

# Effect of various kinds of beverages on stress oxidative, F<sub>2</sub> isoprostane, serum lipid and blood glucose of elite taekwondo players

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## ABSTRACT

**Background:** Athletes' recovery is important in improving their performance. Nutritional strategies can be effective in enhancing recovery rate. Choosing the best food items in appropriate intervals can play effective roles in resynthesis of fuels and recovery of muscle injury. Beverage micro and macronutrient content are helpful in fuel restoration. In this study, we assess the effects of various kinds of beverages on oxidative stress, muscle injury, and metabolic risk factors in taekwondo players.

**Materials and Methods:** This quasi-experimental study was performed on 21 taekwondo players of Isfahan. After collecting fasting blood, they performed runningbased anaerobic sprint test (RAST). Blood lactate was tested again and participants were divided into 3 intervention groups, that is, receiving 500 cc dough, non-alcoholic beer, and chocolate milk at 4 day intervals. After a 2-h recovery period, blood sampling was repeated. Elites consumed other beverages in later phases. Dietary intake and fasting triglyceride, cholesterol, blood sugar, lactate dehydrogenase, and F<sub>2</sub>-isoprostane concentrations were determined. Data were analyzed with a simple repeated-measures test and post-hoc tests using the Statistical Package for the Social Sciences software.

**Results:** Data showed that cholesterol levels non-significantly decreased after intervention. Triglyceride level was lower after taking dough and carbohydrate replacement drink. Blood glucose concentration increased after intervention periods, however, this increase was significant only after non-alcoholic beverage consumption. Lactate dehydrogenase levels reduced after all cycles, however, F<sub>2</sub>-isoprostane level showed no significant change. There was not significant change in lactate dehydrogenase and F<sub>2</sub>-isoprostane levels.

**Conclusions:** Non-alcoholic beer consumption can reduce lactate dehydrogenase concentration; however, it leads to blood sugar increase. Moreover, dough consumption significantly reduced triglyceride level in taekwondo players.

**Key words:** Athletic performance, beverages, F<sub>2</sub>-isoprostanes, oxidative stress

## INTRODUCTION

Recovery plays a critical role in improving athletes' performance. Limited rest time, high intensity, and competition rate of strenuous sports emphasize on the

necessity of following the most suitable approach to manage the functional overload of professional athletes.<sup>[1]</sup> A proper nutritional strategy is helpful in order to achieve proper recovery, with multiple competing periods and several times per day. The content and time of nutrient consumption impact the resynthesis of fuel supply, reduction of muscle injury, and optimizing the competition performance.<sup>[2]</sup>

One of the most rapid repletion methods is drinking supplement beverages. Fluid supplements are preferable to solid products. Liquids are more tolerable in suppressed appetite of instant post-exercise period and they help in

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cell rehydration and substituting lost electrolytes due to sweating.<sup>[3]</sup> Beverage micro and macronutrient content and their utilization, during or post-exercise period, are effective in fuel restoration. Studies reflect that the consumption of carbohydrate-protein beverages during post-exercise recovery periods can facilitate glycogen restore and muscle turnover speed.<sup>[4]</sup>

Chocolate milk composition is similar to common sports drinks, and it can enhance blood sugar level, speed of muscle glycogen repletion, and protein turnover. Its branched chain amino acids, carbohydrates, electrolytes, and easily absorbed casein and whey protein help athletes' muscle stores.<sup>[5]</sup>

Dough or Persian salty yogurt drink with a consistency similar to milk which contains high amount of whey protein and critical electrolytes such as sodium and calcium can affect athletes' performance. Moreover, non-alcoholic beer as a source of carbohydrate, minerals, and vitamins is a popular and available supplement fluid.<sup>[6]</sup> Choosing the most proper recovery beverage can be useful for nursing and medical members of sports medicine to guide athletes. In the present study, we compared the effects of dough, non-alcoholic beer, and carbohydrate replacement drink on lactate dehydrogenase enzyme level, F<sub>2</sub>-isoprostane, lipid, and glucose blood level.

## MATERIALS AND METHODS

This quasi-experimental study was performed on 21 elite taekwondo players. Written informed consents were obtained from all the participants. Athletes followed their regular physical activity and dietary patterns. The professionals were asked to stop their exercises for 24 hours before initiation of the intervention program. They were also asked to note their food intake in one-day "food recall" questionnaires.

Five milliliter venous blood was collected, and after 10-min warming up exercises, athletes followed standard protocol of running-based anaerobic sprint test (RAST). Blood lactate was tested after running the protocol and 1-h post-RAST by a calibrated lactometer (Scout Company, Germany).

Athletes at a 4 day interval, received 500 cc isocaloric beverages as dough, non-alcoholic beer, and chocolate milk. After taking the first beverage, they spent a 2-h recovery period. Then, the participants' venous blood was taken; the other two beverages were consumed following the same guidelines. In other words, 21 participants who enrolled in one experimental study group consumed all three beverages. Interventions were performed at 4-day washing

periods. Participants' indirect VO<sub>2max</sub> was determined by Harvard Step Test and their 24-h recalls were assessed using a NUTRITIONIST IV Software (Version 7.0; N-squared Computing, Salam, OR, USA). Serum triglyceride, total cholesterol level, and blood sugar assessed with enzymatic kits (Pars Azmoon Ins, Tehran, Iran). F<sub>2</sub>-isoprostane level as the marker of muscle breakdown was determined with Bender Medsystems GmbH Kit, Vienna, Austria.

Means and standard errors were calculated for each variable. Data were compared between different times using a simple repeated-measures analysis, and post-hoc comparisons were also performed too. All the analyses were done using the Statistical Package for the Social Sciences software (SPSS Inc, Chicago, IL, USA) (version 20). *P* value of <0.05 was set as the significant level. Paired *t*-test and analysis of variance (ANOVA) test were also performed.

## Ethical considerations

Ethics Committee of IUMS approved the study process, and informed consent was gained from all of the subjects.

## RESULTS

The taekwondo players' mean age was 23 ± 2.7 years. Levels of lipid profile and blood sugar before and after drinking beverages during pre and post-recovery periods are shown in Table 1. Total cholesterol levels decreased after the three intervention periods, however, this reduction was not significant. Comparison of total cholesterol change after intervention did not reflect a significant difference (*P* > 0.05).

Plasma triglyceride was lower after dough and carbohydrate replacement drink intake. The mentioned decrease was marginally significant in taekwondo players after dough consumption (*P* = 0.076), whereas there was a non-significant difference after carbohydrate drinking periods. In addition, non-alcoholic beer intake non-significantly increased triglyceride level. Between groups comparison of athletes' triglyceride was not statistically significant (*P* > 0.05).

All the three beverages increased blood sugar level. Within subject difference was marginally significant after consuming non-alcoholic beer (*P* = 0.083), however, the mean change of plasma glucose did not show a significant increase for the three beverages. Moreover, lactate dehydrogenase level reduced after all the intervention cycles. Mean change of this plasma enzyme level was statistically significant after non-alcoholic beer consumption (*P* = 0.048). In addition, no significant increase was observed between mean pre and post-recovery F<sub>2</sub>-isoprostane values and between groups

**Table 1: Plasma concentrations of profile lipids and blood sugar before and after ingestion of beverage**

Variable	Dough	Non-alcoholic beer Mean (SE)	Carbohydrate drink	P value
Blood sugar mg/dl				
Pre-recovery	114.77 (0.76)	114.54 (0.99)	113.90 (1.31)	
Post-recovery	115.13 (0.88)	115.36 (0.92)	114.45 (1.22)	
P value	0.51	0.08	0.38	F=0.13 P=0.87*
Total cholesterol mg/dl				
Pre-recovery	150.68 (1.70)	149.64 (0.99)	150.27 (1.28)	
Post-recovery	148.64 (2.03)	148.86 (1.43)	149.77 (1.60)	
P value	0.13	0.433	0.57	F=0.61 P=0.54
Triglycerids mg/dl				
Pre-recovery	88.72 (2.12)	86.95 (1.93)	89.40 (2.38)	
Post-recovery	87.86 (2.03)	87.63 (2.03)	88.36 (2.18)	
P value	0.07	0.36	0.22	F=1.83 P=0.17

\*P value of between groups comparison

**Table 2: Plasma concentrations of oxidative stress, muscle damage markers before and after ingestion of beverage**

Variable	Dough	Non-alcoholic beer Mean (SE)	Carbohydrate drink	P value
Lactate dehydrogenase U/L				
Pre-recovery	247.77 (1.85)	250.91 (2.40)	246.50 (1.59)	
Post-recovery	246.73 (1.37)	248.23 (2.04)	245.82 (2.02)	
P value	0.53	0.048*	0.48	F=0.83, P=0.44*
F <sub>2</sub> -Isoprostane ng/ml				
Pre-recovery	72.07 (0.71)	73.74 (0.37)	73.23 (0.40)	
Post-recovery	72.39 (0.24)	74.10 (0.26)	73.70 (0.54)	
P value	0.63	0.24	0.25	F=0.01 P=0.96

\*P value of between groups comparison

comparison did not show any statistically significant difference ( $P > 0.05$ ). There was no significant change in individuals' food intake. Participants did not complaint about any side effects. Mean and standard error of oxidative stress and muscle damage biomarkers before and after drinking beverages are shown in Table 2.

## DISCUSSION

In this study, we compared the effects of various types of beverages including dough, non-alcoholic beer, and carbohydrate-rich beverages on blood sugar, lipid profile, lactate dehydrogenase, and F<sub>2</sub>-isoprostane levels of elite taekwondo players. Findings show that all three beverages at pre- and post-recovery periods enhanced blood sugar and F<sub>2</sub>-isoprostane levels, whereas these fluids supplements' intake decreased plasma total cholesterol and lactate dehydrogenase levels. Mean triglyceride change was different after consumption of the three beverages. Non-alcoholic beer increases the triglyceride level, and the other liquids lowered plasma triglyceride level.

In a study by Bishop *et al.*, plasma glucose levels reduced in the placebo group in comparison to the group that received carbohydrate-rich beverages, both at fatigue and at 1 hour after exercise.<sup>[7]</sup> Carbohydrate sport beverages increased glucose level and glycogen restoration rate during the recovery period.<sup>[8]</sup> It seems that stress hormone release was accompanied with post-exercise blood glucose reduction. Carbohydrate beverage consumption can compensate hypoglycemic periods of sports. Moreover, it can balance the fatigue perception, lowering quality of athletes' performance.<sup>[9]</sup> Nutrient profile of milk and its products as carbohydrate, whey, electrolytes, and water can be effective on glucose level in athletes' recovery periods.

The observed effect of fluid drink on triglyceride and total cholesterol levels are comparable with previous findings. In a 6-week intervention trial with fermented milk product, Ageraek *et al.* observed a significant reduction in cholesterol level of 58 healthy participants, whereas plasma triglyceride showed no significant change.<sup>[10]</sup> Panagiotakos showed that

milk product intake decreases total cholesterol and triglyceride concentrations.<sup>[11]</sup> Cholesterol and triglyceride levels' reduction shows an approximately similar trend, however, its strength is affected by sample size of the studied participants.

The effect of yogurt, as a milk product, on lowering serum total cholesterol can be explained by its lactobacillus acidophilus content.<sup>[12]</sup> Bioactive compounds, calcium, conjugated linoleic acid fermentation bacteria, and probiotic components can play critical roles in reducing plasma cholesterol and triglyceride levels.<sup>[12]</sup>

Exercise leads to a higher lactate dehydrogenase concentration as a converting enzyme with fuel supplying roles and also its level reflected the increased free radical concentration which is caused by stress of sport.<sup>[13-17]</sup> In addition, its level affects lactate concentration of athletes' muscle and their performance ability.<sup>[18,5]</sup> Karp *et al.* on comparing the effects of chocolate milk, fluid replacement drink, and carbohydrate replacement drink consumption in highly-trained cyclists observed increased post-exercise lactate level; exhaustion time and glycogen-depleting exercise of participants can be managed by milk chocolate beverages.<sup>[6,5]</sup> However, the mentioned effects were non-significant in a comparison of within-subject difference in the Thomas trial on male trained cyclists.<sup>[6,5]</sup> The non-significant within and between comparison of our supplement beverages on F<sub>2</sub>-isoprostane as a muscle injury and free radical arachidonic acids peroxidation indices<sup>[19]</sup> can be explained using Steensberg findings.<sup>[20]</sup> They observed that plasma F<sub>2</sub>-isoprostane level decreases significantly in response to sport stress, however, this reduction is compensated in 1 hour after the recovery period.<sup>[20-22]</sup> The Trevor trial involving 127 men and women in the age group 30–65 years showed that low fat diet containing a daily ω3-rich fish meal can reduce cell lipid peroxidation rate and lower urinary F<sub>2</sub>-isoprostane excretion. This reduction was higher in participants following aerobic exercises in addition to the mentioned diet. Lack of reported studies on the effects of fluid supplements on F<sub>2</sub>-isoprostane level makes more comparison impossible. These findings can help nursing and medical team members of sports medicine to guide elites and professional athletes in rapid and most proper recovery periods.

The limitations of our study were small sample size of participants and a before-after study design. Moreover, measuring detailed nutrient and electrolyte content of beverages can be effective in our assessment.

In regards to the strong points, the present study assessed the effects of isocaloric volume of dough intake in comparison to other available fluid supplements on lipid

profile, blood sugar, muscle damage, and oxidative stress markers in professional athletes for the first time.

## CONCLUSION

In conclusion, we observed that dough, non-alcoholic beer, and carbohydrate replacement drink consumption at pre- and post-recovery periods can decrease plasma total cholesterol and lactate dehydrogenase level. The mentioned beverages can enhance blood sugar and plasma F<sub>2</sub>-isoprostane concentrations. Non-alcoholic beer increases triglyceride level, and the consumption of other liquids was accompanied with lower plasma triglyceride in elite taekwondo players.

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## Conflicts of interest

There are no conflicts of interest.

## REFERENCES

1. Noll KE, Haas CN, Patterson JW. Recovery, recycle and reuse of hazardous waste. *J Air Pollut Control Assoc* 1986;36:1163-8.
2. Roy BD, Milk: The new sports drink? A Review. *J Int Soc Sports Nutr* 2008;5:15.
3. Pritchett K, Bishop P, Pritchett R, Green M, Katica C. Acute effects of chocolate milk and a commercial recovery beverage on postexercise recovery indices and endurance cycling performance. *Appl Physiol Nutr Metab* 2009;34:1017-22.
4. Spaccarotella KJ, Andzel WD. The effects of low fat chocolate milk on postexercise recovery in collegiate athletes. *J Strength Cond Res* 2005;25:3456-60.
5. Karp JR, Johnston JD, Tecklenburg S, Mickleborough TD, Fly AD, Stager JM. Chocolate milk as a post-exercise recovery aid. *Int J Sport Nutr Exerc Metab* 2006;16:78-91.
6. Shiranian A, Darvishi L, Askari G, Ghiasvand R, Feyzi A, Hariri M, *et al.* The effect of different beverage consumption (dough, nonalcoholic beer, carbohydrate replacement drink) on performance, lipids profile, inflammatory biomarkers after runningbased anaerobic sprint test in taekwondo players. *Int J Prev Med* 2013;4(Suppl 1):S5-10.
7. Bishop NC, Blannin AK, Walsh NP, Gleeson M. Carbohydrate beverage ingestion and neutrophil degranulation responses following cycling to fatigue at 75%VO<sub>2</sub> max. *Int J Sports Med* 2001;22:226-31.
8. Lunn WR, Pasiakos SM, Colletto MR, karfonta KE, Carbone JW, Anderson JM, *et al.* Chocolate milk and endurance exercise

- recovery: Protein balance, glycogen, and performance. *Med Sci Sports Exerc* 2012;44:682-91.
9. Walberg-Rankin J. Dietary carbohydrate as an ergogenic aid for prolonged and brief competitions in sport. *Int J Sport Nutr* 1995;5:S13-28.
  10. Agerbaek M, Gerdes LU, Richelsen B. Hypocholesterolaemic effect of a new fermented milk product in healthy middle-aged men. *Eur J Clin Nutr* 1995;49:346-52.
  11. Panagiotakos DB, Pitsavos CH, Zampelas AD, Chrysohoou CA, Stefanadis CI. Dairy products consumption is associated with decreased levels of inflammatory markers related to cardiovascular disease in apparently healthy adults: The ATTICA study. *J Am Coll Nutr* 2010;29:357-64.
  12. Schaafsma G, Meuling WJ, van Dokkum W, Bouley C. Effects of a milk product, fermented by *Lactobacillus acidophilus* and with fructo-oligosaccharides added, on blood lipids in male volunteers. *Eur J Clin Nutr* 1998;52:436-40.
  13. Baradaran B, Tartibian B, Baghaiee B, Monfaredan A. Correlation between superoxide dismutase 1 gene expression with lactate dehydrogenase enzyme and free radicals in female athletes: Effects of incremental intensity exercises. *Tehran Univ Med J* 2012;70:212-9.
  14. Poprzęcki S, Staszkiwicz A, Hübner-Woźniak E. Effect of eccentric and concentric exercise on plasma creatine kinase (CK) and lactate dehydrogenase (LDH) activity in healthy adults. *Biol Sport* 2004;21:193-203.
  15. Karamizrak OS, Ergen E, Tore RI, Akgun N. Changes in serum creatine kinase, lactate dehydrogenase and aldolase activities following supramaximal exercise in athletes. *J Sports Med Phys Fitness* 1994;34:141-6.
  16. Klapcińska B, Iskra J, Poprzęcki S, Grzesiok K. The effects of sprint (300 m) running on plasma lactate, uric acid, creatine kinase and lactate dehydrogenase in competitive hurdlers and untrained men. *J Sports Med Phys Fitness* 2001;41:306-11.
  17. Sumida KD, Frisch F, Donovan CM. Training suppresses hepatic lactate dehydrogenase activity without altering the isoenzyme profile. *Med Sci Sports Exerc* 1995;27:507-11.
  18. Thomas K, Morris P, Stevenson E. Improved endurance capacity following chocolate milk consumption compared with 2 commercially available sport drinks. *Appl Physiol Nutr Metab* 2009;34:78-82.
  19. Liu W, Morrow JD, Yin H. Quantification of F2-isoprostanes as a reliable index of oxidative stress *in vivo* gas chromatography-mass spectrometry (GC-MS) method. *Free Radic Biol Med* 2009;47:1101-7.
  20. Steensberg A, Morrow J, Toft AD, Bruunsgaard H, Pedersen BK. Prolonged exercise, lymphocyte apoptosis and F2-isoprostanes. *Eur J Appl Physiol* 2002;87:38-42.
  21. Mastaloudis A, Leonard SW, Traber MG. Oxidative stress in athletes during extreme endurance exercise. *Free Radic Biol Med* 2001;31:911-22.
  22. Cracowski JL, Durand T, Bessard G. Isoprostanes as a biomarker of lipid peroxidation in humans: Physiology, pharmacology and clinical implications. *Trends Pharmacol Sci* 2002;23:360-6.