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Dietary supplements in the structure of providing high efficiency of competitive result in elite sport

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Summary

Today it is a well-established fact that scientifically substantiated, competent and individualized usage of macro-, micro- and pharmaconutrients is capable of optimizing human capacities, increasing muscle contraction strength, general and special endurance in professional, highly skilled athletes. It is quite obvious that balanced nutrition is a key to providing athlete body with the main substances and energy necessary for the high level of motor activity. The paper considers the role, the place, the validity and the efficiency of dietary supplements utilization in the course of athlete preparation on the basis of March 2018 the IOC Consensus statement on dietary supplements usage by elite athletes, which has become the main regulatory document for specialists of sports medicine and nutritiology. The Consensus has formulated the concept of ergogenic nutritiological means that in future will enable to revise the system of sports preparation pharmacological support in European countries, bringing it closer to world standards. The work briefly highlights the development of sports nutritiology as a science and practice of its provisions realization in elite sport. Based on the Consensus provisions, 4 main classes of dietary supplements for sport have been outlined: 1) functional food, food enriched with additional nutrients or components, different from the usual nutrient composition; 2) specially formulated compounds and sports nutrition for providing energy and nutrients in a more convenient form than regular food for nutritional support in sport; 3) individual nutrients and other food components or plant products in isolated or concentrated forms; 4) multi-component products containing various combinations of substances with a certain intended use.

In addition, the main, more highly specialized groups of dietary supplements have been classified with indication of their representatives, the fundamental differences between dietary supplements and ergogenic pharmacological preparations have been formulated, thus enabling reasonable nutritional and metabolic support of functional and structural reorganizations in the body of athlete, when it forms the prerequisites for emergence of new own ergogenic characteristics.

The article emphasizes that the problem of dietary supplements usage has many unresolved issues of organizational and informational nature, focuses on the formation of holistic algorithm for these ergogenic means utilization, which requires highly qualified specialists – sports nutritionists, above all. The authors present their vision of managing preparation of such specialists in the post-Soviet space, which should become the key to the rational use of dietary supplements in order to increase the competitive process efficiency of members of the national Olympic teams along with preservation of athletes' health.

Keywords*: highly skilled athletes, dietary supplements, efficiency, athletes' health, 2018 the IOC Consensus statement on dietary supplements.*

Problem statement

Today, everything related to the consumption of basic nutrients by athletes as a part of a regular diet or additionally, in the form of dietary supplements (DS), refers to the sphere of new synthetic science – sports dietetics, which arose as a result of interpenetration of sports pharmacology principles and those of sports dietetics a little over 10 years ago (Martin et al., 2006; Burke, 2009) and is actively developing now (Burke, Cox, 2010; Burke, 2017; Garthe, Maughan, 2018). Today it is a well-established fact that scientifically substantiated, competent and individualized usage of macro-, micro- and pharmaconutrients is capable of optimizing human capacities, increasing muscle contraction strength, general and special endurance in professional, highly skilled athletes. It is obvious that balanced nutrition is a key to providing athlete body with the

main substances and energy necessary for the high level of motor activity (El Ghoch et al., 2018).

At the present time, all aspects of dietary or diet supplements usage in sport, and in elite sport, above all, are regulated by March 2018 the IOC Consensus statement on the use of DS by elite athletes, which has become a regulatory document for a sports physician and sports nutritionist. It represents an expert opinion and recommendations of leading sports nutritionists and specialists in the field of sports medicine, based on a detailed analysis of the latest achievements of sports science (Maughan et al., 2018). The Consensus has formulated the concept of ergogenic nutritiological means that in the future will allow to revise the system of sports preparation pharmacological support in European countries, bringing it closer to world standards.

The strategic directions for realization of the Consensus Provisions include stimulation of physical work capacity and acceleration of recovery processes, preservation of athletes' health with the rational and reasonable use of dietary supplements, functional nutrition products and individual nutrients.

The earlier inextricable connection between dietary supplements and preparations created for specific goals of clinical medicine could not take into consideration in the field of sport the following fundamental features of the latter: they do not take into account the peculiarities of the body metabolism during intensive physical loads, have a limited range of application (nosology) and are not adapted to the features of athlete preparation periods. Keeping in mind organizational and technological breakthrough in the field of creating new substances for sport that has occurred during the last decade, one may state that today's dietary supplements are created specifically for load conditions, often with account for energy supply mechanisms, make allowance for all metabolic features of the body during intensive physical loads, have a wide range of application and are able to "close" almost all metabolic rough spots in maintaining homeostatic balance in the body of athlete in accordance with the energy orientation, training load density and volume in the dynamics of annual preparation macrocycle.

Identifying metabolic peculiarities in the process of nutrients assimilation at the cellular and subcellular levels has allowed to determine the athlete's needs for individual components of the diet, to establish their optimal ratios necessary to increase physical work capacity, accelerate the processes of adaptation to loads and the impact of negative environmental factors, intensify the body recovery processes. The necessity of expended energy replacement at the expense of increased energy value of nutrition arose, which, in its turn, necessitated the creation of specialized nutrition for athletes, the development of special products of high nutrition value, as well as diet ones (biologically active, dietary supplements) as important nutritiological factors of ergogenic orientation (Busquets-Cortés et al., 2016). Today, by no means all of the athletes understand the correctness of the choice of a balanced diet, but at the same time everything that can give a competitive advantage, including dietary supplements, seems rather attractive for obtaining success. According to recent data (Garthe, Maughan, 2018), from 40 to 100% of athletes usually take different dietary supplements or functional sport food that are currently defined as "ergogenic nutritiological means", depending on sports event specifics, the level of competition and the validity of the usage of basic nutrients. However, intake of nutrients in the form of dietary supplements by an athlete without nutritional deficiency may not only fail to improve the competitive activity efficiency, but can produce a detrimental effect on the indices of physical and functional fitness, psychological state of the athlete and his/her health and quality of life.

In view of the aforesaid, the **objective** of the given review of scientific and methodological literature was the formation of modern ideas about dietary supplements as an integral part of sports preparation medico-biological support on the basis of applying the IOC-2018 Consensus Provisions.

Brief description and modern classification of dietary supplements for sport

The methods of motor activity nutritiological support should take into account specialization and qualification of athletes, their gender and age characteristics, and be applied depending on training period and the direction of loads. Due to improvement and tightening of doping control, it is extremely important that dietary supplements (and sport food) widely used in sport do not contain substances included in WADA Prohibited list, while providing a pronounced ergogenic effect. Naturally, in elite sport, athletes can use dietary supplements

at their own peril and risk, but this can lead to an unexpected negative impact on their competitive activity efficiency and suspension from sport for a long time. In this regard, a broad discussion of medical, physiological, cultural and ethical issues may be required to ensure that the athlete has the information necessary to make an informed choice of these or those dietary supplements or functional food with a pronounced ergogenic effect (Dmitriev, Gunina, 2018a, b).

According to the Consensus Provisions DSs include: 1) functional food, food enriched with additional nutrients or components, different from the usual nutrient composition (for instance, food with increased vitamin and/or mineral content); 2) specially formulated compounds and sports nutrition for providing energy and nutrients in a more convenient form than regular food for nutritional support in general population (for instance, ready-to-use mixed liquid meals) to be used in sport – sports drinks, gels, products of "sport-bar" category; 3) individual nutrients and other food components or plant products in isolated or concentrated forms; 4) multi-component products containing various combinations of substances with a certain intended use.

Ten years ago, in the practice of training American athletes, a classification was adopted, according to which all DSs were divided into only two classes (quoted in: Platonov, 2017). The first was defined as "food ... for diet enrichment containing one or more of the following dietary ingredients:

- vitamins;
- minerals;
- herbs and other plants;
- amino acids;
- dietary substances for human usage to be added to the diet in order to increase total dietary value;
- concentrates, metabolites, component substances, extracts or combinations with other above listed ingredients".

These included products intended for the systematic diet of athletes, which could not be considered as ordinary food and completely replace the diet. Special emphasis was laid on essential amino acids, β-hydroxy-β-methylbutyrate, a metabolite of the essential amino acid leucine producing anabolic and lipolytic effect, L-carnitine based supplements and creatine-containing products. High priority was given to the system based on β-alanine, sodium bicarbonate and citrate that supports buffering properties of muscles. According to this classification, hormones and substances that mask their presence (i.e., prohibited substances) were referred to the second class of DSs (Hoffman et al., 2009). To a certain extent, this classification has become a prerequisite for the formation of today's views on the role and place of DSs in the practice of sports training.

In the IOC-2018 Consensus, based on the main objective of the application and interests of athlete preparation practice, dietary supplements are divided into several groups:

1. Dietary supplements for prevention or treatment of nutrient deficiency. They include preparation of vitamin D, iron and calcium (Scaramella et al., 2018). In some specific situations iodine, folates, cyanocobalamine are also included in this group, although they are of no importance from the angle of sports practice.

2. Dietary supplements (sports nutrition) to provide energy and macronutrients. They include energy drinks, sports gels, proteins, gainers, ready-to-drinks (RTD), sport drinks and some other forms of supplements. The choice and preference of specific forms are based on the analysis of the basic diet, individual characteristics of the athlete, the results of in-depth medical examination, the content of training and competitive plans, as well as pharmacoeconomic rationale for the price/effectiveness ratio and a comparative analysis of the benefits as compared to regular and balanced high calorie diet (Kreider, 2016).

3. Dietary supplements directly increasing physical fitness. The international expert community refers to this group caffeine, creatine (in the form of creatine monohydrate) (Rawson et al., 2018; Santesteban Moriones, Ibanez Santos, 2017), nitrates, sodium bicarbonate and, so far, β-alanine, on a provisional basis (Blancquaert et al., 2015; Burke, 2017). Doses and patterns of these dietary supplements usage should be based on a rigorous scientific evidence base in terms of safety, legality (not included in the Prohibited List) and efficiency. An additional guarantee of a positive influence of dietary supplements that improve physical fitness is the results of their individual testing by an athlete in the process of nutritional training in the context of imitating competition conditions. Dietary supplements of this group can be referred

to ergogenic nutritiological means necessary for the athlete (Dmitriev, Gunina, 2018b). According to I. Garthe and R. J. Maughan (2018), "... these factors are extremely important, since they increase the total proportion of time spent directly on training and competition while enhancing the efficiency of physical loads". This group, also known as "immunoprotectors", includes vitamins C, D, E, probiotics, carbohydrates, bovine colostrum, polyphenols, glutamine and its derivatives, zinc, caffeine, echinacea and omega-3 PUFA (Marini et al., 2011; Rawson et al., 2018). Not all of them have a sufficient evidence base of relatively high ergogenic efficacy (Stevenson et al., 2016), therefore, the choice of such dietary supplements should be conscious and reasonable to avoid the intake of useless means and unnecessary financial expenses, wherefore the IOC-2018 Consensus has formed the so-called "Decision making tree".

4. Dietary supplements that indirectly improve physical and functional fitness. A number of dietary supplements do not provide a direct ergogenic effect, but improve general health indices, body composition, tolerance of intensive workouts and accelerate recovery from stress and injuries, reduce the severity of exercise-induced muscular damage (EIMD) and manifestations of delayed-onset muscle soreness (DOMS) (Sadeghi et al., 2018).

Unsolved problems of dietary supplements usage in sport

However, despite widespread usage of DSs, the problem of their application in the practice of athletes' preparation has many unsolved theoretical, practical and organizational issues. On the first hand, DSs are manufactured by numerous firms, many of which fail to ensure the production of quality products due to their equipment and staff competence. At the same time, such giants as Optimum Nutrition, Nutrend, Weider, BSN, Biotech, etc. strictly uphold standards for the production of medications (GMP), whereas a product quality control is carried out, for instance, in the United States by the Federal Agency.

On the second hand, the manufactures of DSs sometimes fail to detail the composition of supplements on the labels and introduce ingredients that are prohibited for use in sport (psychostimulants, primarily sibutramine and methylheptanamine, peptide hormones (growth hormone), anabolic designer steroids, such as tetrahydrogestrinone), which can and does lead to doping scandals (Campbell, 2016).

A variety of DSs as ergogenic nutritiological means, their high compatibility with foodstuffs, allow the formation of highly individualized effective programs of nutritive-metabolic support for functional and structural reorganizations in the body of athletes with minor side effects and lack of cross-interaction, which, in case of a rational training process design, ensures high competitive result and helps to preserve athlete health. Absolute inadmissibility of the chaotic usage of dietary supplements, based on promotional actions and non-specialist advices should be noted (Dmitriev, Gunina, 2018a).

The effects of most means and methods for correction of strenuous muscular activity are realized by activating specific and nonspecific recovery mechanisms and stimulating work capacity, general and special, in particular (Platonov, 2015). Through the usage of nutritiological ergogenic means, the recovery processes can be significantly accelerated, while strength, endurance, coordination abilities, as well as attention concentration and other mental characteristics can be increased (Grandjean da Costa et al., 2017). Therefore, in the light of the IOC Consensus Provisions on the use of dietary supplements in elite athletes (Maughan et al., 2018), one of the most important tasks of sports nutritiology is not the treatment, but a mediated directional impact on the results of competitive activity through the support of a significant number of homeostatic links that determine professional qualities of an athlete, while maintaining his/her health and quality of life.

Organizational steps to ensure rational nutrition and reasonable use of dietary supplements in sport

Thus, even this compressed material shows most definitely the complexity and multifacetedness of considered problem. It becomes apparent that only a team of highly qualified specialists may solve it provided that a number of conditions is observed: availability of the opportunity to conduct comprehensive, versatile biomedical examinations, including functional testing, and competent interpretation of their results, presence of polymath experts able to combine an understanding of preparation process basics and

nutritiological support specificity with due account for sports event and competitive discipline specifics, preparation period (stage), energy direction of each specific mesocycle and individual characteristics of the athlete. We have schematically presented the structure for achieving a high competitive result as follows (Fig.).

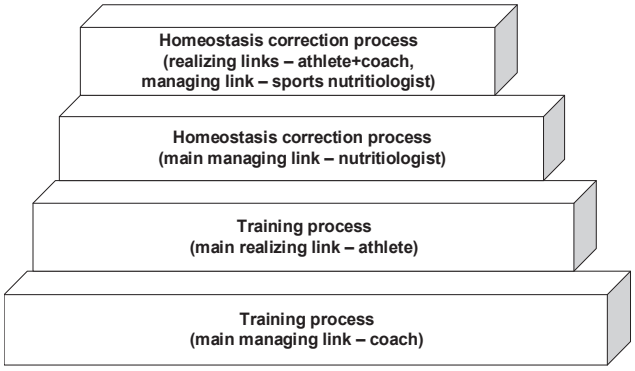

Fig. Managing and realizing links of nutritive-metabolic support for athletes' preparation

As seen in the scheme, it is clear that, as should be the case for any type of extra-training provision of physical work capacity enhancement, the basis for any reasonable interventions in metabolic support is a rationally designed training process, the managing link of which is only the *coach*. The athlete stands at the second level of the system. It is relative to his/her personal characteristic features and training process peculiarities at the given (certain) preparation stage that the system of preparation nutritive and metabolic support is arranged. This stage is formed with account for all available data on the results of in-depth biomedical examination of an athlete and his/her functional characteristics of physical fitness by a highly qualified sports nutritionist. Finally, the system of nutritional and metabolic support of athlete preparation is realized, with constant correction of the established program to support metabolic and structural reorganizations in the body, data of individual tolerance/intolerance of individual program components and its efficiency, by *athlete and coach* together under surveillance of *sports nutritiologist*, which ultimately ensures safety and high efficiency of such an individualized program.

Unfortunately, in the post-Soviet space, the management of support for national teams and individual elite athletes, children and youth sport remains at an extremely low level. Meanwhile, the achievement of the competitive process high efficiency requires complex efforts. Ensuring quality of life and health, medical supervision, treatment of diseases, injuries and sports and medical pathology is the prerogative of sports physician. Training process pharmacological support and the choice of medications for treatment of an athlete, if necessary, as well as the solution of the problem of doping refer to the area of focus of sports pharmacologist, whereas the substantiation of energy and nutritiological density of diets, their formation, correction in the dynamics of preparation, justification of safety and efficacy of dietary supplements with proven ergogenic efficiency and contributing to maintenance of a certain general level of athlete's health are among the tasks to be solved by sports nutritiologist. However, while the departments of higher medical educational institutions in the post-Soviet space somehow or other provide the necessary contingent of sports physicians, then the specialties of "sports pharmacologist", "sports nutritionist" do not even exist in Occupational Classification. Therefore, we do not have certified sports pharmacologists and sports nutritionists as neither medical institutions train them.

Directions for solving organizational problems of nutritional and pharmacological ergogenic factor usage in sport, and in elite sport, above all, should be, in our opinion, focused on:

1. Specification of the Olympic sport needs in sports pharmacologists and nutritionists.

2. Preparation of sufficient number of specialists of respective profile and qualification on the basis of higher educational institutions of physical culture and sport (sports nutriologists, masters, second higher education) and higher medical educational institutions (sports pharmacologist, master course).

3. Provision of the national teams with these specialists able to fast-track the tasks set, and control for the efficiency of their work at an appropriate level of payment.

4. Sufficient financing the national team members necessary for realization of pharmacological and nutritiological support.

5. The presence in the national Olympic team of a specialist in providing modern extra-training ergogenic means and an organizational support algorithm (finances: their allocation, control, distribution; purchase: through whom or directly from which companies or online stores, control for availability of anti-doping certificates, if necessary).

Understanding that fast radical solution of these tasks in the modern realities of established systems of managing sport and health protection in the post-Soviet space is impossible, it seems reasonable to suggest alternative ways to solve this task implemented in the short- and medium-term prospects, in particular:

1. Several activities may be held without accounting for sports event specifics:
– organization (together with government bodies managing sport (ministry, committee, etc.) and the National Olympic Committees) of lecture courses for coaches and sports physicians of the best national teams on the fundamentals of sports dietetics lasting from 5 days;
– organization of interactive seminars within the context of these lecture courses.

2. The task solution may be different with account for sports event specifics and consist in organization of such courses and seminars on sports events, especially those that could bring the Olympic medals, by the Federations themselves.

In addition, there are certain organizational difficulties in providing athletes with ergogenic pharmacological and nutritiological means, which include:

1. Insufficient market analysis of available modern means for acceleration of recovery and stimulation of athletes' work capacity.

2. Lack of unified Centre to purchase everything necessary for sports preparation pharmacological and nutritiological support (a kind of "Sports preparation centre" pharmacy depot); ensuring control over the work of such depot and legislation provided absence of trading margins for the national Olympic teams.

3. Lack of adequate funding athlete pharmacological and nutritiological support (approximately 15–18 euro per day per elite athlete at the very least) and focusing on potential Olympic Games medalists.

4. Formation of the list of modern means for acceleration of recovery and stimulation of work capacity (with account for sports specifics) that should be provided along with the purchase of first-aid medicines and medication support (bandaging material, antibiotics, analgesics, etc.).

5. Lack of procurement manager in the national team.

Solution of this serious complex problem, which is second main issue in the structure of hierarchical provision of competitive activity high efficiency after the rational training process design (Esentaev, 2015), necessitates political willpower, conscious understanding of elite sport as one of the key factors in country image formation on the international stage and adequate funding this area at a level that will ensure the stability of its full-fledged and efficient work.

Conclusion

Therefore, chaotic at present, and thus, often inefficient use of dietary supplements is regulated by clear framework. This allows forming a structured, reasonable and safe system for the use of these complex biologically active substances in accordance with the tasks facing the athlete at each preparation stage. Sure enough, such regulation of nutritiological ergogenic stimulation requires the formation of a training algorithm to provide the Olympic sport with highly qualified specialists in this complex area and expects of the state appropriate steps to reorganize the system for providing national teams with the means to treat acute diseases and injuries in athletes as well as ergogenic nutritiological means proper.

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MAISTO PAPILDŲ EFEKTYVUMAS DIDELIO MEISTRIŠKUMO SPORTININKŲ RENGIMO STRUKTŪROJE

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SANTRAUKA

Šiuo metu yra patikimai įrodyta, kad moksliškai pagrįstas, protingas ir individualizuotas mikro-, makro- ir farmakologinių medžiagų vartojimas gali optimizuoti žmogaus fizinius gebėjimus, padidinti didelio meistriškumo profesionalių sportininkų raumenų susitraukimo jėgą, bendrąją ir specialiąją ištvermę. Be abejo, siekiant sportininkų organizmą prisotinti pagrindinių maisto medžiagų, būtinų siekiant užtikrinti didesnį fizinį aktyvumą, pagrindinis vaidmuo tenka subalansuotos mitybos racionui. Straipsnyje analizuojama maisto papildų vartojimo vaidmuo, pagrįstumas ir efektyvumas rengiant didelio meistriškumo sportininkus, atsižvelgiant į 2018 m. kovo mėnesį priimto TOK Konsensuso nutarimą dėl maisto papildų vartojimo. Jis tapo pagrindiniu sporto medicinos, sporto nutriciologijos dokumentu, reglamentuojančiu šių medžiagų vartojimą. Konsensuse suformuluotos pagrindinės ergogeninių, maisto medžiagų sąvokos. Jos ateityje sudarys galimybę unifikuoti

sportininkų rengimo farmakologinio aprūpinimo sistemą Europos šalyse, priartinti ją prie pasaulinių standartų. Straipsnyje trumpai apžvelgiama sporto nutriciologijos teorinė ir praktinė raida, jos reikšmė rengiant didelio meistriškumo sportininkus. Konsensuse išskiriamos 4 pagrindinės sportui tinkamos maisto papildų klasės: 1) funkcinė mityba, prisotinta papildomų mastinių arba komponentais išsiskiriančių iš įprasto maisto sudėties; 2) specialiai parengtas sportininkų maistas, labiau papildantis energijos atsargas nei įprasta mityba; 3) atskiri maisto papildai ir kiti maisto komponentai, augaliniai koncentruoti produktai, kuriuose yra tikslinio poveikio medžiagų; 4) multikomponentiniai produktai, kuriuose yra tikslinio poveikio medžiagų.

Straipsnyje išsamiai yra klasifikuotos pagrindinės, siauriau specializuotos maisto papildų grupės, aptarta jų sudėtis, suformuluoti pagrindiniai maisto papildų skirtumo nuo ergogeninių farmakologinių preparatų teiginiai, leidžiantys pagrįsti sportininkų organizmo aprūpinimo energinėmis medžiagomis poreikį, charakterizuoti organizmo ergogeninę būklę.

Straipsnyje pabrėžiama, kad maisto papildų vartojimo problema turi dar daug neišspręstų organizacinio ir informacinio pobūdžio problemų, akcentuojama maisto papildų vartojimo algoritmo svarba. Šį tikslą išspręsti gali tik aukštos kvalifikacijos, pirmiausia sportininkų mitybos, specialistai. Autoriai pagrindžia savo tokių specialistų rengimo viziją posovietinėje erdvėje. Jie galėtų padėti, kad tikslingai ir racionaliai vartojami maisto papildai, sudarantys galimybę efektyviau rengti šalių olimpinių rinktinių sportininkus, kartu labiau tausoti jų sveikatą.

Raktažodžiai: didelio meistriškumo sportininkai, maisto papildai, darbingumas, sportininkų sveikata, 2018 m. TOK konsensusas dėl maisto papildų vartojimo.

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