The Swedish Journal of Scientific Research ISSN: 2001-9211.Vol. 2. Issue 6. June. 2015

THE EVALUATION OF GLUTAMINE AND SODIUM BICARBONATE SUPPLEMENTS INTERACTION EFFECTS ON POWER OF THE HANDBALL ELITE

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Abstract

The purpose of this study is the evaluation of the glutamine and sodium bicarbonate interaction effects on the power and relationship between power and blood lactate under anaerobic condition of the handball elite. In order to evaluate the Glutamines effects on anaerobic power parameters of elite handball players, was tested the Erzurum Aziziye municipality handball team players. Three group included six male players was selected as control, (Glutamine and Sodium bicarbonate) and Glutamine experimental groups. All of the players were undertaking aerobic activity. The Glutamine and sodium bicarbonate collection influenced on the parameters power significantly in compare to the other groups ($P<0.05$). The mean results of the Wingate test for the power of the parameters indicated high positive correlation among the parameters amount increasing. The correlation of the pretest power was more than posttest power as a result of supplements effects on the power increasing.

Keywords: Glutamine, Sodium bicarbonate, Anaerobic, Handball.

1. INTRODUCTION:

Long-term training is associated with physical and physiological changes. Handball also requires players to have well developed physical and physiological capacities. Motor ability, sprinting, jumping, flexibility and throwing velocity represent physical activities that are considered as important aspects of the game and contribute to the high performance of the team. Therefore, handball requires a combination of resistance and endurance training. In this game, many movements are characterized as intermittent and change continuously in (Savucu *et al.,* 2012). Hence one can assume that consumption of supplements that will enhance rapid recovery of energy resources and prevent the disturbance of PH levels may enhance the athlete's performance (Kazemi *et al.,* 2005). Over the past 3 decades, extensive research has investigated the potential of sodium bicarbonate ($NaHCO_3$) ingestion for inducing metabolic alkalosis and enhancing subsequent physical performance (McNaughton *et al.,* 2008). During the past decades, numerous studies have demonstrated that increases in the extracellular buffer concentration, via the oral ingestion of an alkaline solution such as sodium bicarbonate ($NaHCO_3^-$), may enhance human exercise performance (Forbes *et al.,* 2005). Early research reported that $NaHCO_3$ loading was effective for improving the capacity for short term, high-intensity exercise, whereas more recent studies have shown that $NaHCO_3$ also can enhance performance during aerobic endurance and prolonged, inter-mittent high-intensity exercise (Bishop and Claudius, 2005). The performance-enhancing effects of $NaHCO_3$ are associated largely with the degree of metabolic alkalosis. The contemporary viewpoint is that, during high intensity exercise, the increased alkalosis attenuates the rate of increase in free protons (H^+) in the sarcoplasm, thereby reducing the competition on the ionizable binding sites of the actin/myosin complex, as well as delaying sarcoplasmic reticulum dysfunction with regard to Ca^{2+} release and uptake (Allen, 2009). The degree of metabolic alkalosis is altered by the dosage and timing of $NaHCO_3$ ingestion. However, although much research has investigated the types of exercise that are enhanced with NaHCO3 ingestion, to date, there has been limited research on the dosage and timing of $NaHCO_3$ingestion that optimizes metabolic alkalosis and the associated ergogenic effects. This is important because doses between 0.2 and $0.3g.kg^{-1}$ have commonly resulted in equivocal performance findings (Renfree, 2007). The suggested beneficial effects of metabolic alkalosis include an increase in extracellular proton buffer capacity (Street *et al.,* 2005), increased muscle phosphofructokinase, phosphorylase and pyruvate dehydrogenase activities (Hollidge-Horvat *et al.,* 2000), enhanced muscle Lac^- and H^+ release from working muscles and a preservation of membrane excitability during muscle fatigue by its effect on K^+, Na^+ and Cl^- fluxes (Sostaric *et al.,* 2006). Sodium bicarbonate (SB) is one of the buffers that its ingestion has been shown to increase blood pH and carbonate ion (Hco_3^-) concentration (Price and Simons, 2010). Glutamine is the most abundant amino acid in human muscle and plasma, fulfilling numerous cell regulatory roles and acts as a fuel source for intestinal cells and leukocytes (Roth, 2008). Glutamine is the most abundant amino acid in the body. The consumption of glutamine increases under such stresses as exercise and disease. Glutamine has received considerable attention, because decreased plasma glutamine concentration is associated with both immune suppression after intense exercise (Castell and Newsholm, 2001). Therefore glutamine supplementation is recommended for athletes

(Sawaki *et al.,* 2004). Recently, the role of glutamine in immunosuppressive condition is a hot topic. Supplementation of glutamine was reported to reduce the infectious incidents after marathon, but failed to improve the post exercise decreases of lymphocyte function (Novak *et al.,* 2002). Glutamine plays a role in many important biological processes and its availability can be limited during exercise (Carvalho-Peixoto *et al.,* 2007). Glutamine is a metabolic intermediate factor in Crebs cycle, so, by reserve the phosphor creatine (pc) and glycogen in muscle fibers especially in oxidative fibers (type 1), glutamine can increase exercise tolerance (Tsintzas *et al.,* 2001). Due to the clinical evidence of glutamine supplementation, it has been suggested that glutamine has potential utility as a dietary supplement for athletes engaged in heavy exercise training (J-Finn *et al.,* 2003). One current widely used supplement is L-glutamine, which increases protein synthesis within skeletal muscle leading to enhanced muscle growth. By increasing muscle mass, the contractile force of a muscle can be increased. The mechanism used to describe the contraction of skeletal muscle is called the sliding filament mechanism. A muscle contracts because myofibrils within the muscle fibers slide in the opposite directions of one another. An increase in muscle growth allows more myofibrils to be activated, which increases force of contraction (Waddell and Fredricks, 2005). Glutamine supplementation stimulates an increase in protein synthesis in the muscle, improves glycogen re-synthesis and can lead to an improvement in performance (Favano *et al.,* 2008). Glutamine has also been shown to enhance fluid and electrolyte absorption in both animal and human models (Lima *et al.,* 2002). During times of severe stress, especially in catabolic states, glutamine requirements are dramatically increased. These stresses can be in the form of prolonged starvation, sepsis, and long duration physical activity. When endogenous stores are unable to meet requirements, skeletal muscle becomes the source of glutamine through muscle catabolism (Santos *et al.,* 2007). More studies indicated the sample effects of glutamine and sodium bicarbonate on the power of the players but the studies about their interaction effects are a few. The purpose of this study is the evaluation of the glutamine and sodium bicarbonate interaction effects on the power and relationship between power and blood lactate under anaerobic condition of the handball elite.

Materials and Methods:

In order to evaluate the Glutamines effects on anaerobic power parameters of elite handball players, was tested the Erzurum Aziziye municipality handball team players. After obtaining the ethical approval before testing was taken the players signs about the consent forms for all athletes. Three group that included six male players was selected as control, (Glutamine and Sodium bicarbonate) and Glutamine experimental groups. The control group was without any treatment, glutamine and Sodium bicarbonate group included 0.3g kg-1 body per day and 0.3g kg-1 body dose of Glutamine and Sodium bicarbonate, respectively and Sodium bicarbonate group included 0.3g kg-1 body dose of $NaHCO_3$. All of the players were undertaking aerobic activity, but none was participating in anaerobic type activity. The physical characteristics of each group of players are described in Table 1. All of the testing took place in the sport and physical education faculty laboratory at the Ataturk university. All the tests being separated together by at least 2 days but no longer than 6 days. After 6 weeks, was measured the anaerobic power and the linked parameter of athletes of the groups such as blood lactate. Immediately after collection of the blood samples, they were analyzed. The samples were also analysed for blood lactate (BLa). The data were analyzed and compared. Subjects reported to the Human Performance Laboratory on three separate occasions. The first testing group was under control condition (Pre test) and without any treatments, the second group was under Glutamine treatment and the third group was under Glutamine and Sodium bicarbonate treatment. After 6 weeks all testing sessions occurred at the same time of day (Post test). Subjects were required to arrive at the laboratory in the early morning following an overnight fast for blood draws. All blood draws occurred at the same time of day for each testing session. Each blood sample was obtained from an antecubital arm vein using a 20-gauge disposable needle equipped with a Vacutainer® tube holder (Becton Dickinson, Franklin Lakes, NJ) with the subject in a seated position. Blood samples were collected into a Vacutainer® tube containing SST® Gel and Clot Activator. Serum was allowed to clot at room temperature and subsequently centrifuged at 1,500 x g for 15 minutes. The resulting serum was placed into separate 1.8-ml micro-centrifuge tubes and frozen at -80°C for later analyses. To quantify anaerobic power performance all subjects performed the Wingate anaerobic power test (Lode Excalibur, Groningen, The Netherlands). Following a warm-up period of 5-min pedaling at 60 rpm interspersed with three all-out sprints lasting 5 s, the subjects pedaled for 30 s at maximal speed against a constant torque (1.2 Nm·body mass). Statistical evaluation of the data was accomplished by a 3 (group) x 2 (time) x 2 repeated measures analysis of variance. A criterion alpha level of $p \leq 0.05$ was used to determine statistical significance. All data are reported as mean ± SD.

Table 1. Mean (±S.D.) physical characteristics of the Player groups (n = 18)

Group	Age	Height	Body mass (kg^{-1})	VO_2max ($1min^{-1}$)
Control	20.1±4.5	180.4±4.7	77.3±2.8	5.30±0.4
Glu+SB	20.8±0.9	182.1±3.6	77.7±4.2	5.26±0.5
Glu	21.1±1.1	183.5±4.4	78.3±4.1	5.18±0.6

Glu: Glutamine, SB: Sodium bicarbonate

2. RESULTS:

The mean comparison results between the three groups (control, Glu and Glu+SB) for the studied parameters indicated the significant differences and the most amount of each parameter belonged to the (Glu+SB) group and the less amounts related to the control. Also for the each group the most amounts belong to the leg and left paw had the less amounts. The Glutamine and sodium bicarbonate collection influenced on the parameters power significantly in compare to the other groups ($P<0.05$) (Table 2). The mean results of the Wingate test for the power of the parameters indicated high positive correlation among the parameters amount increasing. The correlation of the pre test power was more than post test power as a result of supplements (Glutamine and Sodium bicarbonate) effects on the power increasing. So the increased value of power for the post test had the significant difference. Also the most power included to the leg and the less value of power belonged to the left paw under both pre and post test in Wingate test. Because of the lactate acid accumulation in the leg during performance, the most effects of the supplements was on the leg in compare to the other studied parts (Fig. 1). Under post test condition, the most value of blood pH included to the Glutamine and Sodium bicarbonate group and it was 7.106+0.002 and the less value was belonged to the Glutamine group by 6.98+0.002 amount and in compare to the control group that was under pre test condition, the Glutamine group pH was less and control group pH amount was 7.101+0.002. So, among the pH of three group there was significant difference ($P<0.05$). The Glutamine and Sodium bicarbonate collection had the most effect on the blood pH and increased it. The blood lactate (BLa) levels are shown for the three experimental groups in Figs 2. The blood lactate concentration in the control was low and in the Glutamine group was high. There were significant differences between blood lactate levels under per test and post test, especially between Glutamine and collected of Glutamine and Sodium bicarbonate group under post test condition ($P<0.05$). The results showed that Sodium bicarbonate can improve the Glutamine increasing effects on the blood lactate and modified the Glutamine effects.

Table 2. Mean (± S.D.) of anaerobic power of parameters for the three groups during the test session (n=18)

Groups		Power			
		Left paw	Right paw	Back	Leg
Pre test	Control	1160±110 b	1161±110 c	1163±121 c	1164±120 c
Post tes	Glu	1166±111 a	1166±112 b	1170±121 b	1171±121 b
	Glu+SB	1167±111 a	1168±114 a	1171±123 a	1173±124 a

Mean with the same letters in each column does not have significant difference at the 5% probability level to according to the value of LSD.

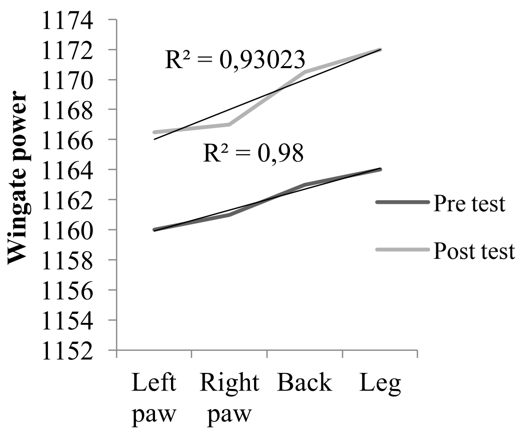

Fig. 1. Relationship between the mean values of power attained during the Wingate tests for control (Pretest), Glutamine and Glutamine+ sodium bicarbonate (Posttest)

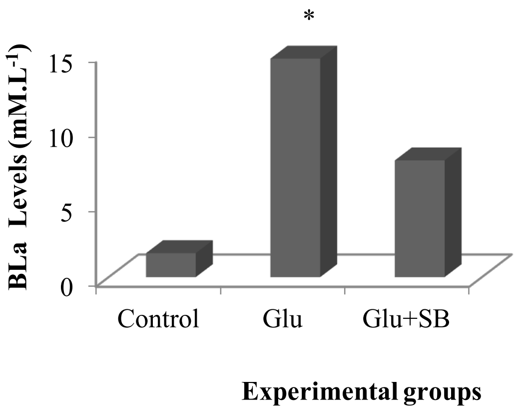

Fig.2. Blood lactate levels three experimental groups. *Significantly greater than the other groups (P<0.05).

3. DISCUSSION:

The results of this study indicate that $NaHCO_3$ given as a 0.3 g kg^{-1} dose to exercise duration, can significantly increase the amount of anaerobic power achievable by athletes and can intensity effects with Glutamine on the power. This study is similar to several others. Researchers observed significant increases in Wingate test mean power subsequent to bicarbonate loading (Douroudos *et al.,* 2006). They suggested, the improvement in performance depends on the doses used, as just the greater amount of $NaHCO_3^-$ was be clearly effective. On the contrary, one of the principal mechanisms proposed to explain why the induced blood alkalosis may enhance exercise performance is an improved H^+ efflux out of the muscle cell, thereby limiting the effects of the decreased pH (Raymer *et al.,* 2004; Requena *et al.,* 2005), especially in the face of increasing metabolic demand (Raymer *et al.,* 2004). It is known that the fatiguing effects of a declining pHi during exercise include allosteric inhibition of the rate-limiting enzymes phosphor fructo kinase and glycogen phosphorylase, decreased release of Ca^{2+} from the sarcoplasmatic reticulum, and a reduction in the number and force of muscle cross-bridge activations (Linderman and Fahey, 1991). An increase in the amount of extracellular bicarbonate potentially facilitates an efflux of H^+ ions from the cell, thus maintaining the pH level in the sarcoplasm and hence maintaining optimal functioning. During exercise periods of longer duration, higher lactate levels were found in the experimental trials than in either the control (McNaughton, 1992). It has been reported that lactate concentration increased after SB administration (McNaughton *et al.,* 1999). Most of these studies justified this increase in lactate concentration to simultaneous increase in speed, duration and power of subject's performance. The results suggest that chronically supplemented Gln protects against exercise-induced hyper ammonemia depending on exercise intensity and supplementation duration (Bassini-Cameron *et al.,* 2008).

Conclusion

In conclusion, the results of this investigation confirm previous studies that have demonstrated combined Glutamine and Sodium bicarbonate may increase anaerobic power of players and it has significant effect on blood lactate concentration especially when it use with the Glutamine, it can modify the Glutamine increasing effects on the blood lactate. The main applied finding of our study was the improved anaerobic power under Glutamine and Sodium bicarbonate consumption together. Glutamine as a result of its amino acidic property caused to increase the blood lactate in this study, although results showed the positive effects of the Glutamine on the blood lactate in the other researches. However, results showed more study on the Glutamine dose to evaluate its effects on the blood lactate. Also various test time is essential for this study.

Practical applications:

Consumption of Glu and Sb supplementation improved the anaerobic power players and had a significant effect on blood lactate concentration decreasing. This supplement complication was used for the first time and in pervious researches this complication has used rare by the researchers. By using of the Glutamine the study showed the different results about the blood lactate.

Acknowledgment

Research was supported by Erzurum Aziziye municipality of Turkey. The authors wish to thank the subjects for their participation in this study.

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