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ERBE DER EUROPÄISCHEN WISSENSCHAFT

HERITAGE OF EUROPEAN SCIENCE

BOOK 47. PART 3



'2026

SWorld

Germany



Prylipko T., Kuklin V.M., Starkova O.V., Tashchuk V.K., Peresichna S.M. et al.

ERBE DER EUROPÄISCHEN WISSENSCHAFT

**INNOVATIVE INGENIEURWISSENSCHAFTEN, TECHNOLOGIEN UND INDUSTRIE;
INFORMATIK, KYBERNETIK UND AUTOMATISIERUNG; CHEMIE UND
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CYBERNETICS AND AUTOMATION; CHEMISTRY AND PHARMACEUTICALS;
MEDICINE AND HEALTHCARE**

Monographic series «European Science»

Book 47. Part 3.

*In internationalen wissenschaftlich-geometrischen Datenbanken enthalten
Included in International scientometric databases*

MONOGRAPHIE

MONOGRAPH

*ScientificWorld-Net Akhat AV
Karlsruhe 2026*

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Erbe der europäischen Wissenschaft: Innovative Ingenieurwissenschaften, Technologien und Industrie; Informatik, Kybernetik und Automatisierung; Chemie und Pharmazie; Medizin und Gesundheitswesen. Monografische Reihe «Europäische Wissenschaft». Buch 47. Teil 3. 2026.

Heritage of European science: Innovative engineering, technology and industry; Computer science, cybernetics and automation; Chemistry and pharmaceuticals; Medicine and healthcare. Monographic series «European Science». Book 47. Part 3. 2026.

ISBN 978-3-98924-139-8

DOI: 10.30890/2709-2313.2026-47-03

Published by:

ScientificWorld-NetAkhatAV

Lußstr. 13

76227 Karlsruhe, Germany

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KAPITEL 2 / CHAPTER 2²

DEVELOPMENT OF TECHNOLOGIES FOR FRUIT AND VEGETABLE PRODUCTS WITH BIFIDOGENIC PROPERTIES

DOI: 10.30890/2709-2313.2026-47-03-009

2.1 The role of functional nutrition in correcting the nutritional status of the population of Ukraine

In conditions of environmental aggression almost all over the world, the need has arisen to increase the need for food products with targeted effects [1, 7, 9]. This direction in human nutrition is called functional.

According to this, a “functional food product” is a special food product intended for systematic use as part of diets by all age groups of a healthy population, which has scientifically substantiated and proven properties, reduces the risk of developing diet-related diseases...preserves and improves health due to the presence of physiologically functional food ingredients in its composition” [3]. According to this, the term “fortified food product” is explained as “a functional food product obtained by adding one or more physiologically functional food ingredients to traditional food products in order to prevent or correct the occurrence of nutritional deficiencies and/or intrinsic microflora in the human body.” [9].

The concept of functional nutrition arose at the intersection of medical and food biotechnology and received official recognition in Japan in 1989 Japanese researchers identify three main qualities of such products: nutritional value, taste properties and physiological effects. [4].

In contrast to the generally accepted concept of rational nutrition, the term “functional nutrition”, Japanese researchers mean the use of products of natural origin, which, when used systematically, have a positive regulatory effect on certain systems and organs of the body, improving the physical and mental health of a person [4].

It is believed that a food product can be classified as a functional food product if the content of a certain functional ingredient in it is at least 15% of the daily

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requirement [3].

The global market for functional products today is approximately estimated at \$60 billion [1, 6, 9]. In Ukraine, the functional food market is underdeveloped and is represented mainly by dairy products, the development of which began in the 1980s [1,7]. At the same time, there are almost no fruit and vegetable products with bifidogenic properties.

In this regard, the problem of organizing and ensuring proper human nutrition in our country, its adequacy and balance is one of the most important tasks of the joint activities of technologists, doctors and sociologists.

These issues are relevant for Ukraine also because the country has a large number of regions and climate zones, which distinguishes it from other countries

the diversity of ethnic groups of people and their physiological characteristics [7, 11]. This is also due to the fact that the importance of the health problem has especially increased in recent decades due to the deterioration of the nutritional structure. Numerous diseases have become widespread [4,5].

The main one is the expansion of the range and volume of production of food products with bifidogenic properties. This is also due to the fact that, despite a certain stability, the composition of microbiocenoses can change both under the influence of various stress agents and the physiological state of the human body. At the same time, it is necessary to take into account the identified relationship between various food ingredients and certain diseases, aggravated by social and economic reasons:

- dietary fiber deficiency and gastrointestinal diseases tract and cardiovascular system;
- deficiency of lacto- and bifidobacteria and disturbance of microbiocenosis gastrointestinal tract [4].

An analysis of scientific and technical literature showed that, taking into account the growth and type of diseases of the population of Ukraine, the most relevant area of research is the development of food products with probiotic properties using fruit and vegetable raw materials.

It has been established [7] that the systematic consumption of products with



probiotic properties, which have a regulatory effect on the body or certain human organs and systems, provides a healing effect without the use of drugs. At the same time, probiotics were noted to be harmless to the body, with a virtual absence of side effects and addiction to them with long-term consumption. Officially registered and approved for use in the food industry, probiotics are bifidobacteria and lactobacilli [8].

Currently, the direction associated with the production of dairy-based products that also have synbiotic properties is considered promising. The use of synbiotics, which are a combination of pro and prebiotics, makes it possible to stimulate the growth of human autoflora and improves survival of introduced bacterial additives in the intestine [1, 9].

It should also be noted that the introduction of biologically active (functional) components into food products makes it possible to impart new properties to traditional products. For example, dietary fiber has a multifaceted effect on the human body: it absorbs toxic compounds that come from food, reduces the concentration and time of their exposure to the intestinal mucosa, and improves metabolism. [4, 8].

The creation of products enriched with dietary fiber is an urgent task for the food industry. For a long time, dietary fiber was considered unnecessary ballast substances, and efforts were made to remove them from finished products. As a result, the actual consumption of dietary fiber by the population has decreased by 2-3 times compared to the norm: instead of 30-35 g per day, the average person eats no more than 10-15 g. [7, 8].

At the same time, thanks to research in modern medicine, it has been established [7,8] that a lack of dietary fiber in food leads to a disruption in the dynamic balance of a person's internal environment and is a risk factor for many diseases, including gastroenterological ones.

No less important is the presence of minerals in the human diet. Minerals are essential, vital components of food that perform important functions in the body. physiological functions [8].

The lack of vitamins also negatively affects human health: his well-being worsens, his overall performance and resistance to various diseases decrease, the



negative impact on the body of harmful working conditions and the external environment increases, treatment of any disease, increasing the body's sensitivity to influences increased background radiation, increases the risk of cancer [5,8, 10].

A very promising direction in functional nutrition is the use of nutraceuticals, which are a source of nutrients such as vitamins and minerals - in the form of juices, vegetable and fruit purees.

This trend is confirmed by an analysis of the consumer market for functional foods, which showed that a prominent place is occupied by food products enriched with dietary fiber, vitamins, minerals and other biologically active compounds [1,3,9].

The most active country in Europe in terms of the sum of all pro-, pre- and synbiotic products, according to Mintel's Global New Products Database (GNPD), is Germany, which has launched 240 dairy products in this category over the past 5 years. The second place is occupied by Great Britain - 144 species, followed by Italy, Austria, Spain, Ireland, and the European top ten is completed by Hungary, Poland, the Czech Republic and Ukraine, in whose markets there has been a noticeable revival only since 2004. [7, 8].

Thus, a critical analysis of scientific and technical literature gives grounds for the conclusion about the need to expand the range and increase volumes of production of probiotic food products on a fruit and vegetable basis with the inclusion of pectin substances, which are both soluble dietary fiber and prebiotics

2.2 Main ingredients used in the production of functional foods

The results of an analytical review of patent information literature showed that the most common functional ingredient is whey as a source of proteins and amino acids. Whey production in the world is constantly growing: from approximately 150 million tons in 2001 to 200 million tons in 2013, with up to 75% of the total volume provided by the European Union and the United States. These countries are the largest exporters of whey products (80%). Main products of whey processing: whey powder and permeate (59%), demineralized and delactosed whey powder (10%), whey protein concentrates (WPC, 12%) and lactose (19%) [2, 5, 8].



An analysis of scientific and technical literature showed that whey-based products are mainly used in human nutrition (36%), animal feeding (21%), nutraceuticals and pharmaceuticals (43%). The composition and properties of the whey are determined by the type of the main product and the features of its technology. Its density ranges from 1.023 to 1.027 kg/m, the dry matter content is 5.8-6.6%, including fat - 0.02-0.9%, protein - 0.5-1.5%, milk sugar (lactose) - 3.2-5.2%, minerals - 0.3-0.9%. The distribution of the main components of whey dry matter is as follows: milk sugar (lactose) - 71.7%, protein substances - 14%, minerals - 7.7%, fat - 5.7%, other - 0.9%. Whey contains about 20% milk proteins. At the same time, whey proteins contain more essential amino acids than caseins and are considered more complete from the point of view of nutritional physiology. In terms of biological value, whey protein is superior to chicken egg protein, which is the standard in the nutritional assessment of food products. According to the FAO/WHO scale, the biological value of whey proteins is 112%, casein - 78%. Whey proteins are one of the more valuable components of milk; they are rich in sulfur-containing amino acids (cystine, lysine and tryptophan). Therefore, the introduction of whey milk proteins into food products, especially those of plant origin, contributes to a significant increase in biological value. This is due to an improvement in the degree of balance of the amino acid composition. The main whey proteins include β - and α -lactoalbumin, immunoglobulins and components of the protease-peptone fraction [1, 9, 12].

The carbohydrate composition of whey and milk is similar. The color of the whey (yellowish-greenish) is due to the presence of riboflavin. Of the organic acids, it contains lactic and citric acids. Whey also contains a natural set of vital mineral compounds, which are classified as functional ingredients.

Table1

Basic ash elements serum	Absolute content%
Potassium	0,09-0,19
Magnesium	0,00
Calcium	0,04-0,11
Sodium	0,03-0,05
Phosphorus	0,04-0,1
Chlorine	0,08-0,11



The serum also contains lactoferrin (less than 0.3 mg/ml), enzymes and other minor components, in particular a number of vitamins such as A, B, C and D3 [3, 6].

The possibility of effective use of whey products in the treatment and prevention of diabetes, intestinal diseases, hypertension, infections, integumentary and bone tissues, immunodeficiency, complications after surgical interventions has been clinically proven [1, 4, 9].

One of the directions for the full use of all whey components is the production of drinks based on it. The most common options for dairy components in drinks: whey with milk or cream, whey with kefir, whey with yogurt, yogurt with the addition of whey and fruit juice, etc. Adding natural whey and lactulose to the drink recipe significantly enriches the product [1,5, 7, 13].

Juice-based drinks have become popular in the functional food market. At the same time, the taste preferences of consumers in recent years have gradually shifted from monoflavors (“Apple”, “Orange”, “Pineapple”, “Pear”) to various fruit mixes that give drinks a special fruity lightness and freshness (“Mango-pineapple”, “Orange-passion fruit-mango”, “Lemon-orange-grapefruit”, “Pineapple-grapefruit”, “Peach-arakuya”, “Cherry-orange-pomegranate”, “Berry mix”, “Orange-lychee”, “Apple mandarin-lemon” and much more) [11, 13].

To make drinks even more attractive and useful, along with fruit juices, it has recently been proposed to add all kinds of plant extracts (ginseng, St. John's wort, lemon balm, green tea, mate tea, extracts of hibiscus, lemongrass, schizandra, marjoram, ginger and chamomile) into the recipe. [3,5, 7, 9, 12].

A group of gelled products based on whey is also known: fruit and berry or fruit jelly, containing whey, citric acid, corn starch, granulated sugar, flavorings and dyes, plant components [10].

The disadvantage of the known gelled products, in our opinion, is the lack of functional properties, as well as the use of food colors and flavors that are not always natural. In their production, the technological operation of whey clarification is also used in order to removal of whey proteins, which leads to a decrease in the biological value of the jelly, an increase in production costs, and, consequently, an increase in



product cost. Despite the large selection and attractiveness of modern dyes, flavors, fillers and products using them, they have selectivity of use, especially in children nutrition, so consumers give preference to environmentally friendly products based on natural ingredients [8].

It should be noted that due to its high popularity, the range of structured products is rapidly growing. At the same time, various gelling agents are increasingly used as structure formers. For example, pectin substances can perform certain functions: By changing the consistency, they impart special properties. The prospects of using pectin substances in the production of functional food products based on whey have been proven [4,6, 7, 8, 9]. [5, 6, 11, 13].

Original research into the use of whey for food purposes was the development of whey, fruit and vegetable products and pectin substances combined in a single product, using the positive aspects of all components [13].

Another common functional ingredient is dietary fiber. Their deficiency in human nutrition leads to disruption of the functioning of organs and body systems. In addition, it has been proven that some types of dietary fiber help increase calcium absorption and act as prebiotics, while creating favorable conditions for the development of probiotics in the intestines, which makes it advisable to use pectin substances as a functional ingredient in probiotic products. Beet pulp, cereals, cereals, grain bran, fruits, berries and vegetables are added as a source of dietary fiber. [3,6, 10].

Thus, the results of the analytical review on the main functional ingredients provide grounds for the following conclusions:

1. Traditionally, fruit and berry additives are added to functional products. The most common type of fillers are fruits and berries (viburnum, sea buckthorn, black currant, chokeberry, rose hips, peaches, apples, cherries, etc.) in their natural state, crushed, in the form of a paste (gruel) and in processed form (juices, concentrates, powders, preserves, jams, alcoholic drinks, extracts).

2. Functional food products also contain vegetable fillers (carrots, beets, pumpkin, Jerusalem artichoke) in the form of purees, juices, and concentrates.

3. To increase the biological value, whey is added to different dosage.



Conclusion

The results of a critical analysis of patent information and scientific and technical literature showed that in the nutrition of the Ukraine population there is lack of dietary fiber, vitamins, and minerals, which contributes to an increase in nutritional diseases. The deterioration of the environmental situation, in turn, reduces human resistance to adverse environmental factors and disruption of intestinal microbiocenosis. Such factors determine the relevance of expanding the range and volume of production of functional nutrition products. In this case, the main physiological ingredients should be considered pre- and probiotics, soluble dietary fiber, fruit and vegetable raw materials, and whey. An analysis of the functional food market has shown that juice-based drinks containing pectin substances and structured products such as fruit and vegetable jelly desserts can become the most competitive



KAPITEL 3 / CHAPTER 3³

A LOOK AT THE DEVELOPMENT OF CONNECTIONIST NEURAL NETWORKS

DOI: 10.30890/2709-2313.2026-47-03-011

Introduction

The nature of human imagination, reflection, and foresight has intrigued scientists since ancient times. Since most scientists were religious, it's not surprising that the human brain and nervous system control all bodily organs. However, thoughts, imagination, and other human cognitive abilities were believed to be linked to the spiritual, immaterial realm. It was believed that since the spirit, bestowed upon humans at birth by a higher power, was responsible for thought and imagination, even the origin of intelligent beings on the planet (the emergence of a second human signaling system) was not discussed.

Descriptions of the functioning of neurons, and then groups of neurons connected by synapses in living brain tissue, and the subsequent modeling of these processes using artificial neurons and synapses were initially not equated with the emergence of thoughts and ideas. Research was limited to examining the influence of the human nervous system on the motor system and the functioning of internal organs. Modeling of neural systems also aimed to understand the characteristics of nerve impulse transmission and elucidate the existence of various internal rhythms in the nervous system⁴. It's important to note that neuroscientists shifted from studying biological nervous systems to creating artificial models of neurons and synapses and began exploring combinations of these elements—that is, connectionist models assembled from individual artificial neurons interconnected. Few believed such systems were capable of solving intellectual problems such as recognition and control, but everyone hoped that the behavior of these models would explain the functioning of the cerebral cortex. Therefore, until the middle of the last century, the processes of imagination,

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⁴ In a number of sources, the first (threshold) model of a biological neuron was considered to be the model of L. Lapicque (1907), which generated impulses.