ANNOTATION
Doctor of Philosophy (PhD) theses
Specialty "6D070100-Biotechnology"
Khussein Samir Sarsembayev's
Biotechnological approaches to the design of products that increase the body's resistance to increased physical stress

General characteristics of the dissertation work.

The work is devoted to the development of specialized sports nutrition using national raw materials, one of which is mare's milk with its unique biological properties, a combination of strains of lactic acid and bifidobacteria, vitamins, macro- and microelements aimed at replenishing energy costs, as well as increasing the antioxidant and immunostimulating properties of the body.

Relevance of the research topic.

Today, in connection with the promotion of an active lifestyle, Kazakhstan's entry into the world sports arena, high sports achievements, the development of new types of sports nutrition, adaptogen products aimed at increasing the body's resistance and endurance to physical and psycho-emotional stress, contributing to an increase in sports results.

Specialized products for intensively trained athletes, considering their high physical exertion, should contain, along with the main nutritional factors, a complex of biologically active ingredients, including collagen hydrolysates, glucosamines, hyaluronic acid, etc., aimed at increasing the endurance and physical activity of an athlete against the background of intense psycho-emotional stress.

It should be noted that at present the main share of products and goods for sports purposes (about 90%) is imported from abroad, at the same time, the import substitution program adopted in our country for the domestic manufacturer will open wide opportunities and prospects to produce local food. These opportunities in the Republic of Kazakhstan are significantly expanding, considering the uniqueness of the raw material base, the richness and diversity of animal and vegetable raw materials with high nutritional and biological value, as well as directed preventive properties.

To optimize the nutrition of athletes, attention should be paid to the development of domestic specialized food products with directed medical and biological properties that have a beneficial effect on the endurance and performance of athletes.

In this regard, today many scientific teams are working on the creation of new specialized food products based on traditional and non-traditional raw materials, using methods of its deep processing, based not only on data on the chemical composition of products, but also on the use of certain biotechnological methods, enhancing functional characteristics and imparting targeted therapeutic and prophylactic properties to products.

Today, thanks to a thorough assessment of the composition and properties of most raw materials that exist in our country, the use of local, unique raw materials, including dry and native mare's milk, as well as the milk of other farm animals, is

justified for the development of new domestic specialized food products with directed antioxidant, immunostimulating and microbiocenosis-normalizing properties.

The purpose of the work: Development of basic biotechnological approaches to the creation of new specialized products that increase the body's resistance to physical stress.

Main tasks:

1. Biomedical substantiation and selection of the main raw materials used in the development of a new dry specialized mixture based on mare's milk with targeted physiological and biochemical characteristics that increase the body's resistance to physical stress.
2. Development of a recipe and technology for a new dry mix based on mare's milk.
3. Evaluation of the chemical composition of a specialized mixture based on dry mare's milk.
4. Experimental evaluation of the properties of the product on various models of physical activity.
5. Evaluation of the role of low molecular weight peptides isolated from mare's milk on endurance and biochemical parameters of animals during exercise.
6. Development and experimental evaluation of a liquid fermented milk product based on mare's milk.
7. Evaluation of the clinical efficacy of new sports nutrition products based on mare's milk.
8. Release of pilot batches of sports nutrition products based on dry mare's milk.

Object and subject of research:

The object of the study was: dried and native mare's milk, skimmed milk powder, vegetable cream powder, vitamin and mineral supplements, dried fruits, brown algae extracts, citrus pectin, fucoidan, vitamin and mineral premixes.

Research methods:

The work was carried out using modern highly sensitive immunological, biochemical, microbiological, physicochemical research methods, on modern highly sensitive instruments - Agilent 6890 N Network GC System gas chromatograph, Sartorius analytical balance, Sartorius MA 45 moisture meter, VELP Arec heated magnetic stirrer, pH meters Sartorius, PB – 11, SHCOTT ProLab 100, ELMI shaker S-3 L, milk quality analyzer Laktan, electric dry-air thermostats TC – 1/80 SPU.

As a result of the dissertation work, a specialized product was created in the form of a dry protein mixture based on mare's milk. In addition, fruit bars based on a dry protein mixture have been developed, as well as a liquid fermented milk product based on mare's milk.

The work used physico-chemical methods for assessing raw materials and finished products.

All developed products were evaluated in an animal experiment on a model of physical activity.

A clinical evaluation of a specialized product in the form of a dry mix based on mare's milk and bars based on it was carried out on triathletes.

The body composition of athletes was studied on the analyzer InBody 770 (South Korea), included - determination of the total amount of water, proteins, minerals, the ratio of muscle and fat mass, fat content, body mass index, weight, skeletal muscle mass.

Biochemical studies of athletes' blood were performed on the ARCHITECT8000 analyzer.

Complete blood count (CBC) was performed on a UNICEL DXH-800 hematology analyzer manufactured by Beckman Coulter.

Scientific novelty of the research results.

For the first time, specialized products have been developed that increase the body's resistance to physical activity for sports nutrition based on mare's milk, and an experimental and clinical evaluation of their effectiveness has been given.

Practical and theoretical significance of the work.

Based on literature data, as well as the results of experimental and clinical studies, the main raw materials are substantiated, and biotechnological approaches to the design of specialized products with directed biomedical properties are developed.

As a result of the research, a dry specialized mixture was created, based on which preventive bars for sports nutrition were developed, intended not only for preventive purposes, but also for mass consumption by persons staying in extreme environmental conditions and experiencing increased physical and neuro-emotional stress.

The product is registered with the Committee for Sanitary and Epidemiological Surveillance of the Ministry of Health of the Republic of Kazakhstan, registration number KZ.16.01.98.004.E.000222.03.21. The product has developed an organization standard, a technological instruction, a registration certificate has been received, as well as a patent for invention No. 34675.

The product was developed industrially at BioElite LLP, Almaty region, an implementation certificate was received.

Evaluation of the clinical efficacy of the product on highly qualified athletes triathletes, who showed it to be high. efficiency, gives grounds for the use of the product in sports practice.

The main provisions submitted for defense:

1. Considering the uniqueness of the chemical composition of mare's milk, the body's need for the main biologically active ingredients, under conditions of increased physical activity, the selection of raw materials is justified, the formulation and technology of a dry specialized product has been developed.

2. An assessment of the chemical composition, nutritional and biological value of a new specialized product indicates its rich protein, carbohydrate, fat, vitamin, and mineral compositions that meet the basic requirements for the development of sports nutrition.

3. The uniqueness of the protein component, in particular the content of low molecular weight peptides in mare's milk, made it possible to enhance the immunobiological and antioxidant properties of the product.

4. Experimental evaluation of the properties of the product on various models of physical activity confirmed its antioxidant properties, a beneficial effect on energy metabolism, as well as the endurance of animals.

5. The rationale for the inclusion of lactic and bifidobacteria (Streptococcus lactis, Lactococcus acidophilus, Bifidobacterium bifidum) in the ratio of 1:1:1 into the formulation of a dry sports nutrition product, as well as a liquid fermented milk product, was biotechnological studies to assess the growth rate of microorganisms, acid-forming activity, as well as their effect on endurance, biochemical and immunological parameters when evaluating the properties of specialized products, including lacto- and bifidobacteria in the formulations.

6. Clinical evaluation of the effectiveness of products on triathletes indicates their favorable effect on performance, removal of neuro-emotional stress, normalization of blood parameters, lipid, and carbohydrate metabolism, as well as immune and antioxidant statuses.

7. The development of the regulatory framework, as well as the registration of the product with the Sanitary and Epidemiological Supervision Committee of the Ministry of Health of the Republic of Kazakhstan, made it possible to produce a pilot batch of the product at food industry enterprises.

Main research results and conclusions.

Comprehensive studies have been conducted on the creation of new specialized sports nutrition products based on mare's milk, which increase the resistance of athletes to increased physical exertion, the composition of sports nutrition products has been substantiated, experimental batches of products have been developed, recommendations for use have been developed, studies have been conducted on laboratory animals, as well as clinical trials on triathletes. Patents were obtained, registration of a dry specialized mixture based on mare's milk was carried out.

Considering the favorable effect of special products on the general condition of athletes, performance indicators, indicators of the cellular link of immunity, as well as antioxidant status, this specialized nutrition can be recommended to various categories of athletes to increase efficiency and improve sports results.

The results obtained allow us to draw the following conclusions:

1. Taking into account the increased need of the body of athletes in conditions of physical exertion and neuro-emotional stress in a complete protein, readily available carbohydrates, polyunsaturated fatty acids, antioxidant vitamins, as well as in macro- and microelements, when developing the formulation and technology of the dry mix for sports nutrition, it was selected natural food raw materials, including dry mare's milk, dry skimmed milk, dry vegetable cream, dry wheat germ, dry sea buckthorn fruits, inulin, dry bacterial cultures, vitamin and mineral complex containing water- and fat-soluble vitamins, selenium, magnesium, zinc, iron , a polysaccharide from brown algae - fucoidan.

2. Evaluation of the chemical composition of a specialized product indicates its balance in terms of the main food ingredients and indicates that 100 g of the product contains 20.7 g of protein, 15.0 g of fat, 58.0 g of carbohydrates, caloric content is an average of 450 kcal / 100 g. 100 g of the product contains: 14-15 mg of α-tocopherol acetate; 1.5-1.7 mg retinol acetate; 120-130 mg of ascorbic acid; 13-14 mg niacin; 220 micrograms of folic acid. In addition, the product contains about 430-450 mg of calcium, about 40.0-42.0 mg of magnesium; 9.0-10.0 mg zinc; 7.0-8.0 mg of iron and 50 μg of selenium, 17.0 mg% and 70.95 mg% of ω-3 and ω-6 polyunsaturated fatty acids, respectively, while the product contains a minimum level of trans fatty acids.

3. The inclusion of dry cultures of lactic acid and bifidobacteria (*Lactobaccillus acidophillus, Streptocuccus lactis, Bifidum bifidum*), taken in a ratio of 1:1:1, into the composition of the product was associated with their favorable effect on the state of intestinal microbiocenosis and an increase in the protective functions of the body.

4. Feeding animals with a specialized product for 21 and 35 days against the background of physical activity (swimming with a load) led to a statistically significant increase in the endurance of rats, a decrease in erythrocyte membranes, in the mitochondrial fraction of the femoral muscle and in the microsomal fraction of the liver of the level of malondialdehyde and diene conjugates , to an increase in the activity of both catalase and superoxide dismutase, as well as a decrease in the level of lactic and pyruvic acids in the blood, the femoral muscle of rats, compared with control animals.

5 Against the background of taking a specialized product in rats of the experimental group, compared with control animals, there was an increase in the blood content of hemoglobin, erythrocytes, and hematocrit, respectively, by 12.9%; 7.4% and 3.2%, which, however, does not reach the level of statistical significance.

6. Evaluation of the effectiveness of low molecular weight peptides isolated from mare's milk during physical exertion, when running on a troibane, showed that consumption by rats for 28 days of 1.0 ml per 100 g of body weight enriched with antioxidant vitamins of the fraction of low molecular weight peptides from mare's milk, favorably affected the content of lactate and pyruvate both in the blood and in muscle tissue. So, in comparison with the control group, the rats of the experimental group had a lower concentration of lactic acid in the blood serum by 40.6% and in the femoral muscle by 24.7%. The content of pyruvic acid did not differ from the initial values.

7. The intake by animals of a fermented milk product enriched with low molecular weight peptides had a positive effect on the endurance of rats during swimming, as well as on the state of the antioxidant defense system, as indicated by a decrease in the blood serum of rats of the final and intermediate LPO products, as well as the restoration of the activity of key enzymes of the antioxidant system.

8. The results of a clinical assessment of the effectiveness of specialized nutrition on body composition indicators (increase in the level of proteins, minerals, decrease in body mass index, decrease in fat, and increase in muscle mass of the body), biochemical and immunological blood parameters of triathletes indicate an

increase in the antioxidant and immune status of athletes by background of food intake. Marked positive changes in blood counts. the content of ferritin, serum iron and iron-binding ability of blood serum testify to the anti-anemic properties of the product and its normalizing effect on the hematopoietic functions of the body.

9. Considering the favorable effect of special products on the general condition of athletes, performance indicators, as well as indicators of the humoral link of immunity, as well as the antioxidant status, this specialized nutrition can be recommended to various categories of athletes to increase efficiency and improve sports results.

Connection with the plan of the main scientific works.

The dissertation work was carried out within the framework of the following projects:

1. BR05636956-OT-20 To develop a technology for improving the health and quality of life of workers in enterprises involved in the production and processing of heavy metal salts.

2. 0115RK02006 Biomedical and biotechnological approaches to the creation of new women's milk substitutes, complementary foods and preschool and school food products based on mare's milk.

Approbation of work.

- VI International conference of young scientists: biophysicists, biotechnologists, molecular biologists, and virologists. Collection of abstracts. Novosibirsk, Koltsovo Science City, 2019.
- VII International conference of young scientists: biophysicists, biotechnologists, molecular biologists, and virologists. Collection of abstracts. Novosibirsk, Koltsovo Science City, 2020.

Publications.

According to the research results, 11 papers were published, of which 6 articles, one article is included in the Scopus database, two publications in KKSON journals, two abstracts at international conferences. Received two patents of the Republic of Kazakhstan for the invention. Also, one article was accepted for publication in the journal included in the Scopus database. The number and quality of publications meets the requirements of the Committee for Quality Assurance in Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan. The percentage of author's participation is 50%.

Volume and structure of the dissertation work.

The dissertation is presented on 123 pages of computer text, includes 34 tables, 18 figures, 227 sources of cited literature. Applications are set out on 35 pages.

Compliance with the directions of development of science or government programs:

Development of specialized sports nutrition products to improve the physical performance of athletes, replenish the body with the necessary nutritional components, to improve the athletic performance of athletes.