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THE EFFECT OF SHORT -TERM COMBINATION OF HMB (BETA-HYDROXY-BETA-METHYLBUTYRATE) AND CREATINE SUPPLEMENTATION ON ANAEROBIC PERFORMANCE AND MUSCLE INJURY MARKERS IN SOCCER PLAYERS
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ORIGINAL PAPER

THE EFFECT OF SHORT –TERM COMBINATION OF HMB (BETA-HYDROXY-BETA-METHYLBUTYRATE) AND CREATINE SUPPLEMENTATION ON ANAEROBIC PERFORMANCE AND MUSCLE INJURY MARKERS IN SOCCER PLAYERS

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ABSTRACT
FARAMARZI, M.; NURI, R.; BANITALEBI, E. The effect of short –term combination of HMB (beta-hydroxy-beta-methylbutyrate) and creatine supplementation on anaerobic performance and muscle injury markers in soccer players. Brazilian Journal of Biomotricity, v. 3, n. 4, p 366-375, 2009. The purpose of this study was to examine the effects of consumption of HMB (beta- hydroxy-beta-methylbutyrate) and creatine supplementation on anaerobic performance and muscle injury markers of soccer players. Twenty-four soccer players from the Iranian soccer first league, at mean age: 20.72 ± 0.70 years, height: 173.33± 4.50 cm, and weight: 58.60± 5.41kg were selected and randomly divided to three groups: HMB supplementation (n=8), combination of HMB and creatine (HMBCr) (n=8), and placebo (n=8). Anaerobic performance was assessed by running anaerobic speed test (RAST), and muscle injury markers measured by serum CK and LDH in the pre and post tests. Supplementation period was six days. The HMB group received 3gr of HMB supplement per day, the HMBCr group received 3gr of HMB and 3gr of creatine, and the placebo group received 6gr of carbohydrate. To investigate the mean differences between pre and post-test variables was used dependent student *t*-test. Furthermore, a one –way ANOVA was done among the three groups, to compare the mean differences of pre and post tests. As there was any significant difference, used the TUKEYs post hock test. The results showed that peak power increased in both groups of creatine and HMBCr supplementation. However, there was significant increase only in HMBCr group (p=0.02). Furthermore, after comparing the

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groups, there was a significant difference between HMB and HMBCr supplementation group (p=0.036). Mean power increased in, HMB and HMBCr groups. But, this was significant in HMBCr group (p=0.014), only. Although, fatigue index showed the small changes in the three groups, there was no significant difference. Also, the mean of serum LDH and CK was decreased. This however, was no significant in any of the groups. In conclusion, the results of this study showed that due to the relative increase in anaerobic performance of soccer players, HMBCr supplementation can lead to increase of anaerobic performance.

Key words: HMB supplementation, Anaerobic performance, Muscle injury markers

INTRODUCTION

Physical activity as a mechanical stressor factor can cause biochemical changes. Also, muscle activity may alter circulation levels of some enzymes such as creatine kinase (CK) and lactate dehydrogenase (LDH) (BLOOMER and RICHARD, 2007). High plasma levels of CK and LDH use as injury markers of muscle tissue. It is shown that mechanical injuries of muscle fibers can increase CK and LDH in circulation (CLARKSON *et al.*, 2002). In soccer players, performing two or three matches in a week can increase the risk of injury and inflammation and reduce the performance (SPIRLIDIS, 2008). Recently, many athletes especially from team sport use beta - hydroxy beta- methylbutyrate (HMB) as a nutritional supplement (SALTER and JENKINS, 2000). It has been suggested that HMB, a metabolic derivative of the amino acid leucine, acts as an anticatabolic agent to reduction of muscle protein breakdown, injury – induced intense activities and enhance recovery from exercise (VAN KOVERING and NISSEN, 1992; CROWE *et al.*, 2003). Although, there is no direct evidence about the HMB effects mechanism, but Howatson *et al*. (2008) suggested that HMB provide carbon for cholesterol synthesize via conversion to beta-hydroxy betamethyl CoA (HMG - CoA) (HOWATSON and VAN SOMEREN, 2008). Another hypothesis is that HMB participates as a part of cell membrane structure (VAN KOVERING and NISSEN, 1992).

Also, it has been suggested that HMB supplementation with 1.5 to 3.0 gr per day reduce muscle proteolysis and increase strength and muscle mass after 3-8 weeks strength training (NISSEN *et al.*, 1996; PANTON *et al.*, 2000). However, these finding isn't confirmed by other studies (KREIDER *et al.*, 1999, SLATER *et al.*, 2001). In addition, CK activities can reduce by HMB supplementation after strength training and long distance running (NISSEN *et al.*, 1996; PANTON *et al.*, 2000; KNITTER *et al.*, 2000). Also, intense and incremental exercise training can provide injury of muscle fiber membrane. It is documented that eccentric contractions such as some movements of soccer can provide more sever injuries (KNITTER *et al.*, 2000). High mechanical force in exercise training, especially in soccer interval activities, can destruct structural proteins of muscle fibers and connective tissue (ARMSTRONG, 1984). HMB supplementation increase lean body mass and strength in exercising humans (JOWKO *et al.*, 2001). Two mechanisms have been proposed for HMB action. The first, HMB can slow or suppress muscle proteolysis that is elevated during exercise. The second possible mechanism concerns HMB being a precursor of muscle-cell cholesterol (JOWKO *et al.*, 2001).

On the other hand, some studies reported that creatine supplementation with 20.0 gr per day for 5 to 7 days can increase muscle energy. In fact, creatine supplementation promotes muscle creatine and phosphocreatine concentration (PCr) (BALSOM *et al.*, 1995; FEBARIO *et al.*, 1995; CASEY *et al.*, 1996). It has been suggested that high concentration of creatine can increase replenishment of ATP and PCr after intense exercise and improve performance in repeated bouts of sever activities (GREENHAF *et al.*, 1993; BALSOM *et al.*, 1995; FEBRAIO *et al.*, 1995; EARNEST *et al.*, 1995; CASEY *et al.*, 1996). It is suggested that phosphocreatine due to its amphipathic nature, can bind to

the plasma membrane increasing its stability. On the other hand, anecdotal evidence (coaching, personal training, etc.) relates that the intracellular osmolarity increase, verified after creatine supplementation, could lead to muscle injuries during physical exercise. However, the experimental results are conflicting and there is no consensus about the relationship between creatine supplementation and the integrity of the muscle macrostructure (MACHADO *et al.*, 2009).

Recently, Corner and Crowe (2007) studied the effect of combination of creatine and HMB supplementation on athletic performance. They reported that consumption of HMBCr can increase fat free mass in soccer players, significantly (CONNOR and CROWE, 2007). However, they demonstrated that only HMB supplementation has no significant effect on strength and body composition (CONNER and CROWE, 2007). Other studies indicated that consumption of HMBCr promotes strength in lifting movements (JOWKO *et al.*, 2001). However, it seems that HMB supplementation probably prevent muscle injury in eccentric movements. Also, HMB can increase anaerobic power that is critical for soccer players. Also, the results of studies about the effects of HMB or HMBCr on the strength were contradictory. On the other hand, there are little studies about the effects of HMB or HMBCr on the anaerobic performance and muscle injury markers in soccer players. Thus, the aim of this study was to examine the effects of short-term combination of HMB and Creatine supplementation on anaerobic performance and muscle injury markers in soccer players.

MATERIALS AND METHODS

Subjects and Procedures

The subjects of present study were selected from one of the teams participating in Iranian soccer first League (2007 – 2008 seasons). This team had 24 players who divided in to 3 groups, randomly. These 3 groups were HMB supplementation (n=8), HMBCr supplementation (n=8) and placebo (n=8). In compliance with the University of ShahreKord, the aims and all experimental procedures were explained, and written informed consent was then obtained from each subject. The study was approved by the Faculty of Human Sciences of the University of ShareKord. After randomization, subjects consumed supplements in a 6 days period. Before beginning of supplementation period, body variables (weight, height) and running anaerobic speed test (RAST) measured in all subjects. Blood samples obtained 48 hours after RAST for determining the muscle injury markers, CK and LDH. Blood samples were taken in seated position from superficial forearm vein after 12 – 14 overnight fasting. Serum was collected from the blood sample and then stored at - 80°C until analyzed for CK and LDH. CK and LDH were determined spectrophotometrically using an automatic blood analyser (Model 7170; Hitachi, Tokyo, Japan) with a test kit (Shikarikid CK; Kanto Chemical Co. Ltd, Tokyo, Japan). Also, peak power, mean power and fatigue index measured in pretest (SIAHKOHIAN and KORDI, 2007). Then, six days supplementation period begins in subjects. Packages including HMB, HMBCr and placebo (Carbohydrate) give to HMB, HMBCr and Placebo groups, respectively. In HMB group, each package was included the 3,0 gr HMB. In HMBCr group, each package was included the 3,0 gr HMB and 3,0 gr Cr and in Placebo group, each package was included 6,0 gr carbohydrates. Subjects had no any information about the content of packages and asked them that solve packages content in 250 ml tepid water and consume with breakfast. Supplementation accompanied for 6 days and subjects follows typical diet in this period. They participated in team training program for six sessions. Each session was included 10 minutes warm-up, 15 minutes technical training, 30 minutes tactical training, 25 minutes soccer game and 10 minutes cool down. After 6

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days supplementation (post test), all measurements repeated in subjects. All measurements accompanied by same staff that blinded to subjects.

Statistical analysis

Data were analyzed by using SPSS software (Version 13.0). For the description of data, mean and standard deviation were used and mean values of variables in pre and post test were compared by dependent t-test. Normalization of variables was measured by Colomgraph – Smirnoph test. Furthermore, a one - way ANOVA was done between three groups to compare mean in pre and post test. If there were significant differences between groups, the Tukey post hock was used. Statistical significance was set at $P < 0.05$.

RESULTS

Table 1 showed the characteristics of subjects in three groups.

Table 1 - The characteristics of subjects in three groups

Variables	Age (years)	Weight (kg)	Height (cm)
HMB	21.56 ± 0.14	62.94 ± 13.40	174.75 ± 4.59
HMBCr	20.75 ± 0.70	57.50 ± 6.91	175.00 ± 6.50
Placebo	19.87 ± 0.64	55.38 ± 10.17	171.88 ±6.13

The findings of present study demonstrated that peak power was increase in HMB and HMBCr groups and was decreased in placebo group. But, there was significant increasing in HMBCr group, only (p=0.002). Also, figure 1 shows that there was significant difference between HMB and HMBCr groups (p=0.036). In fact, HMBCr had more effect on the peak power of the soccer players.

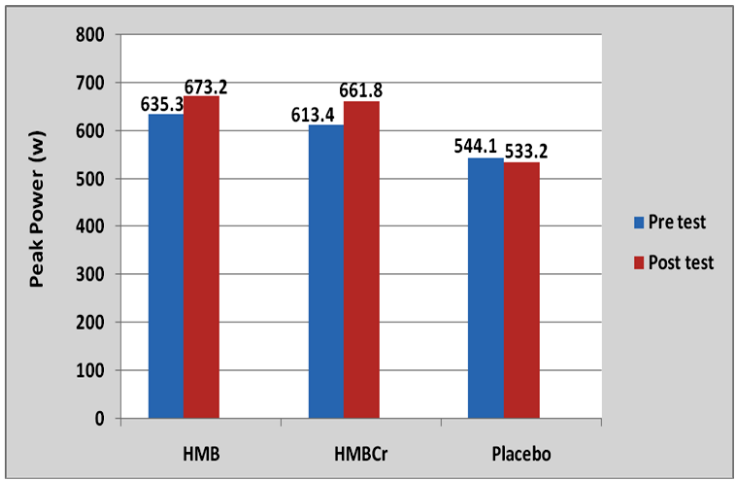

Figure 1 - Peak power of three groups in pre and post test

The findings of this study showed that mean power was enhanced in HMB and HMBCr groups and was decreased in placebo group. However, there was significant increasing in

HMBCr group (p=0.014). Also, figure 2 shows that there was no significant difference between HMB and HMBCr groups (p=0.102). In fact, HMB or HMBCr had no more effect on the mean power of the soccer players.

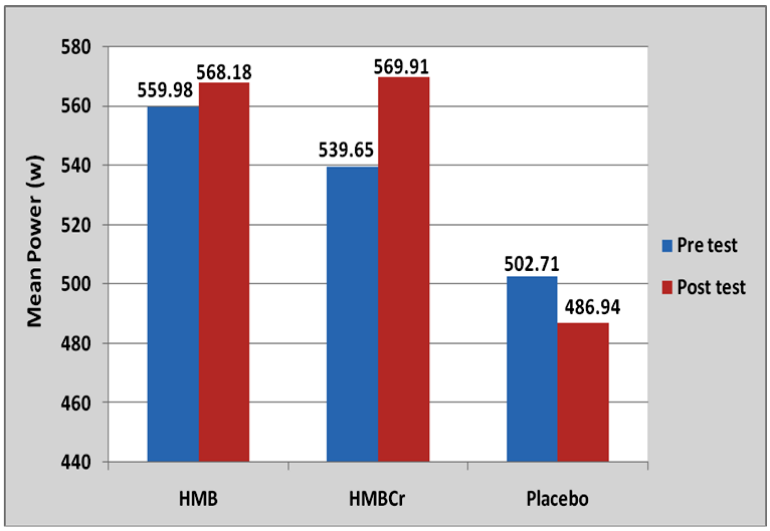

Figure 2 - Mean power of three groups in pre and post test

The findings of this study showed that fatigue index was reduced in HMB and placebo groups but it was no significant (p=0.333). However, HMB can reduce fatigue index in soccer players (figure 3).

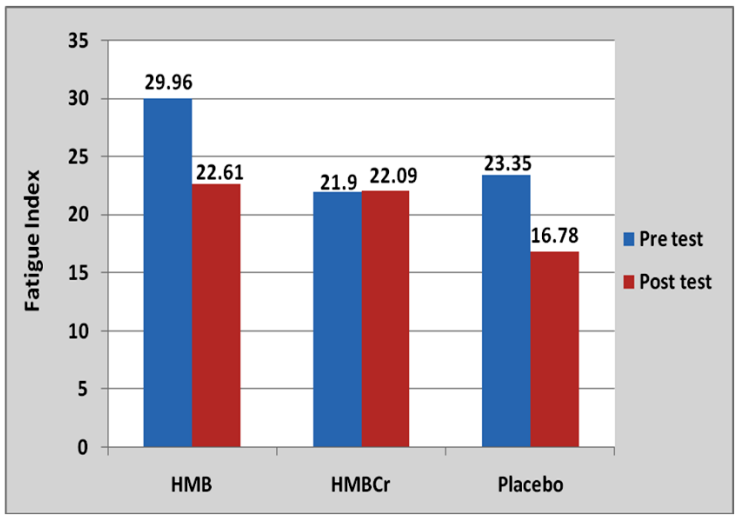

Figure 3 - Fatigue index of three groups in pre and post test

The results indicated that CK levels were reduced in three groups but it was no significant. Also, figure 4 demonstrates that there was no significant difference between three groups in CK levels (0.652). Indeed, HMB or HMBCr had no more effects on the CK levels of the soccer players.

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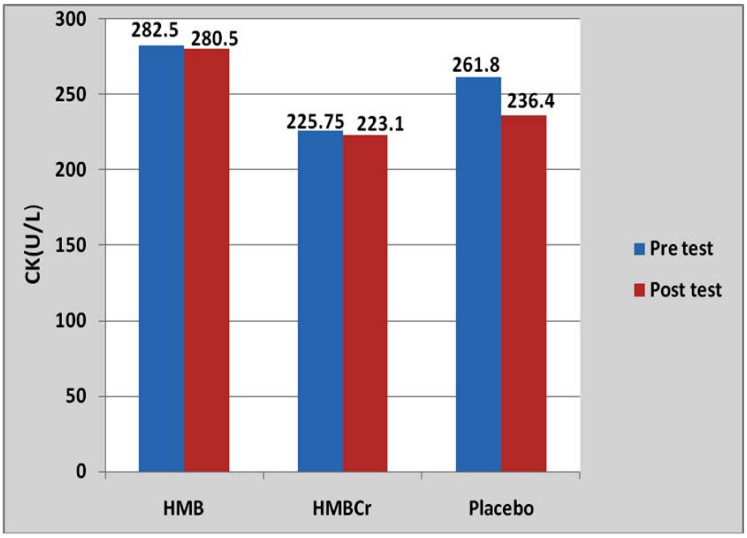

Figure 4 - CK levels of three groups in pre and post test

The findings of this study showed that LDH levels were reduced in three groups but it was no significant. Also, figure 5 indicates that there was no significant difference between three groups in LDH levels (0.652). Indeed, HMB or HMBCr had no more effects on the CK levels of the soccer players.

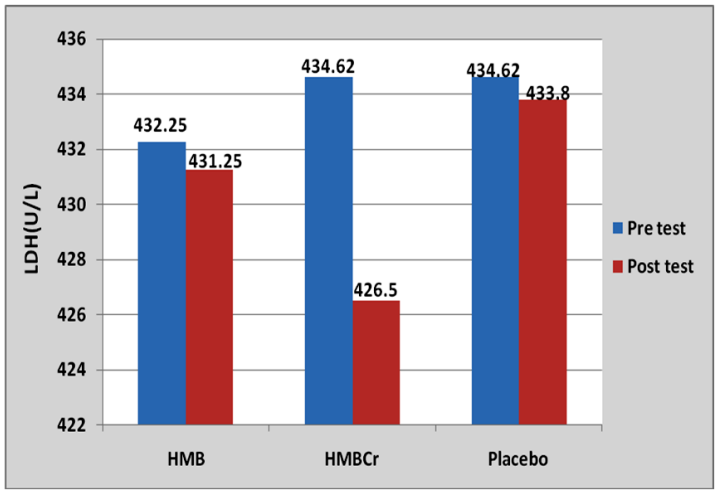

Figure 5 - LDH levels of three groups in pre and post test

DISCUSSION

The aim of this study was examine the effects of short – term combination of HMB and Creatine (HMBCr) supplementation on anaerobic performance and muscle injury markers in soccer players. The results of this study showed that short – term consumption of HMB and HMBCr supplements had significant effects on the peak power (p=0.002) and mean power (p=0.014) of soccer players. Some studies founded that HMB and HMBCr supplementation improve performance (GREENHAFF *et al.*, 1993; BANGSBO *et al.*, 1991;

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JOWKO *et al.*, 2001, O´CONNOR *et al.*, 2007). A study reported that bench press record enhance after HMB supplementation (NISSEN *et al.*, 1996). In other study, Panton et al (2000) indicated that 4 weeks consumption of HMB promotes upper body strength in 20 – 40 years men (PANTON *et al.*, 2000). Also, Jowko *et al*. (2001) founded that HMB and Cr supplementation have positive effect on the muscle strength (JOWKO *et al.*, 2001). On the other hand, some authors don't shown positive effect of HMB on athletic performance. For instance, O´Connor *et al*. (2007) demonstrated that HMB and HMBCr have no significant effect on the muscular power and endurance (O´CONNER *et al.*, 2007). However, some studies confirmed that HMB supplementation has positive effects on the strength and anaerobic performance. For example, Nissen *et al.*, (1996), Gallagher *et al.* (2000) and Jowko *et al*. (2001) reported that HMB supplementation has no positive effect on 1RM (NISSEN *et al.*, 1996; GALLAGHER *et al.*, 2000; JOWKO *et al.*, 2001). It seems that HMBCr via promotion of muscular Cr content can increase the capability of fast movements in athletes. A recent study founded that Cr supplementation has effect on metabolites of soccer players (MACHADO et al., 2008). It supposed that this effect can be via promotion of ATP replenishment during exercise and PCr during recovery period, resulting delayed fatigue (MACHADO et al., 2008). Because of short – term intense activities depended to PCr and anaerobic glycolysis, it seems that PCr availabilities improve performance in these activities. On the other hand, there was no significant difference between mean and peak power in HMB group. Thus, significant increasing of mean and peak power in HMBCr can be related to Cr supplement. Therefore, combination of Cr with HMB can improve anaerobic power more than HMB in soccer players, probably. However contradiction between findings of present study and other study can be related to types of subjects, test and different way of assessment of anaerobic performance and dosage of supplements. Since a study demonstrated that human performance is not resulting from physiological state only, but also some factors such as motivation and self – confidence can improve performance (WILSON *et al.*, 2008).

Also, findings of this study showed that HMB and HMBCr supplementation have no significant effect on the serum CK and LDH levels. However, CK and LDH levels reduced in HMB and HMBCr groups, but this reduction was no significant. This finding confirms other studies findings (NISSEN *et al.*, 1996; VAN SOMEREN *et al.*, 2003; VAN SOMEREN *et al.*, 2005). These studies reported that HMB can reduce muscular injury markers. However, some authors founded contradictory results. For instance, Hoffman *et al*. (2004) indicated that short-term HMB supplementation can not reduce muscular injury markers and has no significant effect on performance of soccer players (HOFFMAN *et al.*, 2004). In general, CK reduction after intense activity resulting from HMB supplementation play critical role in protein metabolism (WILSON *et al.*, 2008). Because of HMB is a part of cell membrane and it can regulate the muscle proteolysis enzymes, it seems that this reduction is occurred.

Also, other finding of present study demonstrated that HMB and HMBCr supplementation can reduce serum LDH levels, but this reduction was no significant. The mechanisms of HMB supplementation effect on the protein catabolism are unknown. However, HMB can modulate muscle proteolysis or regulates cortisol, testosterone, growth hormone, insulin like growth factor-1 (IGF-1) and insulin receptors (WILSON *et al.*, 2008). It seems that HMB supplementation is no effective for trained subjects. Hoffman *et al*. (2004) reported that HMB supplementation is effective for untrained subjects, since these subjects have high potential for muscular injuries during training (HOFFMAN *et al.*, 2004). Because of present study subjects were trained soccer players, thus there was no significant different between groups in CK and LDH levels.

PRACTICAL APPLICATION

The findings of present study demonstrated that HMB and HMBCr supplementation can increase the anaerobic performance in soccer players. It seems that HMB and HMBCr supplementation have no significant effects on muscular injury markers. However, it is recommended that consumption of HMB and HMBCr with 3g/day for 6 days can improve anaerobic performance and reduce CK and LDH levels in soccer players. Nevertheless, these findings need to more study in future.

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