

Original Article

Efficiency of using a range of biologically active additives for middle distance runners

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Abstract.

Topicality. Significant intensification of metabolism in the body of athletes requires additional consumption of ergogenic agents, as the lack of vitamins, minerals, carbohydrates and proteins adversely affects the performance of athletes. The best way out of this problem is to use dietary supplements. Protein, amino acids and their derivatives belong to them. Disruption of the amino acid ratio or the absence of at least one of the essential amino acids leads to inhibition of protein synthesis and other abnormalities in metabolism, which reduces physical performance. Therefore, the relevance of research into the ergogenic properties of amino acids for future use in sports practice is obvious. **Objective:** To identify the metabolic effects of the use of the amino acid complex on the performance of middle-distance runners, body composition and antioxidant properties. **Results.** The complex of biologically active additives has influenced the state of the antioxidant system of athletes, which is associated with a positive effect on the catalase link and membranes of erythrocytes. The complex of amino acids also stimulates the reduction of malonic dialdehyde content, which indicates the state of the body's pro- and antioxidant balance. This effect could have caused both the complex under study as a whole and its individual components, the antioxidant activity of which was shown in previous studies. This is especially true for N-acetylcysteine, glutamine, branched-chain amino acids, vitamin B6, which regulate the synthesis of tryptophan in the body. The latter can block the production of cortisol, an anti-catabolic hormone, inhibit the development of fatigue, affect the glutathione system and cause other changes that, in the aggregate, give an overall positive metabolic effect. **Conclusions.** The use of a complex of biologically active additives for athletes for three weeks, as an additional means of increasing physical performance, has a positive effect on the component composition of the body weight of athletes, oxygen-transport function of the blood, energy efficiency of energy supply, as well as the state of the AO-system, which provides versatile regulators metabolism may result in increased physical performance and accelerated recovery of athletes. The latter allows us to recommend a complex of biologically active supplements for use against the background of the training process and competitive activity of middle distance runners in order to correct metabolism and achieve ergogenic effect.

Keywords: sports, metabolism, blood, lactate, antioxidant system.

Introduction

Formulation of the problem. Sports are associated with significant energy consumption, profound morphological and functional alterations in the body of athletes that cannot be overcome without adequate pharmacological and nutritional support (Didur M.D., 2002, V.N. Platonova, 2003, Stankevich L.G., Zemczova I.I. 2003, Khmelnytska Yu., 2010).

Significant intensification of metabolism in the body of athletes requires additional consumption of ergogenic agents, as the lack of vitamins, minerals, carbohydrates and proteins adversely affects the performance of athletes. The optimal way out of this problem is to use biologically active food additives, among which a particular place belongs primarily to proteins, amino acids and their derivatives (Erkomajshvili I.V., Seluyanov V.N., 1990, Zemczova I.I., Putro L.M., Stankevich L.G., 2003, Kulinenkov D.O., Kulinenkov O.S., 2002).

The promotion of amino acids used in sports activities implies that they have a clear anabolic effect, promote increased strength and speed, maintain health and enhance immunity. Separate references to experimental and clinical research findings are generally controversial or absent (V.N. Platonova, 2003, Erkomajshvili I.V., Seluyanov V.N., 1990). Therefore, the relevance of research into the ergogenic properties of amino acids and their derivatives for future use in sports practice is obvious.

There are situations where the use of protein is not able to give the athlete the amino acids he needs to activate the mechanisms of anabolism as soon as possible. This applies, first of all, to the period after the end of the training session and the night's sleep, since the digestive process requires at least 1-2 hours. In this case, they use amino acids, which are already "digested" protein and absorbed very quickly. Amino acids make a significant contribution to the energy of muscular activity, especially endurance, are quickly absorbed into the

bloodstream, are well absorbed and do not cause allergic reactions (Kulinenkov D.O., Kulinenkov O.S., 2002, I.I.Zemczova, S.A. Olijnik, 2004).

Not only the composition of consumer amino acids has a definite meaning, but also their ratio in the food supplement. Violation of this ratio or the absence of at least one of the essential amino acids leads to inhibition of protein synthesis and other abnormalities in metabolism. However, it is proved that the right amino acid supplement increases the absorption of other proteins that come with food (Zemczova I.I, Putro L.M., Stankevich L.G., 2003, Stankevich L.G., Zemczova I.I., 2005). In addition, it is known that individual amino acids can stimulate physical performance (Platonov V.N., 2017), as well as perform a number of specific functions in the body. So L-amino acids (arginine, ornithine, glycine, leucine, isoleucine, valine, lysine) have anabolic action, increased doses of L-arginine and L-ornithine stimulate the body's own growth hormone; branched-chain amino acids (leucine, isoleucine and valine), in addition to building function, have an anabolic effect, are a backup source of nutrition, increase immunity and stabilize the hormonal background of the body (I.I.Zemczova, S.A. Olijnik, 2004, Gorchakova N.A., Gudivok Ya.S., Gunina L.M., S.A.Olejnika, 2010).

Glutamine is a very important and indispensable substance for recovery after some stressful conditions (surgery, injuries, tissue damage, intense physical activity). Studies have shown that glutamine has an anti-catabolic property, blocking the activity of cortisol in muscles - the main factor in the breakdown of muscle proteins (Kulinenkov D.O., Kulinenkov O.S. 2002), stimulates glycogen synthesis in muscles (Didur M.D., 2002), acting as a precursor to replenishing muscle reserves glycogen after exercise (Zemczova I.I, Putro L.M, Stankevich L.G., 2003, Khmelnytska Yu., 2010), increases insulin sensitivity, thereby promoting fat loss. Studies involving patients in clinics have shown that even large doses of glutamine are quite safe (Erkomajshvili I.V., Seluyanov V.N., 1990).

Experiments with athletes of different specializations have found that branched-chain amino acids (BCAA)- leucine, isoleucine and valine - a popular nutritional supplement, provide some contribution to reducing central nervous system fatigue, as well as meeting athletes' energy needs during a stressful 6 workout, (Platonov V.N., 2017). BCAAs have been found to compete with tryptophan for brain absorption. Tryptophan is a precursor to serotonin that can suppress CNS and cause fatigue. Therefore, the addition of BCAA to the blood stream reduces the ratio of tryptophan to these amino acids and promotes inhibition of fatigue (Erkomajshvili I.V., Seluyanov V.N., 1990). Data from scientific studies on the use of BCAA athletes indicate an increase in their physical and mental performance (I.I.Zemczova, S.A. Olijnik, 2006), the protection of muscle glycogen from exhaustion (Stankevich L.G., Zemczova I.I., 2003), the reduction of protein splitting in heavy physical activity (Zemczova I.I, Putro L.M, Stankevich L.G., 2003), resistance to development fatigue (Stankevich L.G., Zemczova I.I., 2003).

Among the amino acids with antioxidant activity, N - acetylcysteine (NAC) plays a significant role. It is a sulfur-containing amino acid, a cysteine derivative known as an antioxidant and pharmacological agent (Gorchakova N.A., Gudivok Ya.S., Gunina L.M., S.A.Olejnika, 2010). The NAC effectively counteracts the effects of free radicals, which are intensively formed under intense physical activity. Studies have also revealed the anabolic and ergogenic effects of NAC V.N. (Platonova, 2003, Zemczova I.I, Putro L.M, Stankevich L.G, 2003).

Interesting and promising for use in sports is whey protein because it is able to increase the content of glutathione, an antioxidant that plays an important role in the manifestation of immunity (Didur M.D., 2002). Data from literature indicate that whey protein significantly increased the level of glutathione compared to casein. This may be due to the high content of cysteine in whey protein, since it is part of the tripeptide - glutathione (Zemczova I.I, Putro L.M, Stankevich L.G., 2003).

According to scientific sources, the metabolism of cysteine, tryptophan and BCAA is closely linked. Therefore, the study of the effect of their combined consumption together with whey protein and vitamin B6 on the metabolism of middle-distance runners is of absolute importance.

Research methods and organization.

The study used pedagogical and biochemical methods, measurements of the component composition of the body, methods of mathematical statistics using standard computer programs. LP-420 photometer (Dr. Lange, Germany) with a set of reagents from the same company was used to determine the lactate blood content. The content of hemoglobin in the blood was determined by the hemoglobin cyanide method, malonic dialdehyde - by reaction with thiobarbituric acid (TBA), catalase activity - by color reaction with phenylhydrazine, erythrocyte peroxide hemolysis (EPH) - by determining the amount of hematocyte by hours incubation in buffer solution at 37 °C (Gorchakova N.A., Gudivok Ya.S., Gunina L.M., S.A.Olejnika, 2010).

The study involved 12 track and field athletes specializing in middle distance running (first class sports qualification, CMS). The subjects were in the pre-competition stage of the competition period and were divided into 2 groups: control, which used placebo (glucose tablets) and experimental, which used for 3 weeks a complex of biologically active additives in daily doses: serum protein (firms PROTECH, USA) - 50 g per 200 ml of milk immediately after training); branched chain amino acids (PROTECH) - 4 capsules (1 capsule - 1.5 g) 30 min before training and 4 capsules 30 min after training); acetylcysteine company BALKAN PHARMA (Bulgaria) -

2 pieces 3 times a day after meals; Vitamin B6 (from Holzkirchen, Germany) - 100 mg, 2 times a day with tea immediately after meals; glutamine (PROTECH, USA) - 5 capsules 30 min after training (1 capsule-5g), taken together with amino acids (Platonov V.N., 2017, Khmelnytska Yu., 2010).

Athletes of both groups determined biochemical parameters at rest before testing, then determined physical performance on the treadmill using a set of steps of increasing power, and then the same biochemical parameters.

Results of the studies and their discussion.

The use of a complex of biologically active additives has led to significant changes in the various metabolic pathways of middle distance runners. In particular, in the athletes of the experimental group, the hemoglobin content in the blood increased from $141.5 \text{ mmol} \cdot \text{l}^{-1}$ to $149.3 \text{ mmol} \cdot \text{l}^{-1}$ ($p < 0.05$). The established fact can be of exceptional importance for the preservation of the oxygen-transport function of the blood, which is a limiting factor in the manifestation of endurance of athletes (Fig. I).

Under the influence of a complex of biologically active additives, a decrease in blood lactate accumulation

was observed in response to the standard treadmill running load, from $2.98 \pm 0.25 \text{ mmol} \cdot \text{l}^{-1}$ to $1.84 \pm 0.32 \text{ mmol} \cdot \text{l}^{-1}$, $g < 0.05$. The revealed fact testifies to increase of economy of energy supply of muscular activity.

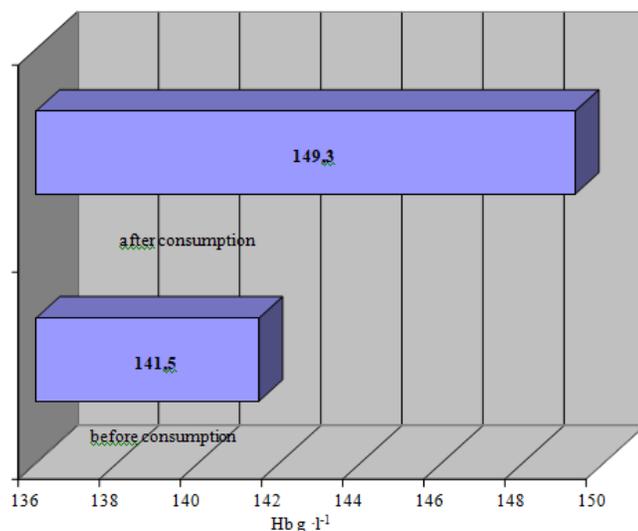


Fig. I. Effect of the metabolic complex on the hemoglobin content of athletes

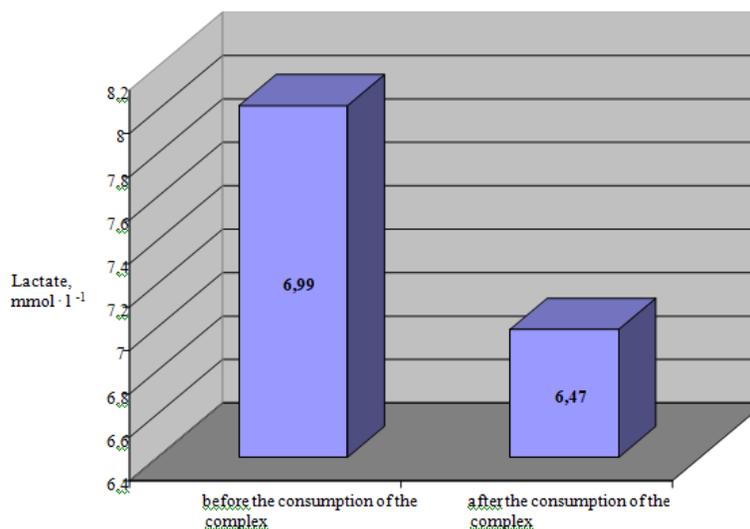


Fig. II. The effect of the metabolic complex on the content of lactate in the blood after treadmill jogging

When performing the step-increasing power load in the athletes of the experimental group on the first stage and the second, there was a decrease in blood lactate content from 2.72 ± 0.22 to 1.71 ± 0.18 $\text{mmol} \cdot \text{l}^{-1}$ and $3, 56 \pm 0.24$ to 2.83 ± 0.30 $\text{mmol} \cdot \text{l}^{-1}$, respectively ($p < 0.05$), relative to the control group that used "placebo". This indicates an increase in athletes' readiness, resulting in a lower metabolic response to a higher body load.

When performing athletes in the treadmill treadmill running group, there was a decrease in blood lactate content from 6.99 ± 0.2 to 6.47 ± 0.15 $\text{mmol} \cdot \text{l}^{-1}$ ($p < 0.05$) with an increase in relative loading power relative to the data. control group (Fig. II).

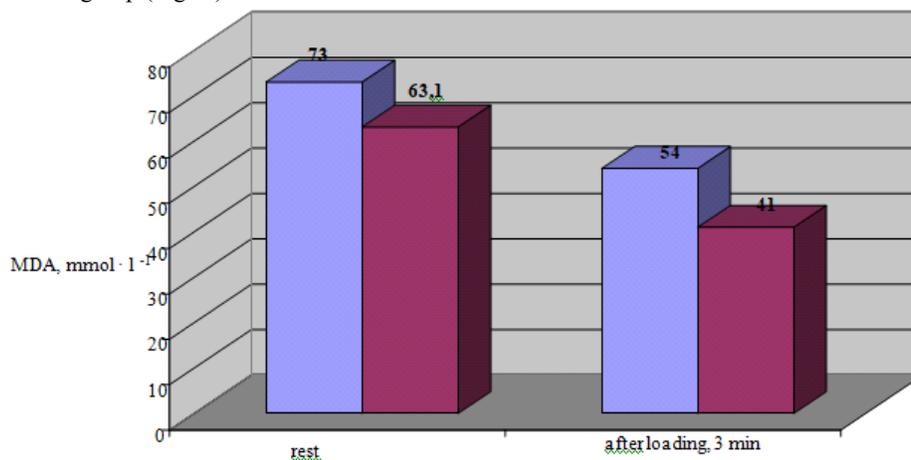


Fig. III. The effect of the metabolic complex on the content of MDA in the blood after running jogging
■ - control group ■ - experimental group

The detected effect indicates an increase in the possibilities of energy supply of muscular activity of the body of runners in the middle distances under the action of a complex of biologically active nutritional supplements.

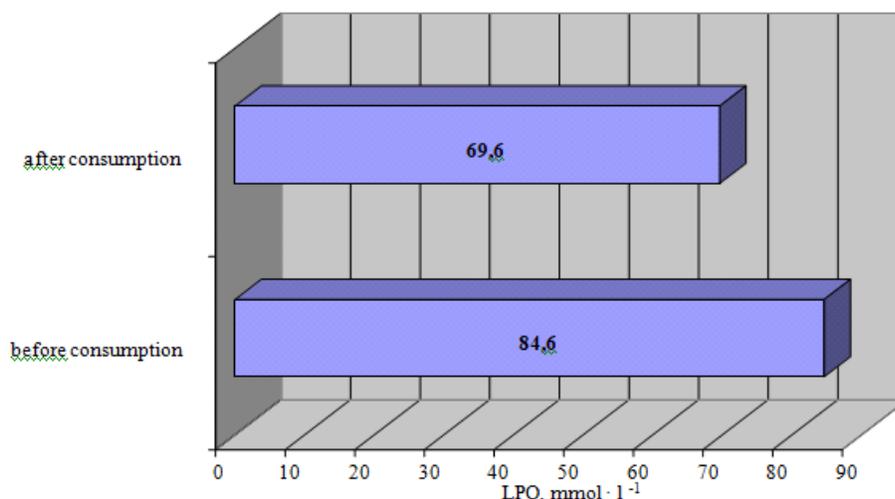


Fig. IV. The ability of the blood to accumulate MDA in the model system of yolk lipoproteins

The metabolic complex did not have a significant effect on the total body weight of athletes. At the same time, in the athletes of the experimental group, the percentage of fat content in the body, which was recorded on the scales - Tanita fat analyzer, decreased from 19.75% to 17.73% (\approx by 2%). The revealed change in the component composition of the body, apparently, is due to the lipotropic effect of the components of the metabolic complex and is a positive phenomenon that can affect the manifestation of physical performance of runners. Among the components of the complex used, this action could be caused by vitamin B₆, as well as whey protein, which includes methionine and cysteine, whose lipotropic action is known (V.N. Platonova, 2003).

Along with the listed effects, under the influence of the metabolic complex, significant changes in the indicators characterizing the antioxidant (AO) status of the body of athletes were noted. Thus, the content of malondialdehyde (MDA) in the blood of athletes of the experimental group decreased both at rest and for 3 min of the recovery period after performing a complex of testing loads on treadmill, which indicates an increase in the antioxidant potential of the organism as a whole (Fig. III).

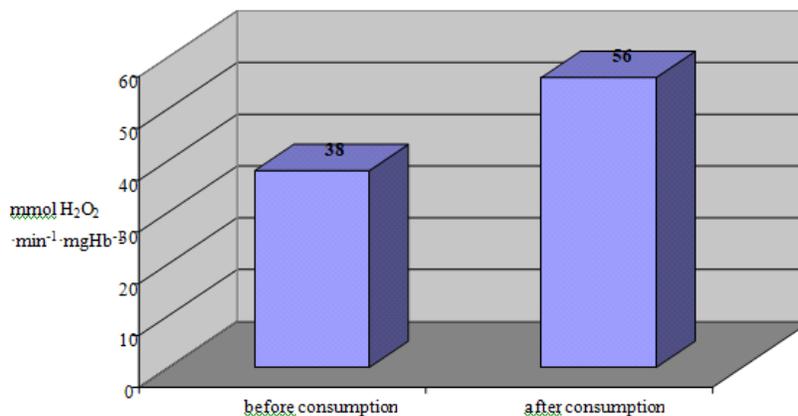


Fig. V. Influence of the metabolic complex on Catalase activity of blood after running accelerations.

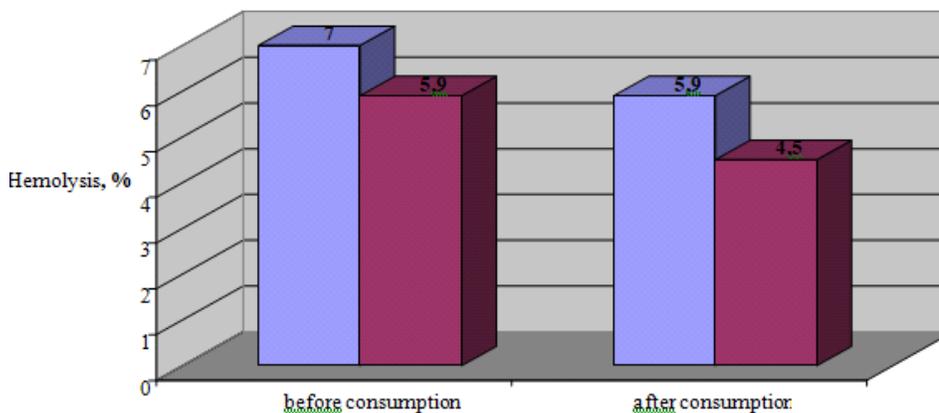


Fig. VI. Influence of metabolic complex on hemolysis of erythrocytes in blood after running accelerations.

■ - control group ■ - experimental group

Studies of the AO activity of the blood of athletes using the model system of yolk lipoproteins confirmed the data obtained. It is revealed that the blood of athletes who used the metabolic complex has a higher antioxidant capacity, which was recorded by reducing the accumulation of MDA in the presence of stimulating the process of lipid peroxidation (LPO) of Fe^{+2} ions (Fig. IV).

The study showed an increase in Kat - blood activity in the athletes of the experimental group under the influence of biologically active additives. The result of this is an increase in the enzymatic degradation capacity of hydrogen peroxide, which is a toxic substance formed in the body as a result of metabolism (Fig. V).

The membrane-protective effect of a complex of biologically active additives is revealed by registering a decrease in the erythrocyte peroxide hemolysis of the athletes of the experimental group both at rest and after performing the test load on the treadmill (Fig. VI). This indicates the membrane-protective effect of a complex of biologically active additives, which results in a decrease in hemolysis of erythrocytes.

Conclusions.

Summarizing the metabolic effects of the use of a complex of biologically active additives by athletes, we can conclude that it effectively affects the metabolic background of the body. Its use by athletes - middle distance runners for three weeks, as an additional means of increasing physical performance against the background of the training process, has a positive effect on the component composition of the athletes body

mass, oxygen-transport function of the blood, energy efficiency, as well as providing the state of the AO-system multifaceted regulatory impacts on different sides of the metabolism may result in increased physical performance and accelerated recovery of track and field athletes middle distances. The latter allows us to recommend a complex of biologically active supplements for use against the background of the training process and competitive activity of middle distance runners in order to correct metabolism and achieve ergogenic effect.

If the authors have any conflicts of interest to declare.

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