Effect of Branched-Chain Amino Acids and Ginseng-Creatine supplementation on delayed onset muscle soreness and muscle damage in volleyball players

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Abstract

The objective of this study was to investigate the impact of BCAA and ginseng-creatine supplementation on serum indices of muscle damage and soreness in volleyball players. Eighteen male volleyball players (age: 20.5±1.5 yr) participated as subjects in this study. Subjects were randomly divided into three groups (N= 6 per group), branched chain amino acid (BCAA), Ginseng-Creatine (GCR) and placebo control (PLCB). All subjects performed lower- body resistance exercise (6 sets, 10 repetitions, 75% 1RM). The BCAA was given at doses 4 g/3 times day, GCR: Creatine 0.33/kg/body weight/3 times day Ginseng 1.5 g/3 times day (Optimum Nutrition Company) in addition to this amount 250 ml apple juice. Placebo (PLA): 250 ml apple juice 3 times/day. 60 minutes before and after exercise tests Blood samples were collected 30 min prior to exercise, 24 and 48 hrs post exercise to measure CK, LDH and muscle soreness. Results revealed that baseline serum values for CK, LDH and baseline muscle soreness were not different between groups in the 30 minutes before the exercise test (p>0/05). However, Muscle soreness significantly increased above baseline in all groups at all-time points. There were significant increases between the pre-exercise and post-exercise values for the placebo group, means LDH levels from 24 hrs, but there were no significant differences between two groups (p< 0.05). In conclusion, the current results showed that BCAA and GCR reduced muscle breakdown, preserved muscle in athletes and decreased delayed onset muscle soreness in Volleyball players.

Key words:

Branch-chain amino acid, creatine volleyball, muscle damage, muscle soreness.

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Introduction

The competitiveness of sports has dictated that the athletes become faster, stronger, and bigger to keep up with the demands of their sport. The Nutritional Supplement is one such area that has been shown to decrease fatigue in athletes. Various sports such as volleyball use this as to Delayed-Onset Muscle Soreness (Phyllis, 2006).

Volleyball players are required to compete weekly, leaving limited time for full recovery before the next training session or competitive event. One potential limiting factor after a competitive match is muscle soreness and damage, with the resultant skeletal muscle stiffness, swelling, reduced range of movement, muscle fatigue and loss of strength, all contributing to performance decrements.

Unaccustomed exercise causes muscle damage. The sensation of muscle damage is often referred to as delayed onset muscle soreness (DOMS). DOMS usually begins within 24 hours and peaks within 48 hours after exercise. The severity of DOMS depends upon many factors, perhaps most prominently on exercise intensity, type and the training level of the individual (Evans 1991).

Several studies have previously investigated the effectiveness of oral branched chain amino cid (BCAA) (valine, isoleucine, leucine) administration on the DOMS. Shimomura et al. (2006, 2010) reported that BCAA supplementation prior to squat exercise in human decreased DOMS occurring for a few days after exercise On the other hand, Jackman et al. (2010) could not find significant differences on DOMS between placebo and BCAA supplementations during recovery from higher intense ECC induced by repetition knee extension.

Some studies have reported that creatine monohydrate is an anabolic compound via its effects on decreasing muscle protein breakdown and/or increasing intracellular water levels (elbattawy, 2007: Parise et al. 2001). Creatine, when supplemented for short-time periods, improved performance

during repeated bouts of high intensity exercise (Kreider, 2003). Creatine is not the only dietary supplement that may provide ergogenic and health benefits. Ginseng (Korean ginseng) has been shown to have similar properties under certain circumstances. (Michael et al. 2006) noted an increase in pectoral strength, quadriceps strength, and post-exercise recovery following dietary supplementation with ginseng root powder. (Phyllis et al, 2006) found that many supplement manufacturers add ginseng to combination products, because ginseng is beneficial for fatigue. Creatine and ginseng both components are important to recovery. Therefore, The purpose of this study was to compare the effects of branched chain amino acid and a combination of ginseng-creatine monohydrate on delayed onset muscle soreness and muscle damage for volleyball players.

Definition of Terms

1. Muscle soreness - the discomfort often felt after exercise that generally subsides within 2 to 3 days. (Matthew, 2008)
2. Muscle damage - muscle injury in humans that frequently occurs after unaccustomed exercise, particularly if the exercise involves a large amount of eccentric contractions. These minute tears induce release of muscle proteins into the blood, inflammation, DOMS, muscle spasms, and force loss. (Matthew, 2008)

Table (1)

Indication differences between upper and lower quartile to calculate validity coefficient

Tests	upper quartile		lower quartile		Paired Differences	T test
	Means	SD (±)	Means	SD (±)		
Squat Strength Testing (exersice)	53.10	7.26	40.60	11.50	12.50	6.31*
muscle soreness	1.30	0.48	3.10	1.41	-1.80	-4.90*

Level 0.05 = 1.729 (N=20)

Table (2)
The correlation coefficient between the first and second application for tests to find the reliability coefficient

Tests	upper quartile		lower quartile		T test
	Means	SD (±)	Means	SD (±)	
Squat Strength Testing (exersice)	51.70	8.08	52.50	6.94	6.48*
muscle soreness	1.30	0.48	1.40	0.67	7.16*

Level 0.05 = 0.444 (N=20)

Methods Participants

Eighteen men volleyball players (media Club) (age, 20.44±1.46 years; weight, 79.47±9.21 kg; height, 187.31±5.40 cm) without any musculoskeletal disorders and regular resistance training were recruited. Subjects were randomly and equally divided into three groups (N= 6 per group), branched chain amino acid (BCAA), Ginseng-Creatine (GCR) and placebo control (PLCB). There were no statistical differences in all physical characteristic parameters (age, height, body weight, body fat, muscle soreness, strength squat test) between the groups before experiment. Participants were asked to continue normal activity and eating routines during the course of the study. Participants were also asked to notify the researcher if they changed their intake of any medications or dietary supplements, including vitamin and mineral supplements.

Table (3)
Pre Measurement by Kruskal-Wallis test between the three groups

Variables	Groups	Mean Rank	Chi-Square	Sig
Height	BCAA Group	9.08	0.06	0.97
	Ginseng -Creatine Group	9.58		
	Placebo Group	9.83		
Weight	BCAA Group	8.17	0.57	0.75
	Ginseng -Creatine Group	10.33		
	Placebo Group	10		
Age	BCAA Group	10.58	0.73	0.69
	Ginseng -Creatine Group	8.08		

Follow Table (3)
Pre Measurement by Kruskal-Wallis test between the three groups

Variables	Groups	Mean Rank	Chi-Square	Sig
	Placebo Group	9.83		
Age Training	BCAA Group	10.5	0.46	0.79
	Ginseng -Creatine Group	8.5		
	Placebo Group	9.5		
Fat%	BCAA Group	8.5	0.33	0.85
	Ginseng -Creatine Group	9.83		
	Placebo Group	10.17		
Total calories	BCAA Group	8.5	0.32	0.84
	Ginseng -Creatine Group	10.17		
	Placebo Group	9.83		
Creatine Kinase	BCAA Group	9.17	2.33	0.31
	Ginseng -Creatine Group	12		
	Placebo Group	7.33		
Lactate Dehydrogenase	Placebo Group	10.33	0.58	0.75
	BCAA Group	10		
	Ginseng -Creatine Group	8.17		
Squat Strength Testing	BCAA Group	12.67	4.86	0.09
	Ginseng -Creatine Group	9.92		
	Placebo Group	5.92		
muscle soreness	BCAA Group	9.5	0.00	1
	Ginseng -Creatine Group	9.5		
	Placebo Group	9.5		

Dietary Analysis

Dietary Analysis One-week (1/8/2014 to 7/8/2014) dietary analysis (excluding supplementation) revealed no differences in energy, protein, fat and carbohydrate intake between groups throughout the study (see Table 1).

Harris and Benedict basal metabolic rate equation: BMR (kcal/day) for men = (13.7516 weight (kg) + 5.0033 height (cm) − 6.7550 age (year) + 66.4730) (Anita Bean (2009))(Jose Antonio et al. (2008)) (Jackman et al. (2010))(Nosaka, K. et al. (2006))(Shimomura et al. 2010)

Nutritional supplements design

branched chain amino acid (BCAA) (50% leucine, 25% isoleucine, 25% valine (Optimum Nutrition Company) for 15 days(8/8/2014 to 25/8/2014). 4 g/3 times day form BCAA in addition to this

amount 250 ml apple juice(Payam et al 2013 ; Jackman et al 2010 ; Coombes et al 2000). (GCR: Creatine 0.33/kg/body weight/3 times day Ginseng 1.5g /3 times day (Optimum Nutrition Company) (Jung et al 2011; Michael, 2006; McNaughton, 1989) in addition to this amount 250 ml apple juice. Placebo (PLA): 250 ml apple juice/3 times/day.

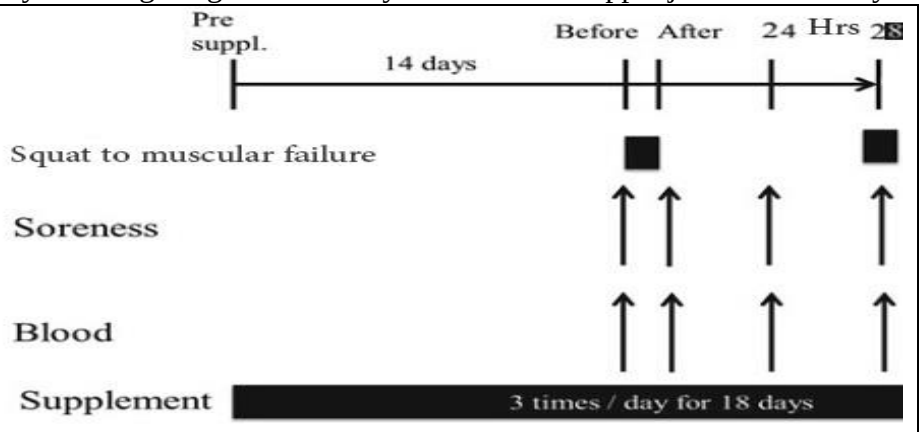

Fig. 1 Schematic illustrating the experimental protocol. Abbreviations: Blood, blood sampling; Measurements: determination of muscle soreness, and Strength squat test.

Exercise Protocol

On the initial day of testing, subjects performed 6 sets of barbell squats to muscular failure using a 75 % of their 1-RM with 3 minutes of rest between sets. In an attempt to identify any difference in recovery between treatment groups, subjects returned to the gym 48 hours after the initial bout and repeated the exercise bout again. Repetitions were counted during both exercise trials and compared between groups. Three groups were supervised by study coordinators during all training sessions. (payam et al, 2013; Matthew, 2008; McHugh, 2003; Paddon-Jones, Muthalib, & Jenkins, 2000).

Measurement of Body composition

Body composition was estimated using Bio-electrical impedance analysis (BIA). Subjects were given up to 4 maximal attempts to achieve 1RM. Rest periods of 3 to 5 minutes were given between trials.

Table (4)
physical characteristic parameters

	BCAA Group			Ginseng Creatine Group			Placebo Group		
	M	**St**	**Sk**	**M**	**St**	**Sk**	**M**	**St**	**Sk**
Height	187	3.22	0.64	188	7.16	0.71	187	6.02	-0.51
Weight	76.9	4.80	-0.59	80.9	10.55	0.96	80.7	11.90	0.25
Age	20.7	1.50	-1.27	20.2	1.72	0.68	20.5	1.38	-1.38
Fat%	14.06	2	-0.54	14.95	3.04	-0.67	15.11	3.19	0.21
Pre-Squat strength test	56.33	18.38	0.97	52.17	15.92	1.12	55.43	14.98	0.17
Total calories	1896.01	66.59	-0.93	1959.76	166.65	0.96	1951.69	182.93	0.07
CHO	260.70	9.16	-0.93	269.47	22.91	0.96	268.35	25.15	0.07
PRO	118.50	4.16	-0.92	122.48	10.41	0.85	121.97	11.44	0.06
FAT	42.13	1.48	-0.93	43.55	3.70	0.84	43.37	4.07	0.85
PRO/g	1.54	0.05	0.85	1.52	0.07	0.85	1.52	0.08	0.85
M: **Mean**		St: **St. deviation**				Sk: **Skewness**			

Measurement of Muscle Soreness

A visual analog scale (VAS)(Appendix1) such as a 7-point Likert scale of muscle soreness is given to the athletes at baseline (prior to exercise) and again at one or more points following exercise (such as 24 and 48 h after exercise). A typical scale may range from 0 (no soreness present) to 6 (a severe pain that limits ability to move).(payam et al, 2013: Matthew, 2008)

Serum Markers of Muscle Damage

Blood sample was collected from an antecubital vein at 4 points; immediately before and after the exercise, and following 3 days before breakfast (Fig.1). Sera were immediately separated after collection, and been kept at deep freezer (-20 C) till analysis. Serum creatine kinase (CK) and lactate dehydrogenase (LDH) were analyzed and used as indicators of muscle damage, as described in the almokhtabar of Clinical Chemistry.

Statistical analysis

All statistical tests were calculated using SPSS version

16 for Windows. The arithmetic mean, standard deviation, percentage and Non-parametric data were analyzed by the Kruskal-Wallis test. An alpha level of 0.05 was used to determine statistical significance.

Results

There were no differences among groups for age, bodyweight, height, percent body fat and Squat strength test (Table 4). Moreover, 9-day analysis revealed no differences in energy, protein, fat and carbohydrate intake between groups throughout the study as shown in table 1.

Muscle Soreness

Regarding muscle soreness, the pre-exercise values were not different among groups. Muscle soreness significantly increased above baseline in all groups at all time points ($p < 0.05$; Fig 2). Peak soreness occurred in all groups at 24 hrs after exercise. Also, the three groups had no effect on soreness scores.

Serum Marker

Means CK levels are presented in Fig3. CK level reached its peak activity 48 hours after exercise with significant differences (132.62 ± 29.77, 166.28±65.91, 475.43±328.04, 563.75±314.89) U/l for the placebo-supplemented group, (181.88 ± 60.08, 200.2±64.47, 262.03±110.67, 259.90±152.44) U/l for the GCR supplement group and (141.98 ± 48.12, 155.57±58.33, 225.57±43.67, 230.48±111.09) U/l (mean ± SE) for the low dose BCAA supplement group). In BCAA and AGCR groups, CK was no significantly elevated at the 24 and 48 hrs.

Means LDH levels are presented in Fig3. LDH level reached its peak activity 24 hours after exercise with significant differences (132.62±28.04, 166.28±67.96, 475.43±85.45, 563.75±166.49) U/l for the placebo-supplemented group, (136.83±20.59, 159.17±33.05, 185.83±79.08, 199.17±81.04) U/l for the GCR supplement group and (142±29.77, 137.33±34.71, 145.17±30.71, 142.17±25.72) U/l (mean ± SE) for the low dose BCAA supplement group). In BCAA and GCR groups, LHD was no significantly elevated at the 24 and 48 hrs.

Table (5)
Non-parametric by Kruskal-Wallis test between the four measurements

Groups	variables	Measurements	Mean Rank	Chi-Square	Sig
BCAA Group	Squat Strength Testing	before the Strength Testing	7.17	0.41	0.52
		48h after the Strength Testing	5.83		
	muscle soreness	before the Strength Testing	3.50	15.401	0.002*
		after the Strength Testing	17.33		
		24h after the Strength Testing	16.92		
		48h after the Strength Testing	12.25		
	Creatine Kinase	before the Strength Testing	7.83	7.327	0.060
		after the Strength Testing	9.67		
		24h after the Strength Testing	17.50		
		48h after the Strength Testing	15		
	Lactate Dehydrog-enase	before the Strength Testing	12.67	0.113	0.990
		after the Strength Testing	12.33		
		24h after the Strength Testing	13.17		
		48h after the Strength Testing	11.83		
GCR Group	Squat Strength Testing	before the Strength Testing	6.42	0.007	0.94
		48h after the Strength Testing	6.58		
	muscle soreness	before the Strength Testing	3.50	15.118	0.002*
		after the Strength Testing	16.25		
		24h after the Strength Testing	17.50		

Follow Table (5)
Non-parametric by Kruskal-Wallis test between the four measurements

Groups	variables	Measurements	Mean Rank	Chi-Square	Sig
		48h after the Strength Testing	12.75		
	Creatine Kinase	before the Strength Testing	9.50	1.967	0.579
		after the Strength Testing	11.83		
		24h after the Strength Testing	14.67		
		48h after the Strength Testing	14		
	Lactate Dehydrog-enase	before the Strength Testing	7.50	5.225	0.156
		after the Strength Testing	12		
		24h after the Strength Testing	14		
		48h after the Strength Testing	16.50		
Placebo Group	Squat Strength Testing	before the Strength Testing	9.08	6.18	0.013*
		48h after the Strength Testing	3.92		
	muscle soreness	before the Strength Testing	4	14.10	0.003*
		after the Strength Testing	14		
		24h after the Strength Testing	18.17		
		48h after the Strength Testing	13.83		
	Creatine Kinase	before the Strength Testing	5.50	13.57	0.004*
		after the Strength Testing	9.33		
		24h after the Strength Testing	16.50		
		48h after the Strength Testing	18.67		
	Lactate Dehydrog-enase	before the Strength Testing	6.33	9.61	0.022*
		after the Strength Testing	11.25		
		24h after the Strength Testing	18.75		
		48h after the Strength Testing	13.67		

Table (6)
Non-parametric by Kruskal-Wallis test between the three groups

variables	Measurements	Groups	Mean Rank	Chi-Square	Sig
Squat Strength Testing	before the Strength Testing	BCAA Group	8.17	1.14	0.57
		Ginseng -Creatine Group	11.33		
		Placebo Group	9		
	48h after the Strength Testing	BCAA Group	11.92	7.79	0.02*
		Creatine & Ginseng Group	12.08		
		Placebo Group	4.58		
muscle soreness	before the Strength Testing	BCAA Group	9.50	0.00	1.000
		Ginseng -Creatine Group	9.50		
		Placebo Group	9.50		
	after the Strength Testing	BCAA Group	11.83	2.301	0.316
		Ginseng -Creatine Group	7.42		
		Placebo Group	10.92		
	24h after the Strength Testing	BCAA Group	8.58	1.267	0.531
		Ginseng -Creatine Group	8		
		Placebo Group	11.92		
	48h after the Strength Testing	BCAA Group	9.92	2.018	0.365
		Ginseng -Creatine Group	12.67		
		Placebo Group	5.92		
Creatine Kinase	before the Strength Testing	BCAA Group	9.17	2.327	0.312
		Ginseng -Creatine Group	12		
		Placebo Group	7.33		
	after the Strength Testing	BCAA Group	8.67	1.064	0.587
		Ginseng -Creatine Group	11.33		
		Placebo Group	8.50		
	24h after the Strength Testing	BCAA Group	8	1.368	0.504
		Ginseng -Creatine Group	9		
		Placebo Group	11.50		

Follow Table (6)
Non-parametric by Kruskal-Wallis test between the three groups

variables	Measurements	Groups	Mean Rank	Chi-Square	Sig
	48h after the Strength Testing	BCAA Group	7.17	4.351	0.114
		Ginseng -Creatine Group	8.17		
		Placebo Group	13.17		
Lactate Dehydrogenase	before the Strength Testing	BCAA Group	10.33	0.575	0.750
		Ginseng -Creatine Group	10		
		Placebo Group	8.17		
	after the Strength Testing	BCAA Group	8.25	0.501	0.778
		Ginseng -Creatine Group	10.25		
		Placebo Group	10		
	24h after the Strength Testing	BCAA Group	5.33	9.715	0.008*
		Creatine & Ginseng Groub	8.42		
		Placebo Group	14.75		
	48h after the Strength Testing	BCAA Group	6.67	2.772	0.250
		Ginseng -Creatine Group	11.67		
		Placebo Group	10.17		

Table (7)
Percentages rates change sequential measurements of pre measuring for variables.

Groups	Measurements	before	after		after 24h		after 48h	
		M	M	%	M	%	M	%
BCAA Group	Squat Strength Testing	56.33	--	--	--	--	50.17	-10.94
	muscle soreness	1	5	400	4.83	383	3.5	250
	Creatine Kinase	141.98	155.57	9.57	225.57	58.87	230.48	62.33
	Lactate Dehydrog-enase	142	137.33	-3.29	145.17	2.23	142.17	0.12
GCR Group	Squat Strength Testing	52.17	--	--	--	--	51	-2.24
	muscle soreness	1	4.17	317	4.33	333	3.33	233
	Creatine Kinase	181.88	200.2	10.07	262.03	44.07	259.9	42.9
	Lactate Dehydrog-enase	136.83	159.17	16.33	185.83	35.81	199.17	45.56
Placebo Group	Squat Strength Testing	55.83	--	--	--	--	30	-46.27
	muscle soreness	1	4.5	350	5.17	417	4.17	317
	Creatine Kinase	132.62	166.28	25.38	475.43	258.49	563.75	325.09
	Lactate Dehydrog-enase	128	171.67	34.12	289.5	126.17	245.17	91.54

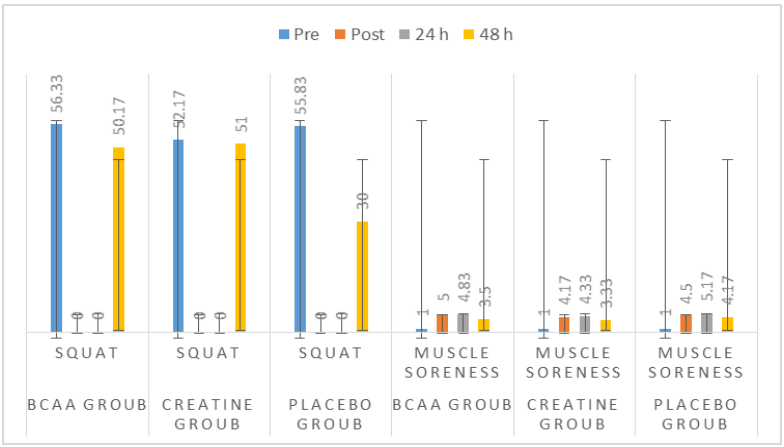

Fig 2. Squat strength test & muscle soreness during 48 hours

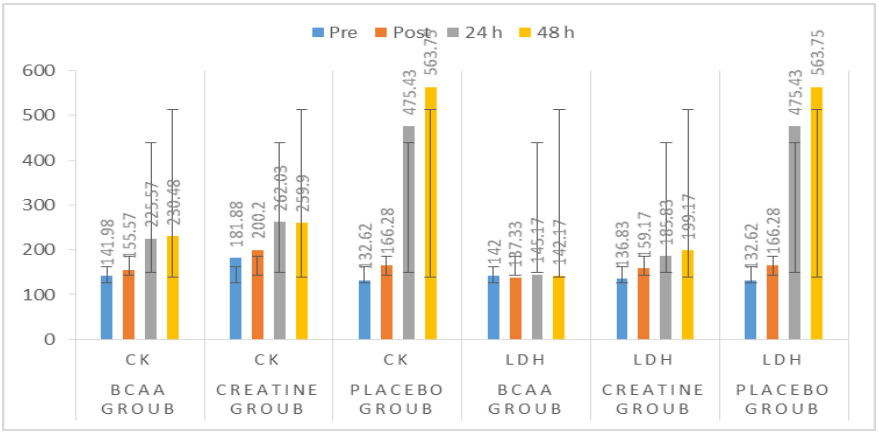

Fig 3. Serum creatine kinase & lactate dehydrogenase concentration during 48 hours

Discussion

The current study showed significant differences among groups in strength test the serum CK, and muscle soreness. Creatine kinase increased at all time among three groups. However, no significant differences were found among groups at any point in time. These data are not in agreement with Coombes et al (2000) and Koba et al (2005, 2007). They reported that BCAA intake before and during exercise reduced indirect markers of muscle damage.

Our findings are also in agreement with Nosaka et al.,

(2006) and Shimomura et al., (2006) who reported that supplementation of 4 g BCAA during and after exercise can reduce muscle breakdown, preserve muscle in athletes and reduce delayed onset muscle soreness.

Possible explanations for differences between our findings and other published data could be attributed to age, exercise protocol and intensity of exercise. Serum creatine kinase (CK) and lactate dehydrogenase (LDH) are indication of the degree of metabolic adaptation to physical training of skeletal muscles. These enzymes are involved in muscle metabolism, and their serum concentration is normally very low. They increase considerably after intensive exercise. Changes in serum activity of muscle enzymes have been reported in normal subjects and athletes after strenuous exercise. The amount of enzyme efflux from muscle tissue to serum can be influenced by physical exercise. These results showed that the use of BCAA didn't reduce serum CK activity 24 and 48 hrs after heavy resistance exercise. Serum CK activity was elevated in all groups after exercise and was highest in the placebo group. It was obvious in BCAA group that the Ck and LDH levels were non-significantly lower than the control one indicating that the muscle soreness is lower (higher muscle fitness). The positive action of BCAA in lowering the muscle soreness could be referred to

- Its compensatory and protective impacts on muscle tissue where valine, leucine and isoleucine (important components of BCAA) are essential amino acids that make up one-third of muscle proteins.
- BCAA supplements prevent the breakdown of muscle tissue during intense exercise. They are converted into two other amino acids – glutamine and alanine – which are released in large quantities during intense aerobic exercise. Also they can be used directly as fuel by the muscles, particularly when muscle glycogen is depleted.

The present results indicated that Strength and lean tissue changes were not significantly different between the GCr and BACC groups. These results are compatible with those results recorded by Attele et al.(1999) who found that multiple components of the

ginseng root could produce their influences via a variety of physiological pathways:

- GCr increases muscle creatine-phosphate content and glycogen content (by up to 40%) and causes rapid rephosphorylation of ADP back to ATP by the CK reaction improving skeletal muscle contraction performance (Jones et al. 2009).
- Increased muscle content of creatine following GCr helps to maintain ATP concentrations during a single maximal effort sprint and enhances the rate of ATP and phosphocreatine re-synthesis following intense exercise (Casey et al. 1996).
- Another possible role of creatine in protection against prolonged exercise induced muscle injury is its antioxidant property. The increased storage of creatine and enhanced ATP and phosphocreatine resynthesis mainly in fast-twitch muscle fibers may explain the lack of CrS effect upon strenuous contractile activity-induced injury in thigh muscle. The greatest creatine uptake rate is observed in the fiber type with the smallest creatine content. During contractile activity, the use of phosphocreatine by fast-twitch muscles can be as much as 33% higher than the use by slow-twitch muscles (Casey and Greenhaff, 2000).

-Ginseng-creatine supplementation may enhance recovery during rest periods following repeated efforts (Elbattawy, 2007; Michael, 2006; Birch et al. 1994).

- In addition to the recovery theory, Bessman and Savabi (1990) have suggested that creatine, via interaction with phosphocreatine, can increase protein synthesis and influence muscle hypertrophy. Others have suggested that creatine supplementation may increase myosin heavy chain synthesis following a strength training with young adult males who ingested creatine throughout the length of the program (Willoughby and Rosene, 2001).

In conclusion, the current results showed that BCAA and GCR reduced muscle breakdown, preserved muscle in athletes and decreased delayed onset muscle soreness in Volleyball players.

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