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The Effect of Four Weeks of Beta-Alanine Supplementation on Anaerobic Power and Plasma Lactate Level in Unprofessional Male Bodybuilders

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Abstract

The aim of current study was to investigate the effect of four weeks of beta-alanine supplementation on anaerobic power and plasma lactate level of unprofessional male bodybuilders. For this purpose, the study plan was performed as pretest-posttest with control group and as one blind trial. 20 mature and unprofessional athletes were randomly divided into two groups of 10 people including supplement and placebo (supplement group: 25±0.81 years old, weight 82.10kg±4.78 kg and BMI 24.34±2.19kg/m^2 and placebo group: 24.40± 1.07 years old, weight 80.60±5.85 kg and BMI 23.34±1.16 kg/m^2). Within experimental period of four weeks, the subjects of supplement group received six mg daily beta-alanine supplement for five days a weeks and the subjects of placebo group received placebo to the same dosage (Aspartate Flavor Powder). Both groups also participated in four weeks of bodybuilding exercises, designed by the researcher. As pretest and posttest, the subjects of both groups participated in anaerobic test of RAST respectively in one day before and after finishing experimental period to evaluate the indicators of anaerobic power and to measure blood lactate levels. Blood samples were taken from them immediately after RAST test. To analyze data, dependent t-test as well as two-way covariance analysis test was used. Statistical operations were checked in significance level of P≤0.05 and then the following results were obtained: compared to placebo group, four weeks of beta-alanine supplementation led to significant improvement of anaerobic peak power and fatigue index of subjects (P≤0.05) but it didn't have any significant effect on average anaerobic power and plasma lactate level following one session of intense anaerobic activity. Since, increased anaerobic peak power and reduced fatigue can indicate improvement of subjects' anaerobic power, it can be concluded that this type of supplementation has caused improvement of participants' anaerobic power.

Keywords: Beta-Alanine Supplementation, Unprofessional Bodybuilder, Anaerobic Power, Plasma Lactate

INTRODUCTION

Fatigue processes as a threaten factor for performance of most sport activities have been always interested by researchers. Sometimes, fatigue is categorized into two sections of central (brain and shock spinal cord) and environmental (skeletal muscles). However, these two sections are always distinguished with caution (15).

Local muscular fatigue arising from accumulation of metabolites such as hydrogen ion and muscle pH decline is one of the most important reasons of functional decline during extreme activities as well as lactate level above threshold. Identifying and prescribing the supplements which are able to cope with fatigue and improve the athlete's performance through increasing the coping potential and increasing muscular acidity, is of a great importance. Beta-alanine supplement has been highlighted among the others, given the findings reported on its effect on the fatigue arising from sports activities (2). Beta-alanine is an amino-acid beta that amine group has been located in the beta position of the carboxylate group in its molecular structure.

This aminoacid exists in all skeletal muscles cells, but not combined with any protein or enzyme in the biosynthesis. When, beta-alanine is combined with histidine, it will turn to carnosine dipeptide (7). In muscular cells, carnosine avoids of muscle environment hyperacidity. Almost 20% of muscles' pH buffering capacity is supplied by this combination. By decreasing muscular acidity (maintaining the balance of muscle pH), carnosine causes increasing the ability and performance of muscle in long and severe activities and muscular fibers, which have the highest amount of carnosine, can generate the most power for longer time periods (18). A plenty of carnosine exists in skeletal muscles texture (especially fast twitch type muscular fibers) but its levels are limited by the beta-alanine that is available for muscles (16). The most prominent method of increasing beta-alanine for body muscles is using beta-alanine supplement.

The studies have shown that beta-alanine supplement increases the concentration of muscles carnosine that reduces athletes' fatigue in severe physical activities and increases total amount of accomplished muscular activity (17) and also facilitates the recycling between repeated turns of intense sport activities through increasing the buffering capacity of skeletal muscles (1). Therefore, beta-alanine supplementation seems to be more suitable for sport activities which are dependent on rebuilding ATP from anaerobic glycolysis pathway to the great extent (1). It should be noted that beta-alanine supplementation, in addition to increase buffering capacity of hydrogen ion, has other roles such as protecting vital molecules against glycation, antioxidant properties as well as increasing calcium sensitivity in twitch fibers (6). The studies about the effect of beta-alanine supplement on the concentration of muscular carnosine have shown that only within four weeks of using beta-alanine supplement, carnosine level has increased in athletes' muscles to the extent of 64% and following that within 10 weeks of using beta-alanine, carnosine level increases in muscles to the extent of 80% (5).

Despite the effect of beta-alanine supplement on muscular carnosine, in the studies which have been conducted about the effect of beta-alanine supplementation on the concentration of muscular metabolites caused by intense sport activities and sport performance, some contradictory results have been obtained such as Eslamdust et al, (2014) who investigated the effect of 7 days of beta-alanine consumption with different dosages of 3.2, 4.8 and 4.6 gram a day on the concentration of blood lactate in young male athletes following Maximum Wingate Test and concluded that beta-alanine supplementation in short-term doesn't have a significant effect on blood lactate after short intense activities(4). The same result was observed by Kern and Robinson (2011) while investigating the effect of 8 weeks of beta-alanine supplementation on blood lactate level after an intense activity(11). On the other hand, Jordan et al (2010) observed reduction of lactic acid generation after maximal sport activity as the result of 4 to 13 weeks of beta-alanine supplementation (10).

In some of studies, the researchers also investigated the effect of beta-alanine supplementation on sport performance such as Comic et al (2010) and Derave et al (2007) who showed that beta-alanine supplementation in the long-term led to improvement of sport performance in the participants (2-3) but on the contrary, Jordan et al (2015) founded that high-dose beta-alanine supplement doesn't have significant effect on anaerobic power peak of elite biker girl, despite significant reduction in perceived exertion(9). This result was concluded by Kern and Robinson (2011), while investigating the effect of 8 weeks of beta-alanine supplementation on anaerobic performance(11).

On the other hand, no specific side effects have been defined for beta-alanine supplementation by investigating existing texts.(13) Given lack of reliable information about the effect of beta-alanine supplementation on intense sport performance and the concentration of lactic acid as generated metabolite during these activities as well as contradiction in the results of different studies, current study is sought to answer the question; whether 4 weeks of beta-alanine supplementation affects anaerobic power and lactate level of plasma following intense sport activity in unprofessional bodybuilders or not?

Methodology

Participants: After verifying the inclusion criteria, 20 mature and healthy 24-26 years-old men were selected through convenient sampling method. For this purpose, after recalling the bodybuilding community of Qazvin, the athletes who had declared

ready, were accurately informed about the steps of the study, the conditions of test and probable risks during a one briefing session and were given the personal consent form of participating in the study and personal information questionnaire in which the rate of sport experience, the number of weekly exercise sessions, the history of specific injury or disease, the history of using sports nutrition supplements were determined. Afterward, the participants were randomly assigned into two groups of 10 including beta-alanine supplementation and placebo. The inclusion criteria in study were having physical and mental health, not smoking and drinking alcohol, having regular sports history over the recent three years (at least exercising six hours a week, not using any kind of sport nutrition supplements over a past month and during experimental period of the study, not changing typical diet during experimental period, not participating in sport activities out of the recommended program during the experimental period.

Table 1. General Characteristics of Participants in Two Groups of Beta-Alanine and Placebo

Characteristic	Group	Number	Mean	Standard Deviation
Age (Years)	Beta-Alanine	10	25	0.81
	Placebo	10	24.40	1.07
Weight (Kg)	Beta-Alanine	10	82.10	4.78
	Placebo	10	80.60	5.85
Height (Cm)	Beta-Alanine	10	183	6.92
	Placebo	10	179.90	5.19
(Kg/M^2)BMI	Beta-Alanine	10	24.34	2.19
	Placebo	10	23.34	1.16

Research Plan: This was a single blind trialin pretest-posttest plan with control group. One day before starting4 weeks of beta-alanine supplementation as an experimental period, the participants took RAST maximum anaerobic test and their blood lactate was measured using lactometer device immediately after the test. Then, beta-alanine supplementation experimental trial was conducted on experimental group and placebo (aspartate flavor powder) prescription for control group as single blind. Thus, participants at supplement group were given six grams of daily beta-alanine supplement and participants at control group received six grams of daily placebo (aspartate flavor powder) 5 days a week within 4 weeks half an hour before weight training.

Besides, the participants of both groups performed the protocol of similar weight training recommended by researcher. At the end of experimental period and after one day of rest, the participants took the RAST test again and immediately after that, blood lactate was re-measured.

To reduce the effect of diet on the results of study, all participants were also asked to take notes from their diet before pretest over 24 hours and then apply the same diet a day before posttest and also not to have any exercises a day before pretest and posttest.

The program of Weight Training: This four-week training program include selected moves of barbell bench press, underhand cable pull downs, barbell shoulder press, barbell curl and grip triceps pushdowns, leg extension and leg curl with machine which were conducted in three sets with 10 repetitions five days a week, the first week 60% of a maximal repeat in which to meet the overload principle, the intensity of exercises was increased for weekly 5%.

Power = Weight × 1225÷ Time ^{3}

Measuring Anaerobic Power: Anaerobic power peak, mean anaerobic power and anaerobic fatigue index were measured using RAST maximal anaerobic test as explained below:

Before taking the test, the participants warmed up for10 minutes .According to RAST test, to obtain anaerobic power peak, each participant performed six repetitions of 35 meters running track with maximum speed. Anaerobic power for each subject was measured in each repetition using the following formula.

Power = Weight × 1225÷ Time ^{3}

Then, the highest point among repetitions was considered as anaerobic power peak and mean anaerobic power of each participant was calculated

through dividing the sum of all 6 repetitions by 6 and following that, to obtain fatigue index, the difference of maximum power and minimum power limit was divided by total passed time in 6 repetitions of sprint.

Measuring Blood Lactate: Before the test and also immediately after finishing it, participants' blood lactate levels were measured through taking blood sample from the index finger of non-handedness using Scott lactometer model made by Sense Lip Company which measures through enzymatic spectrophotometry and in mMoL per liter.

Statistical Analysis of Findings: descriptive statistic was used to summarize, categorize and introduce the manner of data distribution. Also, Shapiro-Wilk test was used to determine the normality of data distribution. In next section, to test research hypotheses, dependent t-test as well as two-way covariance analysis test was used. Statistical operations were investigated in significance level of P≤0.05 and statistical program SPSS V22 was used for calculations.

RESULTS

In beta-alanine supplementation group, in comparison between the mean of pretest and posttest of anaerobic power peak variables, a significant increase in mean anaerobic power and a significant decrease in fatigue index can be seen (P≤0.05) but non-significant increase can be recognized in the variable of plasma lactate level, but in placebo group, unlike beta-alanine supplement group, a significant decrease can be seen in anaerobic power peak variable in posttest compared to pretest and in other variables of this group, there is no significant difference between pretest and posttest (Table 2).

Table 2. The Results of Dependent T-Test for Comparing the Mean of Pretest and Posttest in Each Group for Different Variables

Variable	Group	M±Sd		T	DF	Sig
		Pretest	Posttest			
Anaerobic Power Peak (Watt)	Beta-Alanine Group	591.62±104.01	682.21±49.06	-3.701	9	*0.005
	Placebo Group	603.69±25.10	585.64±22.12	1.187	9	*0.26
Anaerobic Power Mean (Watt)	Beta-Alanine Group	482.88±71.06	517.09±49.06	-3.701	9	*0.005
	Placebo Group	519.92±28.36	507.87±21.11	-2.035	9	0.07
Fatigue Index (Watt Per Second)	Beta-Alanine Group	13.25±2.78	10.57±2.64	3.753	9	*0.005
	Placebo Group	12.03±2.44	11.57±2.36	0.788	9	0.45
Plasma Lactate Level (Mmol Per Liter)	Beta-Alanine Group	7.55±2.35	8.37±4.01	0.786	9	0.45
	Placebo Group	6.81±2.89	8.91±2.35	4.110	9	*0.003

Significance Level (P≤0.05)

Table 3. The Results of Two-Way Covariance Analysis Test for Comparing the Mean of Pretest and Posttest of Each Group for Different Variables

Variable	F	Sig
Anaerobic Power Peak (Watt)	14.43	*0.001
Anaerobic Power Mean (Watt)	2.82	0.111
Fatigue Index (Watt Per Second)	4.12	*0.058
Plasma Lactate Level (Mmol Per Liter)	0.87	0.36

Significance Level (P≤0.05)

To compare posttest of the variables for two groups, the results of covariance analysis test indicated a significant difference between two groups only in variables of anaerobic power peak and fatigue index; in beta-alanine supplementation group, anaerobic power peak is significantly higher and fatigue index is lower. While, there is no significant difference in anaerobic power mean and plasma lactate level (Table 3).

DISCUSSION

According to the results of the study, all three indicators of anaerobic readiness including anaerobic power peak, anaerobic power mean and fatigue index as well as plasma lactate level have significantly been improved in beta-alanine supplementation group unlike placebo group in the comparison between pretest and posttest. According to the comparison of posttest data in both two groups, only anaerobic

power peak and fatigue index have significantly been increased and decreased respectively in beta-alanine supplementation group compared to placebo group.

These findings are consistent with the study results of Stout et al (2008), Kern and Robinson (2011), Camic et al (2010) and Sale et al (2012) about the effect of beta-alanine on the anaerobic power indicators(17-11-2-14). Also, the results of this study are consistent with the studies of Hoffman et al (2015) about the effect of this combination on power performance and the shooting accuracy of soldiers and also with the study of Jordan et al (2010) about the effect of beta-alanine on blood lactate levels (8-10).

For confirming the results of this study, given the approximate time of intense sport activity of the research (RAST test) within one to two minutes, the dominate energy machines in performing this activity by research participants has been anaerobic glycolytic machine which is theoretically responsible for supplying dominant energy in intense activities of timing within 15 to 120 seconds and through generating lactate and hydrogen ions in activate muscular fibers as well as transferring them to blood causes increasing the muscle and blood acidity and tangible decline of environment pH and as the result reducing the performance and continuity of intense activities (12).

It is also confirmed that beta-alanine supplementation can increase the concentration of muscles carnosine. Given this information for confirming the results of the study, the possibility of increasing carnosine concentration caused by 4 weeks of beta-alanine supplementation can be noted. This substance is a buffer for hydrogen ions caused by anaerobic glycolysis which prevented accumulation in muscle and blood and moderated their negative effects on intense performance. According to the comparison of non-significant increase of generated lactate amount in posttest of beta-alanine group with pretest as well as significant increase in posttest of placebo group with pretest, beta-alanine supplementation probably causes decreasing the concentration of generated lactate and decline of environment pH through increasing the rate of muscles carnosine and buffering capacity.

In this case, in a review study and through the conducted studies up, Hobson et al (2012) has argued that beta-alanine causes improving the performance in sport activities with time period of 60-240 seconds (6). Given lack of measuring of muscles carnosine in this study, there are some uncertainties in this regard. On the other side, the role of beta-alanine supplementation increasing the calcium sensitivity of twitch fibers of involved muscles can also be noted which it can be probably suitable in increasing participants' anaerobic power and reducing their fatigue index.

On the contrary, these findings aren't consistent with the research results of Jordan et al (2015) about the effects of beta-alanine on anaerobic power and also with the studies of Eslamdust et al (2014), Drave et al (2007) and Kern and Robinson (2011) about its effect on blood lactate level(9-4-3-11). This inconsistency in findings can be related to the dosage and time of intake beta-alanine supplementation, physical fitness level of participants, the type of used training protocol and the length of activity.

CONCLUSION

In comparison with placebo consumption, 8 weeks of beta-alanine supplementation caused significant improvement in the anaerobic power peak and fatigue index of unprofessional male bodybuilders; but it didn't have significant effect on anaerobic power mean and plasma lactate level after one session of intense anaerobic activity. Since, increased anaerobic power peak and reduced fatigue index can indicate the improvement of participants' anaerobic power, so it can be concluded that the supplementation has improved participants' anaerobic power. According to the findings of this study, coaches and athletes in fields of speed and power sports can be recommended to use long-term beta-alanine supplementation with the dosage suggested in this study to improve anaerobic power.

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