva S, Bakytzhanuly A, Utepbergenova G. Use of mare's milk in the treatment of non-alcoholic steatohepatitis. Sys Rev Pharm., (2020), 11(12): 1568-1571.
6. Jones PJ, Jew S. Functional food development: Concept to reality. Trends in Food Science & Technology, (2007); 18(7): 387-390.
7. Fedotova GV, Chugumbaev RR, Chugumbaeva NN, Larionova IS, Dzhancharova GK. Quality of life of the population of Russia in the light of modern global challenges. International Journal for Quality Research, (2021); 15(4): 1197-1218.
8. Gnezdova JV, Barilenko VI, Kozenkova TA, Chernyshev AV, Vasina NV. Food safety auditing in Russia in a climate of foreign sanctions and a policy of import substitution. Quality-Access to Success, (2018); 19(167): 155-158.
9. Lochan SA, Rozanova TP, Bezpalov VV, Fedyunin DV. Supply chain management and risk management in an environment of stochastic uncertainty (Retail). Risks, (2021); 9(11): 197.
10. Saba A, Vassallo M, Shepherd R, Lampila P, Arvola A, Dean M, Winkelmann M, Claupein E, Lahteenmaki L. Country-wise differences in perception of health-related messages in cereal-

based food products. Food Quality and Preference, (2010); 21(4): 385-393.
11. Champagne CP, Gardner NG, Roy D. Challenges in the addition of probiotic cultures to foods. Critical Reviews in Food Science and Nutrition, (2005); 45(1): 61-84.
12. Van Kleef E, Trijp HCM, Luning P. Functional foods: Health claim-food product compatibility and the impact of health claim framing on consumer evaluation. Appetite, (2005); 44(3): 299-308.
13. Babaskina LI, Litvinova TM, Babaskin DV, Kiselevsky MV, Savinova OV, Winter EA. Influence of flavonoids on the cytotoxic activity of mononuclear blood cells in model tests. Open Access Macedonian Journal of Medical Sciences, (2019); 7(12): 1900-1904.
14. Lisitsyna AB. Funktsionalnyeproduktyiikhrol v pitaniicheloveka [Functional foods and their role in human nutrition]. MyasnyeTekhnologii, (2017); 5: 13-16.
15. Pershakova TV, Kupin GA, Mihaylyuta LV, Babakina MV, Gorlov SM, Karpenko EN. Biotechnological potential of the vetom series preparations for the production of functional food products. Journal of Food Chemistry & Nanotechnology, (2022); 8(1): 1-5.
16. Kochetkova AA. Funktsionalnyeprodukty v kontseptsiizdorovogopitaniya [Functional products in the concept of healthy nutrition]. PishchevayaPromyshlennost, (1999); 3: 4-5.
17. Nicola C, Bonaccorsi G. The new EU regulations for food safety. Italian Journal of Public Health, (2007); 4(1): 7-12.
18. Alemanno A. The European food safety authority at five. European Food and Feed Law Review, (2008); 1: 2-29.
19. Menrad K. Market and marketing of functional food in Europe. Journal of Food Engineering, (2003); 56(2-3): 181-188.
20. Siró I, Kápolna E, Kápolna B, Lugasi A. Functional food. Product development, marketing and consumer acceptance - A review. Appetite, (2008); 51(3): 456-467.
21. Sun Y, Hayakawa S, Ogawa M, Izumori K. Antioxidant properties of custard pudding dessert containing rare hexose, d-psicose. Food Control, (2007); 18(3): 220-227.
22. Houston MC. Nutraceuticals, vitamins, antioxidants, and minerals in the prevention and treatment of hypertension. Progress in Cardiovascular Diseases, (2005); 47(6): 396-449.
23. O'Connor EL, White KM. Willingness to trial functional foods and vitamin supplements: The role of attitudes, subjective norms, and dread of risks. Food Quality and Preference, (2010); 21(1): 75-81.
24. Arias-Aranda D, Romerosa-Martínez MM. Innovation in the functional foods industry in a peripheral region of the European Union: Andalusia (Spain). Food Policy, (2010); 35(3): 240-246.
25. Boer A, Bast A. International legislation on nutrition and health claims. Food Policy, (2015); 55: 61-70.
26. Spence JT. Challenges related to the composition of functional foods. Journal of Food Composition and Analysis, (2006); 19(Supplement): S4-S6.
27. Karamushko GV, Khatko ZN, NavasardyanNKh. Analiz rynkazdorovogopitaniyaRossiiskoiFederatsiiiRespublikiAdygeya [Analyzing the healthy food market of the Russian Federation and the Republic of Adygea]. New Technologies, (2020); 16(6): 106-115.
28. BusinessWire. Global Functional Beverages Market (2021 to 2030) - by Type, Distribution Channel, End-user and Region - ResearchAndMarkets.com. 2021. Available from: https://www.businesswire.com/news/home/20211028005830/en/Global-Functional-Beverages-Market-2021-to-2030---by-Type-Distribution-Channel-End-user-and-Region---ResearchAndMarkets.com
29. Tutelian VA, Sukhanov BP. Biologicheskiaktivnyedobavki k pishche: Sovremennyepodkhody k obespecheniyukachestvaibezopasnosti [Biologically active supplements: Modern approaches to ensuring quality and safety]. VoprosyPitaniya, (2008); 4: 4-15.
30. Kozhakhmetov S, Babenko D, Nurgaziyev M, Tuyakova A, Nurgozhina A, Muhanbetganov N, Chulenbayeva L, Sergazy S, Gulyayev A, Saliev T, Kushugulova A. The combination of mare's milk and grape polyphenol extract for treatment of dysbiosis induced by dextran sulfate sodium. Biodiversitas Journal of Biological Diversity, (2020); 21.
31. Pieszka M, Łuszczyński J, Zamachowska M, Augustyn R, Długosz B, Hędrzak M. Is Mare Milk an Appropriate Food for People? - a Review. Ann. Anim. Sci. (2015); 16: 33–51.
32. Kushugulova A, Kozhakhmetov S, Sattybayeva R, Nurgozhina A, Ziyat A, Yadav H, Marotta F. Mare's milk as a prospective functional product. Functional Foods in Health and Disease, (2018); 8: 548-554.
33. Tutelian VA, Nechaev AP, Kochetkova AA. Funktsionalnyezhirovyeprodukty v strukturepitaniya [Functional fatty products in the structure of nutrition]. MaslozhirovayaPromyshlennost, (2009); 6: 6-9.
34. LavrovaLYu. Naturalnyeingredientydlyaobogashcheniyamyasnykhizdelii [Natural ingredients to enrich meat products]. MyasnyeTekhnologii, (2016); 11(107): 50-51.
35. Kushugulova A, Kozhakhmetov S, Sattybayeva R, Nurgozhina A, Ziyat A, Yadav H, Marotta F. Mare's milk as a prospective functional product. Functional Foods in Health and Disease, (2018); 8: 548-554.
36. Omarbakiyev L, Kantarbayeva S, Nizamdinova A, Zhumasheva S, Seitkhamzina G, Saulembekova A. Consequences of changing regional integration on environmental development, agricultural markets, and food security. Global Journal of Environmental Science and Management, (2023); 9(4): 951-966.
37. Nogayev A, Serekpayev N, Stybayev G, Baitelenova A, Mukhanov, N. Yield and nutritional value of forage crops for dairy goat production in the steppe of northern Kazakhstan. International Journal of Ecosystems and Ecology Science (IJEES), (2022); 12(4): 481–490.
38. Akhmedova TP. Ispolzovaniepishchevykhvolokondlyaobogashcheniyapishchevykhproduktov [Using fibers to fortify foods]. 2014; 354. Bukva, Orel.
39. Wansink B, Westgren RE, Cheney MM. Hierarchy of nutritional knowledge that relates to the consumption of a functional food. Nutrition, (2005); 21(2): 264-268.
40. Yesmagulova BZ, Assetova AY, Tassanova ZB, Zhildikbaeva AN, Molzhigitova DK. Determination of the Degradation Degree of Pasture Lands in the West Kazakhstan Region Based on Monitoring Using Geoinformation Technologies. Journal of Ecological Engineering, (2023); 24(1): 179–187.
41. Kozhanova N, Sarsembayeva N, Lozowicka B, Kozhanov Z. Seasonal content of heavy metals in the "soil–feed–milk–manure" system in horse husbandry in Kazakhstan. Veterinary World, (2021); 14(11): 2947-2956.
42. Mukhamadiyev NS, Chadinova AM, Sultanova N, MengdibayevaGZh, Anuarbekov KK. Development of Environmentally Friendly Protection Measures Against Pests and Diseases. OnLine Journal of Biological Sciences, (2023); 23(2): 243–250.
43. Tumashbay T, Yesim G, Spanov M, Ibrayeva N, Kemerbay R, Shaldarbekova A. Influence of Socio-Organizational and Personal Resources of the Employee on the Positive Perception of Work. Academic Journal of Interdisciplinary Studies, (2023); 12(4): 37.