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The Effect of Branched Chain Amino Acids Intake Before and After Exercise on Physical Performance and Recovery

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Study Area: Bursa, Turkey

Coordinates: 40°11'N; 29°03'E

Key words: Supplement, Leucine, Ergogenic aids

Abstract

A total of 14 male athletes participated in the study voluntarily. Perceived muscle soreness (DOMS), speed and vertical jump performances were evaluated to measure their physical performance. The measurements were repeated before, immediately after, 24, 48 and 72 hours after exercise. This study with the cross-over model was conducted. In the comparisons between the groups (BCAA-Placebo), there was a significant difference in DOMS and speed in time, there was no significant difference in trial and trial * time interaction. In addition, there was no difference in a vertical jump in trials, time, and trial * time interaction. Finally, it has been determined that BCAA (2:1:1) acute intake before and after exercise in athletes, who took an average of 3 g of leucine daily, had no effect on physical performance and recovery.

Introduction:

Individuals who exercise to be healthy or to increase physical performance need ergogenic aids. Development of muscle hypertrophy and physical performance is influenced by variables such as exercise, nutrition, growth factors, growth hormone, and cortisol (Özer *et al.*, 2017; Pancar *et al.*, 2018; Tahhan *et al.*, 2018; Pancar, 2020; Tasdogan *et al.*, 2020; Çinar *et al.*, 2019; Özdal *et al.*, 2019). Thus, they support their personal diet program with appropriate nutritional supplements to improve performance during training or competition. Among these nutritional supplements, BCAA draws attention in recent years.

BCAA consists of leucine, isoleucine, and valine. BCAA, which are abundant in muscle proteins, constitute 14-18% of total amino acids and about 1/3 of essential amino acids. BCAA are mostly catabolized in the muscles and increase with exercise (Shimomura *et al.*, 2010). BCAA is rapidly absorbed after oral administration. They cannot be synthesized by the human body, so they must be taken with diets (Santos & Nascimento, 2019). It has been proven that BCAA (especially Leucine) taken with exercise stimulate mTOR and p70-S6 kinase, which have a key role in cell development (Jackman *et al.*, 2017; Schoenfeld, 2016).

BCAA reduces protein degradation (Dorrell & Gee, 2016) and increases protein synthesis by providing an anabolic effect (Valenzuela *et al.*, 2019; Santos & Nascimento, 2019), it has been found to reduce DOMS, accelerate recovery (Howatson *et al.*, 2012), reduce lactate

(Monteiro *et al.*, 2009), and preserve physical performance (Damas *et al.*, 2016). Contrary to these studies, there are also studies showing that it has no positive effect on recovery (Areces *et al.*, 2014), physical performance (VanDusseldorp *et al.*, 2018), muscle damage markers (AbuMoh'd *et al.*, 2020). Since the effects of BCAA cannot be determined clearly in these studies, further studies are needed.

This study aimed to examine the effect of low dose BCAA taken just before and right after exercise on physical performance and recovery.

Methodology:

A total of 14 male amateur footballers participated in the study voluntarily. Participants were found to have an average age of 21.7±2.2 years, a bodyweight of 72.9±4.1 kg, and a BMI of 24.1±3.1 kg/m². The inclusion criteria of the participants are as follows; a) not having any illness, b) actively playing football, c) not using any supplements for the last 6 months.

In our study, a total of 2 measurements were made with the Cross-over design, and after each measurement week, a 14 washout period was given to eliminate the effect of exercise. All participants were randomly divided into two groups. After warming up, pre-tests were applied and they were allowed to take BCAA / Placebo. After 30' passive waiting, they were allowed to start exercising. Post-tests were applied from the end of the exercise. Participants intake BCAA / Placebo end of the test, which was just after exercise. 24, 48, and 72 hours of tests were also completed,

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respectively. All procedures to eliminate the effect of circadian rhythm were performed at the same time of day for 2 trial weeks.

Pre-Post Tests respectively; vertical jump (2 trials with 30-sec interval) and 30 m speed test (2 trials with 3 minutes interval) and DOMS (100 mm) were scored. Participants were informed about not doing any physical activity or exercise between the tests, and not consuming food or smoking.

Exercise Protocol: participants performed a total of 100 drop-jumps from a height of 0.6 m. Upon landing, participants were encouraged to immediately jump vertically with maximal force. Five sets of 20 drop-jumps were performed with a 10 s interval between each jump and 2 min rest between sets (Howatson *et al.*, 2012; Nosaka, 2006; Miyama & Nosaka, 2004). After 10 minutes of jogging, they complete the warm-up by doing static and dynamic stretching movements for 10 minutes (Jung *et al.*, 2018).

Dietary control and analysis: one week before the study, they were asked to follow a 1-week diet (time and amount). Participants were informed about the consumption of the same foods which were consumed in the first week or similar values and sizes in the other weeks. Also, they were informed that they should not take alcohol and caffeine 1 day before the measurement days and that they should have eaten meals 2 hours at the latest. Nutrition Information System (BEBIS) program was used for daily calorie intake and macronutrient calculations (Güven *et al.*, 2009).

BCAA amount and time: BCAA enriched in leucine at a ratio of 2:1:1 (Leucine, Isoleucine, Valine) was used in our study. It was served as 2g at two different times, just before and immediately after exercise. For the placebo group, an aspartame sweetener, no-calorie value, was used. The BCAA / placebo drink was prepared with 400 ml of water where the participants could not see it, and they were allowed to drink in colored bottles.

Vertical Jump: vertical jumps were measured by using the My jump2 smartphone application (Bogataj *et al.*, 2020). Participants were asked to make 2 trials with 30 seconds intervals and the best grade was recorded.

Speed test: participants were asked to make 2 trials with 3' intervals in a 30 m area determined by photocell and the best grade was recorded.

Muscle Soreness: participants were asked to evaluate their DOMS by using a visual analog scale. Soreness was assessed along a 10 cm scale (0 cm=no soreness, 10 cm=extreme soreness) for each measurement (VanDusseldorp *et al.*, 2018).

Two-way ANOVA was used for repeated measures. When sphericity cannot be achieved, the Greenhouse-Geisser correction was applied. SPSS 22 package program was used for all statistical analyzes with significance level at <0.05 .

Results:

Diet Control and Evaluation: No statistically significant difference between the trials in terms of total calorie, protein, and carbohydrate values ($p > 0.05$). The placebo group received about 3010 mg and the BCAA group received about 3041.70 mg of Leucine daily.

Figure-1: Comparison of vertical jump

Figure 2. Comparison of speed

Vertical Jump: there is no statistically significant difference in the trials, time, and trial * time interaction in Vertical Jumping ($p < 0.05$). PE; Prior to Exercise/IAE; Immediately After Exercise/ 24h; 24 hours after exercise/ 48h; 48 hours after exercise/ 72h; 72 hours after exercise.

Speed: although there is a significant difference in time ($p < 0.05$) for speed performance, there is no significant difference ($p > 0.05$) in the between trials and trial * time interaction. PE; Prior to Exercise/IAE; Immediately After Exercise/ 24h; 24 hours after exercise/ 48h; 48 hours after exercise/ 72h; 72 hours after exercise.

Figure 3. Comparison of muscle soreness

Muscle Soreness (DOMS): although there is a significant difference in time for DOMS ($p < 0.05$), there is no significant difference ($p > 0.05$) in between trials and trial * time interaction. Mm; millimeter, PE; Prior to Exercise/IAE; Immediately After Exercise/ 24h; 24 hours after exercise/ 48h; 48 hours after exercise/ 72h; 72 hours after exercise.

Discussion and Conclusion:

BCAA intake before and after exercise does not affect speed, vertical jump, and perceived muscle soreness (DOMS) and recovery in our study.

There are conflicting results regarding BCAA. Some studies showed that BCAA accelerates the recovery period and maintains physical performance (Greer *et al.*, 2007; Howatson *et al.*, 2012), but others concluded that it does not affect recovery and physical performance (Gee & Deniel, 2016; Waldron *et al.*, 2017). AbuMoh'd *et al.*, (2020) 16 male long-distance runners were asked to run until they were

ORIGINAL ARTICLE

exhausted with increasing intensity exercise. The form of BCAA was composed of 300 mg of valine, 250 mg of leucine, and 100 mg of isoleucine in each gram. They were allowed to take 20 grams of BCAA 1 hour before exercise. According to the study, creatine kinase (CK) was higher in the group receiving BCAA. But there was no difference between the groups in myoglobin (Mb). It was observed that the group taking BCAA had longer running times. As a result of the study, BCAA could be effective in endurance athletes. Wisnik *et al.*, (2011) studied the effect of BCAA on psychomotor performance with the participation of 10 male professional football players. They applied the protocol of treadmill exercise that simulated a soccer game. Participants were only asked to take 7 g BCAA (2: 2: 1) 1 hour before exercise. It was observed that psychomotor skills were significantly lower (10%) in the BCAA group. BCAA can be used in sports branches that require immediate reactions.

Waldron *et al.*, (2017) examined the effect of BCAA intake before and after exercise (70%, 10 * 6 sets of squats * 3 days) on CK and DOMS. According to the findings, CK and DOMS showed similar increases in both groups. However, the DOMS was found to be significantly higher in the BCAA group at the 24th hour compared to the placebo group. Since the DOMS measurement method is subjective, it can be thought that it is not sufficient to reveal the negative effect of BCAA alone. Areces *et al.*, (2014) studied the effect of 7-day BCAA loading on marathon runners on muscle damage (urine Mb), muscle strength, and DOMS after marathon running. They provided them to take 5 g BCAA (2: 1: 1) for 7 days before the competition. According to the study, there was no difference between the groups in urinary Mb, DOMS, and muscle strength. As a result of this study, BCAA intake may be insufficient in marathon running.

VanDusseldorp *et al.*, (2018) examined the effect of intake of 0.22 g / kg/day BCAA (3:1:1) on physical performance with 20 resistance training athletes. Participants intake BCAA/Placebo two times (morning and evening) for 8 days. 10 repetitions * 8 sets of 70% intensity exercise were performed. According to the findings, similar increases in CK were observed in both groups, while only 48 hours were found to be significantly lower in the BCAA group compared to the control group. DOMS was found to be significantly lower in the BCAA group at 48 and 72 hours compared to the placebo group. BCAA group returned to normal 24 hours after exercise for maximum voluntary muscle strength. It has been found that taking BCAA twice a day will speed recovery in people who exercise resistance. Dorrell & Gee (2016) examined the effect of intake of different amounts of BCAAs (placebo, 6 and 18 g) on physical performance before and after exercise with 5 resistance training athletes. Both groups (6g and 18g) who received BCAA performed better than the placebo group.

Also, they found that both groups scored also less DOMS. They reported that BCAA intake prevented the decrease in performance and reduced DOMS. Coombes & McNaughton (2000) studied the effect of pre-post exercise BCAA intake with 16 sedentary participants, with exercise performed in a bicycle ergometer at 70% intensity. CK and lactate dehydrogenase levels were significantly higher in the placebo group on days 1, 3, and 5. Gee & Deniel (2016) investigated the effect of BCAA (2: 1: 1) on physical performance (jumping and throwing) and DOMS with 11 resistance training athletes. In the study, the participants were allowed to consume 20 g BCAA in two separate times, 5 minutes before (10 g) and 5 minutes after (10 g) exercise (80%/4 sets/8 repetitions). It was observed that DOMS increased in both groups. Also, the BCAA group showed better physical performance at 24 hours. As a result of the study, they suggested that BCAA intake just before and after exercise would shorten the recovery time.

It is seen that different results were obtained in these studies examined. These differences are thought to result from the methodological differences used in the studies. Differences in the physical capacity of the participants (sedentary, elite), the rate of muscle damage due to the selected exercise protocol (70%, 80%, 100%), the muscle damage marker analyzed (CK, lactate dehydrogenase, Mb), whether or not to follow up nutrition, differences such as the time and amount of BCAA intake may affect study findings.

In conclusion, although there was a significant difference in DOMS and speed in time, there was no significant difference in trial and trial * time interaction. Also, there was no difference in the vertical jump in trials, time, and trial * time interaction. In conclusion, DOMS and physical fatigue occurred in both BCAA and placebo groups via exercise protocol, and thus, physical performance changed over time in this study. It has been determined that BCAA (2:1:1) taken acutely before and after exercise in athletes did not affect physical performance and recovery. It was thought that athletes, who take an average of 3 g of leucine in their daily diet, do not need to take BCAA as ergogenic aids.

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