



Research Article

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Experimental research into the influence of the branched chain amino acid on the long distance runners' resistance to fatigue

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ABSTRACT

Purpose: Long distance runners' fatigue may be postponed by supplementing the branched chain amino acid. Method: 16 medium and long distance runners are classified at random into an experimental group (BCAA) and a control group. During the experiment, the two groups of runners will have sports of the same load. After six weeks, increasing aerobics load experiment (4mmol/L of blood lactate) and simulated 3km and 5km tests under extreme load are carried out on the treadmills respectively. Blood is sampled before the sports, immediately after the sports and 30 min after the sports for measuring the level of blood glucose, blood lactate and alanine. Research results: in extreme load sports, after the BCAA group has sports, their blood glucose immediately after having sports falls far below the level of the resting state ($P<0.05$); the level of blood glucose of the control group immediately after having sports and 30 min after having sports falls far below the level of blood glucose of the resting state ($P<0.05$). The alanine concentration of the BCAA group immediately after having sports and 30 min after having sports rises far above the level of resting state and is significantly higher than that of the control group ($P<0.05$); that of the control group immediately after having sports is significantly lower than the level of the resting state ($P<0.05$). The blood lactate of the BCAA group after having sports is significantly lower than that of the control group ($P<0.05$). Conclusion: BCAA may help to postpone the long distance runners' fatigue and eliminate the fatigue after having sports.

Keywords: Supplementing; Branched Chain Amino Acid (BCAA); Medium and Long Distance Runner; Fatigue; Relieve

INTRODUCTION

In order to keep improving the sportsmen's performance, the coaches will generally use such extreme sport methods as a lot of exercises, high strength exercises, anaerobic threshold and so on. However, one of the greatest challenges that disturbs the sport effect is that sportsmen always feel fatigue after excessive exercises, and it has always been the subject of research in the sport medicine to resist and immediately repair the fatigue[1]. The greatest feature of long and medium distance running is a lot of exercises, which increases the exercise load, and the organisms' fatigue. Should the organisms' fatigue not be recovered immediately, the organisms can not fulfill their tasks continuously, and its exercise level will fall. Accordingly, the medium and long distance runners' resistance to fatigue is very important.

EXPERIMENTAL SECTION

The Branched-chain amino acids (BCAA) includes Leucine(Leu), I-soleucine (Ile) and Valine(Va1), all of which have branched chain carbon backbone [2]. The amino acids that are necessary for human bodies but can not be produced in human bodies by compounding must be provided by the protein in food.

Subjects and methods:**Research subjects**

12 medium and long distance runners from a university in Anhui Province are selected, and healthy without the history of acute or chronic illness. In recent half an year, they have sports and join in matches as before. Within two weeks before the experiment, they never take any Chinese traditional or western medicines that are to improve the capabilities of having sports or resist the fatigue. They are classified into an experimental group and a control group, both groups have no significant difference in their ages, height, weight, training duration ($P>0.05$). See Table 1 for the subjects' particulars.

Table 1 Subjects' Particulars

	Experimental group (n=6)	Control group (n=6)
Age	19.2 ±2.6	19.1±2.7
Height	173.6±5.6	172.6±6.2
Weight	67.5±4.8	66.9±5.1
Training duration	4.2±2.3	4.5±2.7

Research method

Research scheme: Randomized controlled and double-blind method is used for designing this experiment. The 12 sportsmen are randomly classified into the experimental group and the control group. None of the researchers that operate in the experiment knows whether a sportsman belongs to the experimental group or the control group. None of the sportsmen knows whether what they take is BCAA or placebo.

Intervention in the experiment: All of the sportsmen in this research stop taking any sport healthcare products two weeks before the experiment begins. After the experiment starts, all of the subjects have regular food and drinks. The experiment group takes the extreme BCAA capsules every day (each capsule contains 300mg of valine, 250mg of leucine and 100 mg of Isoleucine), four capsules every time and three times per day. The sportsmen of the control group take placebo, which is a capsule containing starch similar to BCAA in appearance. During the six week experiment, all of the subjects have sports as scheduled, and the details, modes, quantity and strength of their exercises are the same, they are not allowed to take or use any Chinese traditional or western medicines or methods that are to improve the capability of having sports or resist the fatigue.

Sampling and index-based testing: 2ml of venous blood is sampled before the test, immediately after the test is completed and 30 min after the test is completed. After the serum is separated from the blood, semi-automatic biochemical analyzer is used for measuring the blood glucose (Glu), and the amino acid analyzer is used for measuring Ala. Finger blood is taken to measure the blood lactate on the YSI 1500 blood lactate analyzer.

RESULTS

See Table 2 for the change in the blood indices before and after the 5km extreme load experiment. After extreme sports, the blood glucose of the BCAA group is significantly lower than the level of the resting state ($P<0.05$); and that 30 min after having sports is restored to the level of the resting state. However, the blood glucose of the control group immediately and 30 min after having sports is significantly lower than the level of the resting state ($P<0.05$). The alanine concentration of the BCAA group immediately after having sports is significantly higher than the level of the resting state ($P<0.05$), and falls slightly 30 min after having sports, however is still significantly higher than that before having sports ($P<0.05$); the alanine concentration of the control group immediately after having sports is significantly lower than the level of the resting state, and it is almost restored to the level of the resting state 30 min after having sports. The blood lactate of the BCAA group immediately and 30 min after having sports is significantly lower than the level of the resting state ($P<0.05$).

Table 2 Change in the Glu, Alanine and Blood Lactate before and after the 5km Ultimate Load Experiment and During the Restoration

		Glu(mmol/L)	Ala(Lmmol/L)	BLa(mmol/L)
BCAA group (n=10)	Resting state	5.39±0.34	251.1±24.2	1.37±0.31
	Immediately post ex	4.61±0.11 [*]	346.3±28.9 ^{*◇}	11.54±2.05 ^{**◇}
	30min post ex	5.15±0.29	292.4±29.8 ^{*◇}	4.25±2.16 ^{**◇}
control group (n=10)	Resting state	5.31±0.40	246.5±27.0	1.37±0.31
	Immediately post ex	4.58±0.25 [*]	199.2±25.7 [‡]	13.04±2.31 ^{**}
	30min post ex	4.78±0.31 [*]	211.3±24.5 [‡]	5.19±1.62 ^{**}

Note. ^{*} $P<0.05$, ^{**} $P<0.01$ compared with the level of the resting state; ^{*◇} $P<0.05$ compared with that of the control group immediately and 30min after the 5km ultimate load exercises.

DISCUSSION

Influence of Branched Chain Amino Acid on the Alanine during Sports

From the resting state to the exercise state, the concentration of alanine rises, and alanine is the main carrier that carries ammonia-N into the liver, and is also the main amino acid in the course of gluconogenesis[3]. During the sports, the quantity of alanine generated in muscles is related to the sport strength and timing. As the endurance sports go on, the concentration of the organisms' glucocorticoid falls [4], the glycogen is consumed, the concentration of blood glucose falls, in particular, the utilization ratio of BCAA gradually falls, and the alanine generated in the muscles gradually reduces, causing the concentration of alanine in the blood to fall gradually. The research results also prove that the change in the blood alanine is related to the sport load; the concentration of alanine in the blood rises after the aerobic load rises gradually in a short term, however, the concentration of the alanine in the blood significantly falls after the extreme endurance sports.

BCAA is mainly broken down in the muscle tissues, and the amino groups released are all converted into nitrogen in the alanine. Supplementing BCAA will increase the content of BCAA in the muscles and circulating blood. During sports, the metabolism of BCAA increases, and the concentration of alanine in the blood increases [5]. It is found in the research results that BCAA can not affect the concentration of alanine in the blood in the resting state, however, the concentration significantly rises after they have sports, and more significantly after the extreme endurance sports. It means that during the sports, organisms consume a lot of energy, and their breakdown metabolism increases, and BCAA is involved in the energy metabolism during sports, and its involvement is related to the quantity of energy consumed during the sports [6]. During restoration after sports, the level of the alanine of the BCAA group is lower than that immediately after having sports probably because BCAA may promote the liver and muscle gluconogenesis after having sports, the tissues absorb a lot of alanine from the blood to synthesize glycogen through circulation of alanine and glucose.

The influence of BCAA on the blood glucose and the blood lactate during sports

During sports, BCAA may help to save the glycogen. Glucose is the important source of energy during sports, and blood lactate is an important intermediate in carbohydrate metabolism, and also important substance for gluconeogenesis during restoration after having sports. Little energy is consumed after short time aerobics which is not enough for the blood glucose to fall. A lot of energy is consumed during the extreme endurance sports, and the break-down of hepatic glycogen and gluconeogenesis may be reduced during long time endurance sports[6], finally sport-induced hypoglycemia is caused. According to the research, BCAA may improve the sport endurance, however there is no significant difference when compared with carbohydrate[7].

According to the research results, there is no significant difference in blood glucose and blood lactate of the two groups after the extreme sport experiment and during the restoration; however, after the endurance load experiment, there is difference in the changes in the blood glucose and the blood. The decrement of blood glucose of the BCAA group immediately after doing exercises is smaller than that of the control group, and it is almost restored to the level of the resting state 30 min after having sports, however, that of the control group is significantly lower than that of the resting state. Similarly, the level of blood lactate of the BCAA group immediately after doing exercises is significantly lower than that of the control group, and the fatigue of the BCAA group leaves faster than that of the control group does probably because due to the presence of circulation of glucose, lactate and the glucose in human bodies, little lactate is generated from the glycolysis of glucose during the increasing aerobics under load and the restoration after having sports, the BCAA exerts little influence on the circulation of lactate and glucose when involved in the energy metabolism, and there is no significant difference with that of the control group. When the quantity and strength of exercise load significantly rises, the blood lactate significantly rises, and the circulation of lactate and glucose of the organisms during sports and after sports goes faster. During the experiment, compared with that of the control group, the concentration of blood lactate of the BCAA group after having sports and during restoration is lower, which does not mean that the less energy is supplied to the BCAA group from the glycolysis after the extreme sports instead, it may be because BCAA promotes the blood lactate generated from the glycolysis to synthesize glucose through the circulation of lactate and glucose after heavy load sports. The results: BCAA may promote the circulation of lactate and glucose during extreme load sports and after sports, prevent the blood glucose after the extreme sports from falling significantly and a lot of blood lactate from being generated, accelerate the restoration of blood glucose and the removal of the blood lactate after having sports, and may help to eliminate the sport-induced fatigue.

CONCLUSION

Immediately after the endurance extreme load sports and during restoration, the alanine in blood of the BCAA group is significantly higher than that of the control group; the blood lactate is significantly lower than that of the control

group, and the blood glucose does not significantly fall. It means that during the endurance sports, BCAA may help to promote the circulation of alanine and glucose, the circulation of the lactate and the glucose, accelerate the gluconeogenesis, and maintain the physical energy during sports and quickly eliminate the fatigue after having sports. It is greatly valuable for improving their abilities to have sports.

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