Evolutionary Genetic Polymorphism and the Questions of Sports Nutrition Personalization

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Abstract: Evolutionary genetic polymorphism which is to preserve individual genetic information in the human genome throughout the development of the body is considered. The genetic portrait of an individual should be taken as the basis for the development of personalized nutrition for athletes which ensures its effectiveness, the possibility of effective prevention and comprehensive treatment of possible sports pathologies. New prescription formulas of isotonic and hypotonic sports nutrition drinks using polyphenols (PP) isolated from needles of woody plants have been developed. PP are added in the amount of 6.7 mg / 250 cm³ of drink. The isotonic properties of the drink are determined by the content of vitamins E, B1, B6, niacin and C and hypotonic properties are due to vitamins B1, B6, B12, folic and pantothenic acids. Immunomodulating antioxidant and regenerative properties of PP based on available studies are shown, which are important in improving the performance and adaptation of athletes to physical and emotional stress. The advantage of the developed technologies is the synergism of the action of active ingredients at optimal dosages and the presence of high efficiency, the absence of adverse reactions and safety during prolonged use in various age groups of athletes.

Keywords: individual athlete genome, isotonic and hypotonic drinks with polyphenols, efficiency, advantages.

1. Introduction

The evolutionary process of the development of the human body is inevitably accompanied by numerous changes in the direction on survival under the conditions of constant influence of internal and external factors. These changes form an individual genotype, the so-called "genetic portrait" of an individual, which allows optimizing diets, including sports nutrition, increasing the efficiency of metabolic adaptation and ensuring the growth of results at individual stages of competitive activity [1].

The prevailing genetic polymorphism must be taken into account in the prevention and comprehensive treatment of various diseases that occur both in the sport of the highest achievements and in the physical culture movement, which is finally aimed at maintaining health and ensuring the quality of life [2, 3].

2. Literature Review

Balanced basic diet according to essential nutrients and energy is of great importance taking into account the individual needs of the body. The additional inclusion specialized products (including biologically active additives (BAA)) in the diet is necessary to support the nutritional and metabolic status of athletes, taking into account the sport, age, gender, specifics of the training process, competitions and the recovery period [3]. The possibility of realizing the given problem was confirmed at the development new forms of dietary supplements, evaluation their effectiveness and functional action [4, 5]. It should be noted that the Russian market of sports nutrition products requires the expansion of their range using new technologies and biologically active complexes. This is due to the development strategy of physical culture and sports in this country, the successes and prospects of training highly qualified athletes at the international level.

3. Materials and Methods

Vitamin premixes, preparations of polyprenols (PP), laboratory and experimental samples of isotonic and hypotonic drinks for sports nutrition were used as materials. Standardized and special methods were used to study the quality, safety and functional properties of specialized drinks [6].

4. Results

The results of our own research and available literature indicate that it is impossible to ensure the athlete's needs in essential nutrients at the expense of a normal diet. Therefore, during the training cycle, the competitive and recovery periods specially developed nutrition systems are used. The methodology of sports nutrition involves the use of specialized products, including drinks with directed functional properties against a balanced basic diet and taking into account the athlete's genetic portrait.

New drinks based on the natural adaptogen PP have been developed. Their functional properties are aimed at adapting athletes to physical and emotional stress. In essence, adaptation is understood as an increase in the speed of recovery after long, exhausting trainings and competitions with subsequent preservation of health and increased performance.

A biologically active complex in the form of PP gets out from the woody greens of conifers.

The prospects for using coniferous woody greens as a source of biologically active substances and their complexes are explained not only by the possibility of their use in diet therapy but also by the availability of the raw material base throughout the year and its relatively low cost.

Isotonic and hypotonic drinks were used as the basis for the production of sports drinks using PP. The formulations of them are given in Tables 1 and Table 2.

Table 1. The formulation of isotonic drink using PP

Vitamins	Unit of measurement	Recommended daily intake	Declared amount in 750 ml	The composition of vitamin premix per kg
E	mg	10.00	10.00	109.300 g of dl-d-tocopherol acetate DAB
B ₁	mg	1.40	1.40	15.00 g thiamine mononitrate DAB
B ₆	mg	2.00	2.00	19.520 g of pyridoxine hydrochloride
Niacin	mg	18.00	18.00	132.00 g nicotinamide DAB
C	mg	60.00	60.00	520,000 g ascorbic acid (Vitamin C) DAB

The recommended amount of vitamin premix is 0.15 g / 750 cm³ of drink. The osmolarity of isotonic drinks is about 300 mosm / l (like blood) that ensures their faster absorption into the blood. It is recommended for people practicing sports during and after training.

Table 2. The formulation of a hypotonic drink using PP

Vitamins	Unit of measurement	Recommended daily intake	Declared amount in 250 ml	The composition of vitamin premix per kg
B ₁	mg	1.4	0.47	15.045 g Vitamin B1-Mononitrate DAB
B ₆	mg	2.0	0.67	19.520 g Vitamin B6-DAB hydrochloride
B ₁₂	mg	1.0	0.33	8.000 mg Vitamin B11 DAB
Folic acid	mcg	200.0	67.00	2.267 g Folic Acid DAB
Pantothenate	mg	60.	2.00	84.360 g Calcium D-Pantothenate DAB
Niacin	mg	18.0	6.00	132.000 g Nicotinamide DAB
Biotin	mg	150.0	50.00	1200.000 mg Biotin USP
C	mg	60.0	20.00	520.000 g Ascorbic acid DAB

The recommended amount of vitamin premix is 50 mg / 375 cm³ of drink.

The formulations are developed based on the recommendations of the European Economic Community 90/496. The carrier is dextrose. Drinks with an osmolarity of less than 300 mosm / l are suitable for restoring water balance during intense training and

sweating. Hypotonic drinks are consumed a quarter of an hour before and during training.

PP are introduced in the amount of 6.7 mg per glass of drink (250 cm³). The price of a sports drink increases by 1.68 rubles. It is insignificant compared to the pricing policy for foreign sports nutrition products.

5. Discussions

Coniferous extracts, triterpenic acids (TTA) and PP contained in the needles have anti-stress, antioxidant, and adaptogenic properties, as shown in simulated experiments on laboratory animals and clinical trials [7–13].

The stress-adaptogenic effect of PP was studied in male rats after their immobilization in the supine position for 16 hours. PP was administered to animals per os 0.5 ml / 100 g body weight. Studies have shown the ability of PP to prevent the effects of stress caused by excessive muscle tension. In this case, PP to a greater extent exhibit a stress-protective effect compared with the drug Eleutherococcus, which was expressed in the following metabolic reactions:

- protection of the spleen and thymus from involution, adrenal hypertrophy, reduction of vitamin C content in them;
- weakening of trophic disorders in the gastric mucosa, a decrease in the number of bleeding manifestations;
- a decrease in the level of glucose and urea in the blood serum;
- slight loss in body weight.

The considered effects of PP are explained by their participation in the dolicholphosphate cycle that positions them as essential substances necessary for the correction of metabolic disorders at the cellular, tissue and organ levels. Sufficient clinical material has been accumulated about their regenerating and protective properties in relation to the cardiovascular, nervous systems and liver. These effects are several times superior to the effects of similar natural complexes. In this case, PP do not cause side effects and are safe for the body even in relatively high doses. Plant PP fulfill their functions by converting them into dolichols, the structural similarity of which is similar to PP. Dolichols occupy key positions in the dolicholphosphate cycle which is the main link in the biosynthesis of glucoaminoglycans and glycoproteins occurred in cell membranes. Glycolization of membrane proteins is a vital process in cell activity. Glycoproteins are involved in the construction of membrane receptors that are used in the biosynthesis of various enzymes and hormones. The important role of dolichols in the regulation of the lipid composition of membranes has been established. Thus, specialized products using PP have competitive advantages in the possibility of optimal dosage of active principles and their high efficiency, taking into account the synergistic properties. Their safety in long-term use is also shown.

Coniferous extract with PP, other biologically active substances are successfully used in hyperthermic baths, which activate and prolong physical performance and recovery processes. The mechanism of this action is associated with the normalization of the

adaptation parameters of the nervous system and capillary circulation in connective tissue structures, an increase in the functional state of organs and systems of the body.

The prospects for using coniferous wood greens as a source of biologically active substances and their complexes are explained not only by the possibility of their use in diet therapy but also by the availability of the raw material base throughout the year and its relatively low cost.

The effectiveness of the use of PP is shown for the cardiovascular, nervous systems and liver by obtaining evidence-based clinical materials [4, 5, 7–13]. A complex dietary supplement has been developed. Its healing function in relation to the cardiovascular system is explained by the synergism of the properties of the ingredients included in its prescription formula. The action of a biologically active complex is implemented in the following main areas: inhibition of undesirable processes; cardiac muscle ischemia; reduction of cell death as a result of cytolysis, which provides the necessary level of stabilization and restoration of the membranes of cardiocytes and the vascular wall; blocking of free radicals and oxidative stress and, as a result, activation of the processes of energy supply and blood supply to the heart muscle; protective role in relation to young cardiocytes and activation of their growth; increase of myocardial energy potential and improvement of heart muscle nutrition. The inclusion of a specialized product in the diet of patients with dyslipidemia and hypertension ensured a significant decrease in the pressure of somatic complaints according to the Giessen questionnaire. Positive dynamics of changes in the quality of life (physical activity, energy, emotional state, sleep and others) was observed. The lipid-lowering effect of statins was enhanced in terms of total cholesterol triglycerides and atherogenicity index. The positive effects of diet therapy on cardiovascular therapy have been confirmed by recording blood pressure. The considered aspect of the work has found practical application in the treatment of hypertension and dyslipidemia.

A specialized biocomplex has been developed. Its functional properties are aimed at restoring nerve tissue, which is important after neurotrauma and strokes. The synergistic properties of the components that make up the drug ensure the restoration of phosphatidylserine in nerve cells, the preservation of the myelin sheath, the maturation and division of stem cells. The practical implementation of these functions is to improve memory, mental performance, blood supply, associative processes and slow down the aging of brain tissue. Vegetative-vascular disorders after traumatic brain injury and stroke are reduced. Leveling of psycho-emotional stress, normalization of sleep, mood and the possibility of social adaptation are noted as side positive properties. The Memree Plus-30L complex (which is part of the product) is a mixture of phosphatidic acid and soybean phosphatidylserine. It is functionally aimed at recovering from physical and emotional stress, reducing stress and, in general, enhancing cognitive health. It has been shown that phosphatidylserine activates metabolic processes in the brain, which is important in the aging of the body, improves attention and memory. The compounding ingredients of the complex have the ability to reduce the level of social stress and cortisol when passing the Trier test.

Another component of the product is glycine. It is characterized as a drug that improves metabolism in the brain, since it is a neurotransmitter that transmits information on nerve fibers. Glycine is associated with numerous receptors in the spinal cord and brain, which inhibit neurotransmitters that transmit information to the central nervous system. The

essential amino acid has a beneficial effect on the effects of stress, normalizes falling asleep, improves mood and memory, protects the body from the negative effects of psychotropic drugs. Medical evidence of the effectiveness of the developed product in the complex treatment of vascular genesis of discirculatory encephalopathy has been obtained. The glycine preparation was included in the diet of patients with this disease. The objectivity of the studies was examined on the basis of registration of neurological status and subjective complaints: impaired memory, attention, dizziness, etc. Psychopathological disorders consisted in the manifestation of asthenic symptoms, neurological status was characterized by extrapyramidal insufficiency, autonomic dysfunction, vestibular-atactic and -cephalgic syndromes. The latter was most often manifested by the appearance of a diffuse headache of varying severity. Manifestations of vestibular-atactic syndrome consisted in the occurrence of dizziness, instability when walking, etc. The use of the developed dietary supplement in addition to classical therapy increased the effectiveness of treatment of the disease in question, which was expressed in the positive dynamics of the clinical symptoms in the examined patients: regression and reduction of headache; increased attention and initiative; improved reproduction and memorization. Indicators of life quality are improved: energy; physical activity; emotional state and others.

An integrated biologic drug consisting of high cleaning of PP has been developed. The drug is positioned as a hepatoprotector, purposefully affecting the correction of pathological changes in the liver, which is confirmed in experimental studies on a model of toxic effects of dichloroethane and acetaminophen on the liver. It was found that the effect of hepatotoxic agents is leveled by including PP in the diet of laboratory animals. Medical evidence of the effectiveness of PP by their inclusion in the diet of patients with alcoholic liver disease is presented. The mechanism of this action is associated with the inclusion of vitamin E in the exchange of dolichol, which is necessary for the normal transport of free radicals. Tocopherol deficiency leads to the development of molecular destructive processes underlying the pathogenesis of liver diseases. The component of a specialized product such as silymarin protects the liver from toxic substances and other harmful factors, interferes with the process of lipid peroxidation and the destruction of cellular structures, converts free radicals of the liver into non-toxic substances. Silymarin activates the biosynthesis of phospholipids and proteins by stimulating RNA polymerase, accelerates the regeneration of liver cells, stabilizes cell membranes. Essential phospholipids are the structural components of cell membranes. They are one of the active components of a specialized product. The use of essential phospholipids leads to the normalization of metabolic processes, protects the cell membranes of hepatocytes, normalizes metabolic processes in the cell. The developed product has been tested in the complex treatment of patients with alcoholic hepatitis. Patients complained of a lack of appetite, weakness, dysomnia, tremor of the extremities. As a result, a hepatoprotective effect was observed against the background of an improvement in the dynamics of biochemical parameters. The effectiveness of the treatment of this disease was increased, while the components of the specialized product had synergistic properties, complementing and enhancing the action of each other.

The developed products passed the certification procedure according to the requirements of international and national Russian standards of the ISO 9001, 22000 and

GMP series. They are included in the Federal Register of the Russian Federation and are manufactured at the enterprises of the industrial partner - ArtLife company (Tomsk).

The obtained data from experimental and clinical studies confirm evolutionary genetic polymorphism and the need for personalization of sports nutrition.

6. Conclusions

The resulting materials were of theoretical and practical importance in the development of sports nutrition products aimed at correcting metabolic disorders in conditions of intense physical and emotional stress.

Developed isotonic and hypotonic drinks using PP have mutually potentiating functional properties with prolongation of physiological effects after the end of the intake course. The advantage of the drink is its high efficiency due to the synergistic effect at the optimal dosages of the active ingredients, as well as safety, the absence of undesirable side reactions and the possibility of prolonged use for athletes of different ages.

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