

Modern Aspects on the Efficiency of the Use of Branch-Chain Amino Acids (BCAAs)

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ABSTRACT

Branched chain amino acids (BCAAs) are essential amino acids and make up one third of the total amino acid content in the human body. After being absorbed from the gut, BCAAs are widely distributed to many organs for metabolism, including muscle, brain, liver, and adipose tissue. Organs absorb BCAAs into the blood to be used for many functions, including neurotransmitter synthesis, protein synthesis, and energy production. The article provides a literature review of recent trends in the effectiveness of the use of branched chain amino acids for sports nutrition.

Relevance. The role and importance of specialized food products containing components of functional action are constantly growing in modern sports practice. Their share in the total volume of food products produced and sold on the market is continuously increasing [1]. The use of specialized sports nutrition products is an indispensable condition for achieving any serious results in modern sports competitions [2]. A number of specialized sports nutrition products can rightfully be attributed to high-tech objects. They are created on the basis of many years of research by specialists in various fields. In the process of developing such a product, information accumulated in the course of experiments conducted in various countries of the world is often accumulated and used. So, for example, at first, sports physiologists revealed, and later, trainers and practitioners confirmed the positive impact that additional consumption of branched carbon chain amino acids has on the body of athletes during increased physical and emotional stress [3–5]. These amino acids, which are composed of leucine, isoleucine and valine, are commonly referred to as the BCAA group, which is a simple abbreviation of the term in English - "branched chain amino acids". The Russian equivalent is AKRC, which also corresponds to the concept of "branched amino acids". Amino acids of this group belong to natural, proteinogenic, i.e., amino acids involved in the synthesis of proteins, the total number of which is 20. At the same time, the amino acids of the BCAA group are included in a narrower group (eight amino acids) called

essential. Such amino acids are synthesized only by plants and are not synthesized in the human body, and therefore they must be obtained from food. As a result of research, it was found that human muscle proteins consist of almost a third of amino acids with a branched side chain. In this regard, amino acids of the BCAA group are able to have a primary effect on increasing the physical capabilities of athletes, while having a general strengthening and restoring effect on the work of the whole organism. BCAA amino acids realize the properties of a powerful natural and safe anabolic agent, i.e. are substances that significantly enhance the process of protein synthesis and muscle tissue in the body. When you take additional amounts of BCAAs, the body naturally switches into an anabolic state and begins to intensify the process of protein synthesis, leading to muscle building. Additional intake of amino acids of this group allows you to control muscle mass, prevent its loss, increase the endurance of the body during prolonged and intense physical exertion. Ultimately, their use allows you to achieve significant progress in the quality of sports training. The most effective use of BCAA acids by people involved in high-speed sports, i.e., where the volume and quality of muscles play a significant role. At the same time, it is necessary to pay attention to the fact that the more intense the physical activity experienced, the more BCAA amino acids will be “burned out” in the process of training and competition. Therefore, if the necessary amounts of BCAAs are not supplied with food, then the body will destroy some of the already existing types of proteins that are required at the moment to ensure the construction of their new varieties. This leads to the conclusion that BCAA deficiency maintains or even triggers catabolic (i.e., destructive) effects in the body. Catabolism is the process of metabolic breakdown, for example, of muscle proteins into their simpler fragments, which is inevitably accompanied by a complete loss of their specific functions that they perform in the body. A necessary condition for preventing this undesirable process and maintaining muscle mass, therefore, is the additional intake of BCAAs. This has become, in particular, one of the main reasons that BCAA amino acids are currently widely used both in pure form and as one of the important functional ingredients in specialized sports nutrition products. Due to the significant similarity in the structure of the molecules of the compounds, all amino acids of the BCAA group are characterized by fairly similar physiological parameters. Along with this, they also have certain individual characteristics. Leucine, for example, takes an active part in maintaining the nitrogen balance in the body. In addition, with a low-calorie diet, it is able to provide up to 10% of the contribution to the bioenergy generated during intense physical exertion. When taking an additional amount of leucine, it provides a decrease in body fat. Leucine increases the stamina of the body and helps to strengthen the central nervous system of a person. It enhances the secretion of insulin, which, in turn, stimulates additional protein synthesis and inhibits their unnecessary breakdown. With the consumption of additional amounts of leucine, objective laboratory parameters of the circulatory system improve: the number of red blood cells increases, the level of hemoglobin increases, and a decrease in blood glucose levels is observed. Leucine accelerates the recovery of the connective tissues of the body and the skin in case of sports injuries. Isoleucine is involved in the synthesis of myofibrils of muscle tissue, ensures the growth and development of striated and longitudinal muscles. It is a necessary component for the normal course of biochemical processes associated with the formation of hemoglobin and glycogen, promotes the breakdown of cholesterol and alleviates the feeling of muscle fatigue during overwork. With a deficiency of isoleucine in the body, a condition similar to hypoglycemia is observed. Valine is one of the main components involved in the process of growth and synthesis of muscle tissues. It improves muscle coordination and reduces the body's sensitivity to pain,

cold and heat. This circumstance is important for athletes who have to participate in competitions held in adverse weather conditions. Valine, together with leucine and isoleucine, can serve as a source of energy in muscle cells and affect the mental state of a person. This ability of valine is associated with the fact that it can prevent a decrease in the level of serotonin in the brain. Many physiologists consider a decrease in the amount of this compound in the brain as one of the possible causes leading to the onset of depressive states. In the process of intensive physical labor and sports training in the blood plasma, additional amounts of ammonia may accumulate, which has a toxic effect on the body. In order to neutralize its action, the amino acid L-ornithine is included in the composition of the product. This is due to the fact that L-ornithine plays an important role in the Krebs cycle by promoting the detoxification of ammonia and preventing its unwanted accumulation in the body. L-ornithine is one of the key participants in the process of converting it into a non-toxic product - urea, which is then excreted through the kidneys. Ultimately, this makes it possible to reduce the negative effects associated with the consequences of prolonged physical exertion, the muscle fatigue caused by them, and also accelerate the process of recovery of the body after intense physical exertion. L-ornithine is also involved in the normal metabolism of muscle tissue, strengthens tendons and ligaments. It stimulates the release of insulin and helps it act as an anabolic hormone, increasing overall protein synthesis in the body and increasing the number of muscle cells.

The three branched chain amino acids (BCAAs) are valine, leucine and isoleucine. They are part of the 20 amino acids needed by the body to produce proteins and essential amino acids. These amino acids are considered branched because they have a "branched" side chain consisting of one carbon atom and three hydrogen atoms. Such amino acids should be consumed with food or supplements.

BCAAs are the only type of amino acid that enters the bloodstream directly, bypassing the liver. This means that the consumption of branched chain amino acids can directly affect their concentration in muscle tissue. Recommended for use before, during or after exercise, BCAAs have been proven to reduce fatigue, increase muscle growth, promote recovery and improve mental focus. BCAAs can enhance protein synthesis by acting on growth hormone and providing the body with the amino acids needed for protein synthesis.

It is important to remember that all nine essential amino acids are required for the production of muscle protein. If all the essential amino acids are needed for muscle protein synthesis, then consuming only three of the nine essential amino acids may not be enough to stimulate muscle protein growth. Supplementation with BCAAs in combination with an intact protein, such as whey protein in supplement form, may increase the potential for an anabolic response to exercise.

BCAAs may increase resistance to fatigue and increased fat oxidation during exercise. BCAAs can help reduce lactate levels and improve muscle oxidation. A study involving soccer players who took BCAAs found that the BCAA group had a slightly faster reaction time than the placebo group, indicating a possible benefit of pre-workout BCAAs in sports that require fast response. A large six-year BCAA study found that athletes who took the supplement before exercise experienced less muscle soreness after exercise. However, no one has compared BCAAs to regular protein foods. Perhaps if athletes ate nuts, meat or drank milk before training, their muscles would also not hurt so much. According to one hypothesis, BCAAs may actually help reduce fatigue. When a person trains a lot, some of the amino acids that come with food - for example, leucine - are spent faster than others - for example, tryptophan. As a result, more

tryptophan enters the brain than usual. And since the “fatigue neurotransmitter” 5-hydroxytryptamine is synthesized from tryptophan, an intensely trained person can feel tired even before they run out of energy. But if an athlete has a high concentration of leucine in the blood, this amino acid will compete with tryptophan in order to pass the blood-brain barrier - this is the name of the walls of the blood vessels of the brain, which selectively pass substances from the blood to the nerve cells. As a result, the brain does not recognize that there is more tryptophan, and then the athlete will not be so tired.

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