### Effect of bicarbonate sodium supplement on skaters' performance

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Abstract: Bicarbonate is the body's most important extracellular buffer. Bicarbonate loading increases the muscle's extracellular buffering capacity and ability to dispose of excess hydrogen ions produced through anaerobic glycolises. The aim of this study was to determine the effect of sodium bicarbonate supplement on skaters' performance in young men. Sixteen skate players in the current study were selected and divided randomly into two groups: sodium bicarbonate (SB) and placebo (P).subject in the SB group orally ingested gelatin capsules that contained sodium bicarbonate at a dose of 300 mg·kg-1 b. w while subject in P group ingested the same osmolar dose of cellulose 60min before 50om speed trial . Blood samples were obtained before and one hour after consuming supplementation and two min after the 500m skate trial. Blood pH, lactate, standard bicarbonate (SBC) and performance of skaters were measured. The subjects were fast for 12-14h. Results indicated that there were statistically significant difference in Blood lactate and pH at the post exercise state between the placebo and sodium bicarbonate (p<0.05) and the result also showed there were statistically significant changes in average skating speed (p<0.05). These data demonstrate that pre-exercise administration of NaHCO3 improves performance, possibly by facilitating the efflux of hydrogen ions from working muscles and thereby delaying the fatigue at sprint performance.

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### 1. Introduction

Energy foods are used in order to improve sport beyond a balanced dietary. In most of sports such as intense anaerobic exercise, short term or strengthen long term sports, body strength against exhausting is an important aspect. Athletes who get exhausted in short time cannot act as well as who get exhausted in long time. Therefore sport coaches and athletes seeking a way to improve their function and avoid increased exhausting. Most athletes especially skaters use drugs or materials that they claim these drugs or materials have energetic features and avoid exhausting (MacArdel, 2009). During last decade sodium bicarbonate has been common for avoiding fatigue during intense short term sports such as swimming, speed running and weightlifting and it is claimed that this matter improve function by neutralizing produced acids through training (Adam et al., 2009). Among many types of skate sport, 500m skate is sprint and anaerobic activity which well over 45 seconds needed for its finishing and it is said that in this type of sport and other powerful and strengthening activities, anaerobic glycolysis is the main energy source for muscle contraction that capacity of this system is limited as well as acidity of

muscles increased and leads to gathering hydrogen ion inside muscles (MacArdel, 2009; Nielsen, 2003). Blood acidity increase avoids energy transfer and muscle contraction and enforce athlete to reduce intensity of his training (Kalis, 1998; Yunoki, 2000; Zoladz, 2005). There are reasons that using sodium bicarbonate before sport activities beside sever muscle contractions can reduce gathering H+ in skeletal muscle, blood and tissue water and delay exhausting (MacArdel, 2009; Wasserman, 1973; Shave et al., 2001). Benefits of using sodium bicarbonate in anaerobic activities that are 60-240 seconds and ergogenic benefits of using sodium bicarbonate in strengthening and sprint activates can be seen in professional athletes (McNaughton et al., 1992). More studies are done about different times and doses of using sodium bicarbonate in many sport protocols and its ergogenic effects on speed running and semi strengthening, rower, swimming, cycling are studied that function improving of athletes are reported (McNaughton et al., 1992). Nielsen et al. (2002) in studying reducing blood saturation by sodium bicarbonate in maximum training resulted that amount of acidosis is decreased after sodium bicarbonate injection by increase of blood buffering and result in blood saturation of artery in maximum practice in return (Nielsen, 2002). In a study Fred et al. (2004) studied effect of using sodium bicarbonate on VO<sub>2</sub> kinetics in heavy exercise. Survey samples include 20 athletes that are divided into 2 control and experiment groups. Subjects' training in different days by ergometer in two 6 minutes and consumed 0.3 gram sodium bicarbonate per kilogram weight of body 1 hour before training. Using sodium bicarbonate increase PH significantly in blood before training in complementary group than control group (7.42, 7.51), by increase of blood PH, local flow of blood decreased and directed hemoglobin oxygen to active muscles that have low oxygen. Experiment results showed that oxygen diffusion is a factor during heavy training (Fred et al., 2004). Most of researchers have studied sodium bicarbonate in different doses from 100- 500 mg per each kilogram of body weight and said that sodium bicarbonate complement with doses less than 200mg per each kilogram of body weight change blood bicarbonate but don't improve athlete function and doses more than 300 mg per each kilogram of body weight can't increase alkaloses, then most of researchers propose that sodium bicarbonate usable solution with a dose of 300 mg per each kilogram of body weight is better for improving body weight (Yunoki, 2000). Sodium bicarbonate using time before resistance sport activity from 30-150 minutes is different and may be effect on Alkaloses amount before sport activity. There are other studies that have not seen effect of sodium bicarbonate consumption in improving athletes. In this case Putteiger et al. (1996) considered amount of used sodium bicarbonate in speedy running. Subjects include 9 persons of cyclers that consumed 0.10 gram sodium bicarbonate and 0.20 gram bicarbonate per each kilogram of body weight 1 hour before each test randomly. Practices program include 4 two minute time that done separately. Vein blood samples were gathered before training and in 3, 5, 10, 11 minutes after two minutes sprint training. Results showed that increase of bicarbonate 0/2gr/kg increase using blood bicarbonate but don't improve function of 2 minutes sprint training (Potteiger, 1996). According to some contradictions in researches and because of lack of resemble study on skaters in inside and outside of country, researcher implement this study.

# 2.Methods

# 2.1. Subjects

16 healthy 20-24 years old boy skaters will be selected as subjects. Firstly they were announced in different parts of Tabriz sport administrations and presence of researcher in skate mission, coaches and athletes. After announcing readiness and arbitrary participation of skaters, their health and satisfaction were studied by questionnaire completion and 16 skaters among 27 skaters were selected after confirming their health and readiness in order to cooperate with present study and after harmonization through questionnaire and based on their readiness. Then they were equally and randomly divided into two bicarbonate and placebo groups and were ready based on scheduled program in skate mission and implemented 500 m skate trial in a similar time. Subjects' selection parameter was their cardiovascular health, lack of diabetes, having skate training, lack of cigarette using and alcohol and all of stages of work, hardness and probable complications for subjects were explained.

### 2.2. Blood samples and measuring variables

5cc blood was obtained each time from elbow vein: 1. before complementary consumption, 1.5 hour after complementary consumption and 3.two minutes after 500m skate trial. Blood samples were poured in tubes including heparin and were sent to laboratory for analyzing. In order to measure blood parameters, enzymatic method were used.

# 2.3. Analytical approach

Firstly after natural assuring of measuring data by using K-S test, data related to any factors of sodium bicarbonate, lactate and blood PH were compared, in three stages including resting, lhour after complementary using and two minutes after finishing 500m skate trial, using repeated measuring test and if there is difference, LSD test in order to further analyze. Additionally, 500m skate test were compared in two groups using independent T test.

# 3. Results

The results are shown by Figure 1-4.

# 4. Discussion

Complementary consumption of soda causes significant increase of blood bicarbonate toward the relaxing state, but it is return to its relaxing amounts after 500 m skate. However, in placebo consumption step, after 500 m skating, blood bicarbonate levels were less than relaxing levels. These foundations may express ergogenic effect due to generating metabolic alkalosis, which may be helpful to improve the application levels by increasing buffering resources. Alkalosis reduction as compared with placebo, avoids the reduction of blood bicarbonate content to less than relaxing levels during extreme exercise. And this case can be appeared in rapid and simpler recovery. This foundation corresponds well with result of last surveys (MacArdel, 2009; MacArdel, 2009; Shave, 2001; Nielsen, 2002; Fred,

2004; Sostaric, 2006). Other results of this survey are like this, there is no difference in relaxing lactate levels pursuant the bicarbonate consumption. Two transitional proteins of band3 and MCT-1, are involved in lactate displacement and acid-base equilibrium establishment in two sides of erythrosine membrane, that are responsible for 5 to 10 and 80 to 90 percent of lactate displacement respectively (Connes, 2004). By the effect of alkalosis, lactate existence amount from active muscle (Hood et al., 1988), but in a survey, increase of lactate blood stream from muscle to blood was observed without any change in lactate accumulation grade. It is suggested that increase of lactate transfer by the effect of increasing ion grade is due to alkalosis induction (Hood et al., 1998; Messonnier et al., 2007). So, by considering that relaxing lactate levels are constant except in pathologic conditions, lack of change in relaxing lactate amount is logical. There is also significant increase in blood lactate levels after doing 500 m skate. However alkalosis couldn't affect the amount of lactate existence to blood, this result is compatible with Cameron et al. (2010) and price et al. (2010) (Price & Simons, 2010; Cameron, 2010).



**Figure 1:** plasma bicarbonate levels diagram in each stage during three times of measurement. \*: Significant difference to pre-experiment and\*\*: Significant difference to post-experiment (P<0.05).



**Figure 2.** Plasma lactate levels in each stage during three times of measurement.\*: Significant difference to post-activity (P<0.05).



Figure 3. Blood PH level diagram during three times of measurement.\*: Significant difference to post-complementary (P<0.05).



Figure 4. 500 m skate test time in each stage.\*Significant difference to bicarbonate stage (P<0.05)

It is imagined that, in the first minutes after exercise, stream H+ existence from muscle to blood, involves more speed than lactate, (Ball & Maughan, 1997) and also it is observed about human that, speed of hydrogen ion stream is more than lactate (Bangsbo et al., 1993). Furthermore, lactate and hydrogen ion absorption by inactive muscles affect the amount of their existence from active muscles. (Bangsbo et al., 1995) There are reports that lactate stream in the direction of extra cellular liquids, are independent of acid and alkalosis conditions in among tissues water, and are usually constant(Ball & Maughan, 1997). So this case could be helpful to justify the lack of difference among groups in blood lactate levels after 500m skate performance.

Also the results demonstrate that blood PH has been decreased in two steps of alkalosis, placebo. But this reduction was significant during placebo step. In another words, alkalosis could modify the blood PH reduction after extreme anaerobic activity. Inducing metabolic alkalosis causes insignificant increase of relaxing PH and controls the anaerobic glycolic that may causes the increase of involving speed of oxidative phosphrylation in the beginning of activity (Ball & Maughan, 1997). Proton and lactate production during maximum exercise is higher than buffer and metabolic capacity of inside the muscle and its rejection in out of call. So, PH can be decreased up to 6/4 in muscle, and 6/9 in blood (Messonnier et al., 2007). Maybe in this survey, PH and lactate variations don't have the same pattern due high cooperation of glycolic in producing energy of 500m skate. In the last part of result of this survey, skate performance in 500 m skate test is better than placebo consumption step. In this direction, there are a lot of evidences which prove that alkalosis can improve the intense short time activity (Adam et al., 2009; MacArdel, 2009; McNaughton & Cedaro, 1992; Messonnier et al., 2007). Finally, it is concluded that, inducing metabolic alkalosis can has positive effect on short time work out application, and also be helpful to reduce recovery time and to improve extreme exercise ability.

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