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Innovations in food production

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Abstract. With growing demands for food quality and increased interest in healthy foods, the development of innovative technologies and functional products is becoming particularly relevant. This study aimed to analyse the current scientific foundations and approaches underlying the creation of innovative food products. A systematic analysis of contemporary scientific and practical research devoted to the development of innovative food products was carried out in the following databases: Scopus, Web of Science, ScienceDirect, PubMed, Google Scholar, eLIBRARY, and others. Key areas of research were analysed, including the search for alternative sources of protein, the use of functional ingredients, biotechnological methods (precision fermentation, mycoproteins, muscle cell cultivation in bioreactors), the use of artificial intelligence, and the digitisation of development and quality control processes. The use of high pressure for the pasteurisation or sterilisation of food products was also considered a promising technology. The review showed that there are many developments in the field of food packaging; innovative packaging can be biodegradable, active, smart, or reusable. The processing of raw material by-products (oil cake, whey, peel, etc.) for the production of flour, fibre, and polyphenol concentrates is a trend at the intersection of sustainability and functionality. This article paid particular attention to the development of new functional products. It highlighted the role of interdisciplinary research in forming the scientific basis for innovation in the food industry. The analysis conducted allowed for identifying promising avenues for development and determine strategic guidelines for further research and the introduction of innovations into production

Keywords: innovative food products; alternative proteins; mycrobic meat; functional ingredients; technologies; raw materials; platforms of innovation

Introduction

The dynamic development of the food industry in the 21st century is driven by the need to address a range of interrelated challenges: ensuring food security, meeting growing consumer demands for food quality and functionality, and introducing environmentally sustainable production technologies. As noted by K. Topolska *et al.* (2021), the food industry worldwide is undergoing a number of changes, mainly driven by consumer demand for safe and healthy foods with pleasant organoleptic properties. The Global Food Innovation Index compared factors contributing to innovation in the food, agribusiness and beverage industries in 10 countries. The ranking of these countries, based on their innovation environment for the food industry, is as follows: 1st place – United Kingdom, 2nd – United States, 3rd – Germany, 4th – Australia, 5th – Canada, 6th – Netherlands, 7th – Japan, 8th – Mexico, 9th – France, 10th – Italy (Charlebois, 2020). In particular, according to the German Innovation Report Food (2023), around 30,000 new food products are developed in Germany every year, of which more than 90% do not remain on the market, meaning that only 10% of products are successful. Of these, 94% of new developments are modifications of existing products, and only 3% are innovative products. In 2002, only 350 innovative food and beverage products were developed and successfully introduced into production in Germany.

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A "novel food" is a newly developed, innovative food product; a food product produced using new technologies and production processes; or a food product that is traditionally consumed or has been consumed outside the European Union and has not been consumed to a significant extent in the EU (Regulation (EU), 2015; European Commission, 2025). The word "innovation" can be defined in many ways. Innovation is "the process of transforming a discovery (i.e., an idea, invention) into a product(s) or service(s) that consumers/customers are willing to buy". Innovation encompasses many aspects, such as science, technology, marketing and organisation, partnership, risk management and social responsibility (Burke, 2024; Wei *et al.*, 2025). However, as noted by J. Prates (2025), discoveries must be translated into products, services, or processes that are disseminated and integrated into the economy so that society can benefit from these discoveries. For an idea to be called an innovation, it must be reproducible at an economical price and satisfy a specific need. Thus, not all ideas are innovations, but only those that are suitable for implementation. Innovations are necessary to gain a competitive advantage and create value, and their results can be both tangible (e.g., new products, projects) and intangible (e.g., new processes and ways of doing business, expert knowledge) (D'Almeida & de Albuquerque, 2024). An innovative product can be a key factor for success in aggressive and competitive food markets. Thus, an innovative product is a new product that did not exist on the market before, while adaptation is the process of giving an old product new properties or adapting a product to new conditions. However, imitation of a new successful product is more common on the market.

The aim of this work was to analyse contemporary scientific and practical research devoted to the development of innovative food products. A systematic analysis was carried out in the following databases: Scopus, Web of Science, ScienceDirect, PubMed, Google Scholar, eLIBRARY, etc. The following keywords were used in the selection: "innovative food products", "functional foods", "biotechnology in food industry", "digitalisation of food production", "innovations in the food industry". The criteria for including sources in the analysis were: relevance to the topic of innovative food products, the availability of experimental data or scientifically substantiated theoretical propositions, publication in peer-reviewed journals and conference proceedings. Particular attention was paid to works describing the practical application of new technologies in the food industry, as well as research on consumer preferences and market trends in the field of functional foods.

Innovative processing technologies and alternative sources of dietary protein

The considerable popularity of vegetarianism in recent years has led many to seek alternative sources of animal products. Plant-based meat and milk substitutes are carving out their niche in the food market. The active promotion of these products is based not only on promises of personal comfort for consumers, but also on the obligation of every inhabitant of the planet to care for the environment. Refusing to consume animal meat is presented as one way to reduce the harmful impact of livestock farming and the meat processing industry on the climate. One of the newest areas of research into alternative sources of protein is microbial proteins. Microbial proteins are produced by precision fermentation using microorganisms (yeast/mould/bacteria) that are programmed to produce milk proteins (casein, whey proteins), egg albumin, collagen, haem, etc. (Le Mouël & Forslund, 2017). Targeted enzyme hydrolysis is a tool for texturing and creating bioactive peptides. At the same time, as described in the work of S. Wei *et al.* (2025), bacteria are also used to produce specific ingredients. This method gives functional properties to microbial proteins, reducing humanity's dependence on agriculture and weather risks. Active research is underway in this area – the selection of strains and regimes, as well as the development of regulatory documents and scaling (Eastham & Leman, 2024; Knychala *et al.,* 2024).

The next relevant area is the production of cultured meat. The cultivation of muscle/fat cells in bioreactors is progressing from minced meat to whole muscle structures. In 2025, Australia authorised the limited sale of cultivated quail meat, demonstrating the transition of this field into the "real world" (Southey, 2025). At the same time, meat analogues based on plant proteins (stretch textures, extrusion/shear, fat binding) are being actively researched (Berners-Lee *et al.,* 2018; Spiro *et al.,* 2024). A successful example of the practical implementation of such developments is the technology of plant-based minced semi-finished products using protein-wheat texturate, which are characterised by a balanced amino acid composition and a significant content of valine, methionine and phenylalanine, making them a complete alternative to meat products for vegetarians (Filin *et al.,* 2023). The production of flour from crickets, yellow mealworms, etc. is carried out in accordance with the EU Regulation on novel foods; a single list is maintained, which specifies the conditions of use and labelling (European Commission, 2025).

The following developments relate to microalgae (e.g., *Nannochloropsis*). They are sources of unsaturated fatty acids and pigments (astaxanthin). There is a growing number of applications for microalgae in the food industry and clinical observations on their effect on the human lipid profile (Prates, 2025). Microalgae have a number of promising applications in the field of functional foods, both in the form of natural biomass (microstructural powders or syrups) and as a source of biologically active ingredients (Kaledina *et al.,* 2020). Most alternative protein sources have advantages:

they are easily digestible, rich in vitamins, minerals and fibre, and suitable for various diets, including vegetarian ones. Another aspect of the use of alternative protein sources is that not all consumers are willing to eat products made with new ingredients. Therefore, consumer opinion should be taken into account when developing food innovations.

In parallel with the search for new sources of protein, modern food processing technologies are actively developing, aimed at improving the quality and functionality of products. Over the past decades, fast and efficient production methods have emerged that improve the quality and shelf life of food products, and suitable alternative processing technologies have been found, such as high hydrostatic pressure, pulsed electric fields, ultrasound, and microwaves (Ozaybi, 2024). Non-thermal pasteurisation of food raw materials, including dairy products at high pressure (400-600 MPa), preserves nutrients, controls protein structures and texture, and improves the safety and organoleptic properties of finished products. Updated reviews for 2023-2025 detail the effect of extrusion on the secondary structure of protein, bioactive components, and aggregation (Ozaybi, 2024; Siddiqui *et al.,* 2024). 3D food printing is used for shaping/texturing, targeted fortification, and "digital gastronomy". Limitations include speed/throughput and the stability of "food ink", as highlighted in reviews by R. Burke (2024) and S. Xiao *et al.* (2025).

Innovative food packaging should be biodegradable, active, smart or reusable. Smart/active packaging is equipped with sensors to monitor the freshness, pH, amines, sulphur compounds of food products, as well as the release of antioxidants/antimicrobial agents to extend shelf life (Chiu *et al.,* 2024; Palanisamy *et al.,* 2025). Algae are used to produce packaging, edible capsules and coatings for compostable containers, which are already being used by large retail chains (Oughton, 2023). A. D'Almeida & T. de Albuquerque (2024) describe developments in biomaterials, such as starch or cellulose films incorporating active ingredients (antioxidants, freshness sensors). Stora Enso (2024) uses FiberLight Tec™ technology to produce lightweight, high-quality cellulose packaging, reducing the carbon footprint and weight of the packaging. Waste-free disposal or use of raw material processing by-products (oil cake, whey, peel, etc.) for the production of flour, fibre, and polyphenol concentrates remains a relevant area, combining production sustainability and product functionality (Lu *et al.,* 2024). Systematic reviews highlight the contribution of waste-free technologies to "triple" sustainability: ecology, economy, and society.

Functional and personalised nutrition and artificial intelligence

Artificial intelligence (AI) accelerates the development of product formulations that take into account consumer requirements (metabolomics, allergies, taste preferences), as well as the optimisation of formulations/sensory properties. Reviews are emerging on the integration of AI into personalised nutrition and the development of new products, such as NotMilk®, NotChicken® (Zatsu *et al.,* 2024; Kuhl, 2025). The integration of more sophisticated AI tools, such as deep learning and advanced robotics, can significantly improve the safety, quality, and efficiency of food products at all stages of the supply chain. P. Detopoulou *et al.* (2023) expect AI to play a key role in improving personalised nutrition in the future by providing real-time dietary recommendations based on an individual's genetic characteristics, lifestyle and health data, thereby transforming public health strategies. I. Kiselev *et al.* (2018) argue that the development of AI-based sensory technologies, such as more accurate electronic noses and tongues, will further improve the accuracy of food quality assessment by enabling non-destructive testing of food products. Innovations in AI-based smart packaging, capable of autonomously monitoring and maintaining optimal food storage conditions, will also contribute to increasing shelf life and reducing food waste on a global scale. Another promising area is the use of AI in sustainable food production. Precision agriculture based on AI, combined with big data analytics, will optimise resource use, reduce environmental impact and increase crop yields (Kutyauripo *et al.,* 2023; Zatsu *et al.,* 2024).

Of all the innovative trends in food production listed above, functional and personalised products stand out. The Food and Agriculture Organization (FAO) (n.d.) uses the following definition: "…functional foods are foods that contain additional beneficial components beyond basic nutrients, offering health advantages for the prevention and management of disease". In other words, functional food is produced by adding or concentrating a beneficial ingredient or replacing an ineffective or harmful ingredient, and has (in addition to its traditional nutritional value) additional health benefits or acts as a remedy for certain diseases (Kaur & Das, 2011). The increase in environmental and social problems is the main driving force behind the development of functional products worldwide. According to C. Karelakis *et al.* (2020), the main consumer motive for purchasing functional foods is a growing desire to use products to prevent chronic diseases such as cardiovascular disease, Alzheimer's disease and osteoporosis, as well as to improve health, for example by strengthening the immune system and promoting well-being. Functional foods are officially recognised by the Japanese government as an alternative to drug therapy and are defined as "Food for Specified Health Use" (FOSHU) (Iwatani & Yamamoto, 2019). According to GOST 52349-2005 (2005), there are seven main types of functional ingredients that give foods functional properties (Table 1).

Table 1. Main types of functional ingredients

No.	Ingredient class	Examples	Main functional effects
1	Probiotics, prebiotics and synbiotics	Probiotics: *Lactobacillus*, *Bifidobacterium*; Prebiotics: lactulose, gluco-oligosaccharides, fructo-oligosaccharides, xylo-oligosaccharides; Synbiotics: combinations	Maintaining healthy gut microbiota, immunomodulation, improving mineral absorption
2	Antioxidants	Polyphenols (flavonoids, phenolic acids, stilbenes), carotenoids (β-carotene, lutein), terpenoids, tocopherols and tocotrienols	Protecting cells from oxidative stress, preventing chronic diseases, cardioprotective and neuroprotective effects
3	Polyunsaturated fatty acids (PUFAs)	Omega-3 fatty acids (eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), alpha-linolenic acid (ALA), omega-6 (linoleic acid, arachidonic acid)	Normalisation of lipid metabolism, anti-inflammatory effect, support for the brain, heart and vision
4	Dietary fibre	β-glucan, inulin, pectin, cellulose	Lowering cholesterol levels, regulating blood sugar levels, promoting beneficial microflora growth, improving gastrointestinal motility
5	Vitamins	Vitamins A, D, E, K, C, B group	Supports metabolism, antioxidant properties, participates in immune responses, prevents vitamin deficiency
6	Minerals	Calcium, iron, zinc, magnesium, selenium, iodine	Bone and tooth formation, regulation of enzymatic processes, antioxidant protection, support of blood formation
7	Proteins and their structural components	Casein, whey proteins, soy proteins, peptides	Muscle tissue formation, pressure regulation (bioactive peptides), antioxidant and immunomodulatory effects

Source: GOST 52349-2005 (2005)

The functional food market in the United States, Japan, the Asia-Pacific region and the European Union is a profitable niche in food production and is forecast to grow worldwide (Bigliardi & Galati, 2013). The existing literature offers various options for classifying functional foods. Functional foods are classified according to their purpose as follows (Bigliardi & Galati, 2013; Mudgil & Barak, 2019): functional foods that are beneficial or improve the lives of children (prebiotics and probiotics); functional products that reduce existing health risks (high cholesterol or high blood pressure); functional products that make life easier (lactose-free or gluten-free products). By product type, B. Bigliardi & F. Galati (2013) propose the following classification of functional products:

- products enriched with additional nutrients, labelled as "fortified foods" (fruit juices enriched with vitamins C and E, zinc and calcium);
- products enriched with new nutrients or components that are not normally found in a given food, labelled as "enriched foods" (probiotics or prebiotics);
- products from which a harmful component has been removed, reduced or replaced with another with beneficial effects, labelled as "altered foods" (adding dietary fibre to reduce the amount of fat in meat products or ice cream);
- products in which one of the components has been naturally enhanced, labelled as "enhanced commodities" (eggs with increased omega-3 content).

According to this classification, the methods used to develop potentially functional foods are presented in Figure 1. The development of successful functional foods is a complex process that differs somewhat from the traditional development of new foods. The work of A. Rudder *et al.* (2001) presents various models of new product development (NPD) with different stages and success factors. However, there is no consensus on which NPD method in the food industry is right or wrong. There are four main critical stages of NPD: product strategy development based on the results of technological and marketing research, product design and production, product commercialisation (product launch) and post-launch, which are common to all these models (Earle, 1997). In accordance with modern scientific concepts, the process of creating a functional food product consists of the following stages: monitoring the nutrition of the population; developing medical and biological requirements for a functional product; selecting and justifying a food matrix; selecting and justifying a functional component; modifying a food product into a functional one; confirming the positive effect.

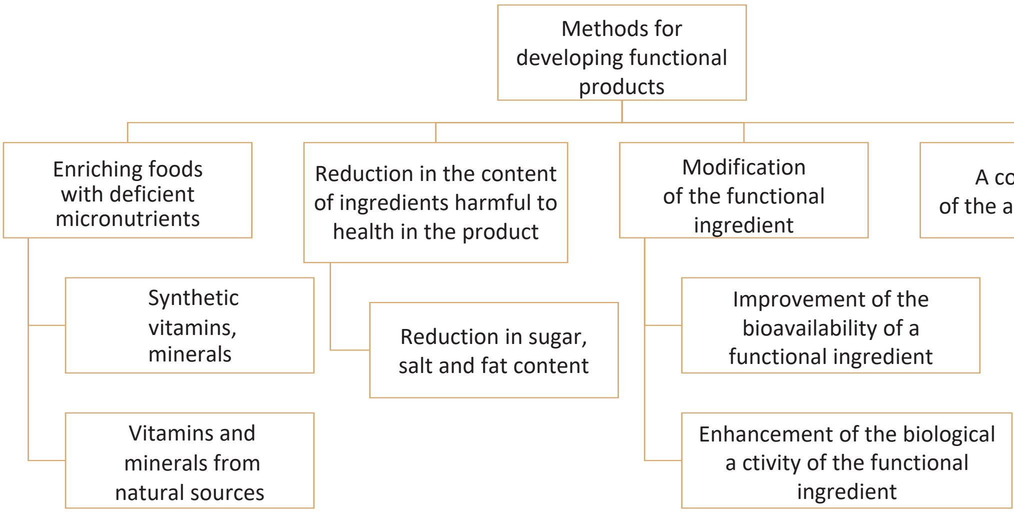

Figure 1. Methods for developing functional foods

Source: developed by the author based on M. Roberfroid (2002), B. Bigliardi & F. Galati (2013)

The dynamics of functional food development are quite intensively discussed in the literature, but the successful process of functional product development remains unresolved for both food manufacturers and scientists and researchers. A study conducted by C. Mark-Herbert (2004) proposed "business reunification" as a method for developing new functional foods. This involves the joint development of products by pharmaceutical companies and food manufacturers with the exchange of resources and skills. One such example was the launch of a probiotic product on the US market through the joint efforts of CAG Functional Foods and a Swedish biotechnology company. However, the partners encountered serious difficulties due to intellectual property rights and brand ownership issues.

Technological and marketing research are crucial stages in the development of a new food product. In addition, one of the key concepts is that NPD is, to a large extent, a team activity. The team should consist not only of technologists, but also marketers, engineers and scientists from various fields. Comprehensive knowledge of the basic concepts of nutrition, the design and implementation of new packaging technology, the product quality assessment process (shelf life testing, sensory evaluation), etc. is required (Brody, 1999). Thus, NPD requires comprehensive scientific and practical knowledge, and intuition plays an important role in this process.

New product development platforms

Successful new product launches require the development of a truly innovative product. Scientific and industry literature often identifies four key platforms on which the development of innovative food products is based. Table 2 presents the four main platforms for innovative product development.

Table 2. Main platforms for the development of innovative products

No.	Platform	Essence	Examples of application
1	Functional ingredients and nutraceuticals	Use of bioactive substances (probiotics, prebiotics, omega-3 fatty acids (FA), polyphenols, vitamins and minerals) to give products additional physiological properties	Yoghurts with probiotics (Hill *et al.,* 2014; Markowiak & Slizewska, 2017), drinks with omega-3 fatty acids, bars with β-glucan (Santos *et al.,* 2018; Mudgil & Barak, 2019)
2	Technological platforms for processing and structuring	Application of new processing and texturing methods that preserve nutrients and improve product properties	High pressure processing (HPP), pulsed electric fields (PEF), fermentation, 3D printing, extrusion (Tewari *et al.,* 2017)
3	Biotechnological and cellular platforms	Use of microorganisms, cell cultures and fermentation to produce alternative ingredients and proteins	Precision fermentation (milk proteins, collagen), cultured meat and fish, microalgae (Alizadeh Khaledabad *et al.,* 2020; Prates, 2025)
4	Digital and personalised platforms	Use of big data, AI and digital technologies for personalising nutrition, designing recipes and tracking quality	Personalised products based on genetics/metabolomics, AI recipe development, digital product twins (Santhuja *et al.,* 2023; Derossi *et al.,* 2024)

Source: developed by the author based on a review of scientific literature

The technical and technological platforms for NPD require production facilities to be equipped with modern equipment and experts in the field. The use of heat treatment in production has a negative impact on the bioavailability of nutrients and bioactive compounds. Alternative technologies, such as high hydrostatic pressure, pulsed electric fields, ultrasound, and microwaves, provide better preservation of nutrients in fruits and vegetables, prevent the growth of microorganisms, and consume less energy (Ozaybi, 2024). Consequently, they have a positive impact from a functional point of view and also contribute to the development of new functional products. The non-thermal food processing methods listed above have undergone significant development in recent years and are now a reality in many food processing plants around the world (Koker *et al.,* 2019).

However, it should be noted that the food industry in Kyrgyzstan lags behind in the implementation of the above-mentioned new technologies that accelerate NPD processes. A more common platform for developing new innovative products for the country is the new raw materials platform. It allows the use of new types of raw materials to create products with improved properties and functionality. This approach involves searching for and using new ingredients that can offer increased nutritional benefits, unique flavours or improved functional properties. According to T. Kiymaz & H. Alpas (2017), C. Björkbom (2023), an important aspect of the new raw material platform is sustainability, i.e. the use of ingredients that are obtained in a sustainable manner or produced with minimal environmental impact, such as algae, insect protein and plant-based protein substitutes. New products can be developed through the use of incompatible ingredients, as indicated in the work of F. Cedeno *et al.* (2025), or through the use of exotic raw materials, according to I. Ferreira & L. Barros (2019), or, conversely, through the use of regional raw materials (Iskakova *et al.,* 2023). As noted by F. Zare *et al.* (2012), the criteria for selecting functional ingredients depend on their chemical composition, cost, availability, and desired functionality.

The search for raw materials with high nutritional value and the study of new ingredients that may have physiologically functional and technological properties, such as improved texture and increased shelf life, are relevant for NPD. Examples include hydrocolloids, prebiotics and bioactive compounds. Consumer perception of new products will also be crucial when selecting ingredients for healthier, safer and more environmentally friendly foods. Therefore, in-depth research into regional raw materials as a source of physiologically functional ingredients, as well as the use of traditional products as a matrix for NPD, has good prospects.

Conclusions

Innovation in food production is the process of creating and implementing new solutions (from ingredients and technologies to packaging and distribution) that improve the quality, safety, functionality, sustainability and appeal of food products for consumers. The current trend towards innovation aimed at developing healthier, safer and more sustainable food products encompasses a wide range of approaches. Three main areas can be identified: replacing traditional animal-based ingredients (meat and milk), developing functional products, and developing new production technologies. All three areas are interrelated. For example, structuring alternative protein sources (microbial or plant-based meat) using extrusion or 3D printing can improve consumer acceptance of new products. 3D food printing can also be used for targeted enrichment, i.e. for the development of functional products. Information about the chemical composition of regional food raw materials and products is important for the development of functional food products. This will allow for the targeted selection of sources of functional ingredients adapted to local conditions and dietary traditions. Of particular importance is a comprehensive assessment of the bioavailability and interaction of nutrients, which is necessary to predict their physiological effect. In addition, the introduction of innovative technologies – biotechnological and digital – ensures the creation of products with specified properties, increased nutritional value and improved sensory characteristics. At the same time, safety and compliance with modern regulatory requirements remain key factors, while taking into account consumer perceptions of innovation (taste, colour, consistency, food structure; consumer traditions, preferences and habits). All of the above studies form a broad interdisciplinary approach to the current state of innovation in the food industry. Further development of innovative food products should be aimed at integrating interdisciplinary approaches to nutrition, biotechnology, consumer psychology, marketing, etc., as well as at in-depth study of regional raw materials that are underutilised in nutrition and the formation of sustainable production strategies (waste-free technologies) in the context of global challenges.

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Conflict of Interest

The author declares that there is no conflict of interest.

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Азык-түлүк өндүрүшүндөгү инновациялар

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Аннотация. Калктын рационунун сапатына болгон талаптардын өсүшү жана пайдалуу азыктарга кызыгуунун жогорулашы шартында инновациялык технологияларды жана функционалдык азыктарды иштеп чыгуу өзгөчө актуалдуулукка ээ болууда. Изилдөөнүн максаты – инновациялык азык-түлүк продукцияларын жаратуунун негизинде жаткан заманбап илимий негиздерди жана ыкмаларды талдоо болуп саналат. Инновациялык азык-түлүк продукцияларын иштеп чыгууга арналган илимий жана практикалык изилдөөлөрдүн системалуу анализи Scopus, Web of Science, ScienceDirect, PubMed, Google Scholar, eLIBRARY жана башка маалымат базаларында жүргүзүлдү. Изилдөөнүн негизги багыттары катары альтернативалуу белок булактарын издөө, функционалдык ингредиенттерди колдонуу, биотехнологиялык ыкмалар (так ферментация, микопротеиндер, биореакторлордо булчуң клеткаларын өстүрүү), жасалма интеллектти колдонуу, ошондой эле жаңы азык-түлүк продукцияларын иштеп чыгуу жана алардын сапатын көзөмөлдөө процессинин санариптештирилиши каралды. Азык-түлүк продукцияларын пастеризациялоо же стерилдештирүү үчүн жогорку басымды колдонуу да үмүт арткан технология катары белгиленди. Кароонун жүрүшүндө азык-түлүктөрдү таңгактоонун көптөгөн жаңы иштелмелери бар экени аныкталды. Чийки зат калдыктарын (жеми, суусат, кабык ж.б.) ун, белоктор, клетчатка, полифенолдук концентраттар өндүрүү үчүн кайра иштетүү – туруктуулук менен функционалдуулуктун кесилишинде өнүгүп жаткан багыт болуп саналат. Макалада өзгөчө көңүл жаңы функционалдык азыктарды иштеп чыгуу маселелерине бурулду. Инновациялардын илимий базасын түзүүдө дисциплиналар аралык изилдөөлөрдүн ролу көрсөтүлдү. Жүргүзүлгөн талдоо азык-түлүк технологияларын өнүктүрүүнүн келечектүү жолдорун аныктоого жана инновацияларды өндүрүшкө киргизүүдө стратегиялык багыттарды белгилөөгө мүмкүнчүлүк берди

Негизги сөздөр: инновациялык тамак-аш азыктары; альтернативдик белоктор; микробдук эт; функционалдык ингредиенттер; технологиялар; акылдуу таңгак; инновациялык платформалар

Инновации в производстве пищевых продуктов

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Аннотация. В условиях растущих требований к качеству рациона и повышенного интереса к здоровой пище, разработка инновационных технологий и функциональных продуктов приобретает особую актуальность. Целью исследования был анализ современных научных основ и подходов, лежащих в основе создания инновационных пищевых продуктов. Систематический анализ современных научных и практических исследований, посвященных разработке инновационных продуктов питания, осуществлялся в базах данных Scopus, Web of Science, ScienceDirect, PubMed, Google Scholar, eLIBRARY и др. Были проанализированы ключевые направления исследований, включая поиск альтернативных источников белка, использование функциональных ингредиентов, биотехнологические методы (точное ферментирование, микопротеины, культивирование мышечных клеток в биореакторах), использование искусственного интеллекта, а также цифровизацию процессов разработки новых пищевых продуктов и контроля их качества. Использование высокого давления в целях пастеризации или стерилизации пищевых продуктов также было рассмотрено как многообещающая технология. Обзор показал, что существует большое количество новых разработок в области упаковки пищевых продуктов. Инновационные упаковки могут быть биоразлагаемыми, активными, умными или многоразовыми. Переработка отходов сырья (жмыхи, сыворотка, кожура и т.п.) для производства муки, сывороточных белков, клетчатки, полифенольных концентратов – направление, развивающееся на стыке устойчивости и функциональности. Особое внимание в статье было уделено вопросам разработки новых функциональных продуктов. Показана роль междисциплинарных исследований в формировании научной базы для инноваций в пищевой отрасли. Проведенный анализ позволил выявить перспективные пути развития и определить стратегические ориентиры для дальнейших исследований в области пищевых технологий и внедрения инноваций в производство

Ключевые слова: инновационные пищевые продукты; альтернативные белки; микробное мясо; функциональные ингредиенты; технологии; умные упаковки; платформы инноваций