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Research Article

Influence of Whey Protein Drinks to Athletes: Taking Track and Field Athletes as Research Objects

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Abstract: According to the nutritional requirement of athletes during exercise, this study aims to invent a drink which mainly contains whey protein and is also added with saccharides and electrolyte, etc., to keep athletes' athletic ability and accelerate the recovery of physical ability. Athletes that were going to participate in a track and field sports meeting of province were asked to drink the whey protein drinks during training and the index of Red Blood Cell (RBC), Hemoglobin (HB) concentration, Hematocrit (HCT), Mean Corpuscular Volume (MCV) of athletes' blood were measured. The blood sugar concentration of athletes in control group before and after the experiment was 4.06±0.55 and 3.25±0.58 mmol/L, respectively, which lowered about 17% ($p<0.05$) and the difference was statistically significant. However, the blood sugar concentration of athletes in experimental group before and after the experiment was 4.34±0.65 and 4.56±0.52 mmol/L respectively, which increased about 3.5% ($p<0.05$) and the difference had no statistical significance. The experimental results showed that whey protein drinks could effectively protect body's erythrocyte function, prevent decline of HB as well as strengthen physical ability, relieve fatigue and maintain the muscle microstructure. Therefore, whey protein drinks can effectively strengthen athletes' immunocompetence as well as the muscle strength and it is also antioxidative and can prevent body damage and relieve fatigue. What's more, whey protein's various sports nutritional properties enable it to be widely applied to sports nutrition.

Keywords: Dairy products, sports drinks, sports nutrition, whey protein

INTRODUCTION

In nowadays, the requirement for athletes' physical abilities becomes higher and higher in competitive sports and besides scientific and assiduous training, athletes also need reasonable nutritional support. Sports drinks are an important water and nutrient resource in exercise. Compared with solid food or food mixed with solids and liquids, sports drinks have higher nutrient dispersity and their temperatures are easier to adjust, which won't cause heavy burden to intestines and stomach and can be absorbed by body quickly. Therefore, they are widely demanded and have potential development in current competitive sports and among exercising people (Marie and Jose, 2008). Generally, sports drinks contains certain amount of sugar, electrolyte, minerals and vitamins to supply basic nutrients that lost during exercise (Marie and Jose, 2008; Rodriguez *et al*., 2009) to adapt to physiological characteristics of people who exercise or do physical labor a lot as well as meet the nutritional needs of them (Fitness Committee on Nutrition the Council on Sports Medicine, 2011). According to the China's national standards of 2009, sports drinks are defined as a kind of soft drinks whose nutritional compositions and contents are appropriate to physiological characteristics and special nutritional needs of people who exercise or do physical labor (Food and Fermentation Industries, 2009). In the experimental research which evaluates effects of sports drinks, researchers can estimate body's utilization of sugars (extraneous sugar) according to hormone responses caused by drinks with different sugar contents and sugar types (Stevenson Emma *et al*., 2006), thus researchers can predict what kind of sugar supplement method can better maintain the state of exercise while the sugar contents are the same.

Recently, whey protein is applied to sports circles more and more and such kind of products are demanded by large number of people who are enthusiastic about muscle and body shape and are keen to show their sports abilities. Scientific researches have increasingly shown that whey protein can bring physiological and physical benefits for those who pursue for excellent results and fast physical recovery abilities. However, whey protein drinks have not popularized in current market yet. This study starts from a practical aspect to discuss a kind of sports drinks that contains whey protein, sugar and electrolyte, which are appropriate for professional athletes. Besides, the study also discusses the production technique and studies the effect of drinks on athletes' exercise.

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Table 1: Index of physical quality test

	X1	X2	X3	X4	X5	X6	X7	X8
Sport events	Standing long jump	3 min push-ups	3 min sit-ups	Standing 3 m run	5*25 m shuttle run	12 min run	Body anteflexion	Changing run
Representative qualities	Lower limbs explosive power	Upper body strength endurance	Waist and abdomen strength	Short distance movement speed	Speed endurance	General endurance	Flexibility	Balance

MATERIALS AND METHODS

Research objects: Athletes of Tianjin University of Commerce who were going to participate in a track and field sports meeting of province were chosen to have centralized training for 6 months. They were divided into an experimental group and a control group randomly and each group had 8 athletes. The average age of the control group was 8.00±1.52 years old and the average height was 170.65±8.25 cm while the average weight before experiment was 63.85±7.35 kg. The average age of the experimental group was 18.35±0.65 years old and the average height was 172.00±6.23 cm while the average weight before experiment was 67.55±8.35 kg. No significant difference in two groups' ages, heights and weights was found. This study was approved by Ethics Committee and all the athletes in experiment signed informed consent form.

Research methods:

Nutritional supplement and training methods: During the preparation for the track and field sports meeting of province, each group completed same training plans twice everyday and 2.5 h for each time. In the training, athletes of experimental group had 800 mL whey protein drinks an hour before and after the training and also had 400 mL whey protein drinks an hour before going to bed. Athletes of the control group had same amount of purified water the same time as the experimental group. The experimental time was 12 weeks and all athletes were required to dine in student canteen during this period. Meal standard was controlled within 15 Yuan and no extra nutrients were supplied to athletes. The whey protein and oligosaccharide in the experiment were all purchased from CPT Vetron Sports New Technology Development Co., Ltd., Beijing.

Training experiment of athletes: Two groups were having same training programs everyday, which were loaded bicycle exercise, standing long jump, 3 min push-ups, 3 min sit-ups, standing 3 m run, 5*25 m shuttle run, 12 min run, body anteflexion and changing run, etc.

Index testing and methods: Two groups had maximal oxygen consumption tests on an 80-Egrometer cycle ergometer (produced in Holland Lode B Y) before and after the experiment. The experiment started after 5 min warm-up and the cycle ergometer had incremental exercise program that initial load was 100 w and every 3 min increased 50 w till athletes were exhausted. The time from beginning to the exhaustion as well as the center rate of sports and maximal oxygen consumption were measured. In the meantime, 3 mL of venous blood were drew 3 min after the exercise and heparin anticoagulant was used to centrifuge and draw serum. Then it was refrigerated for later test.

Blood routine examination: The Red Blood Cell (RBC), Hemoglobin (HB) concentration, Hematocrit (HTC), Mean Corpuscular Volume (MCV) of athletes' blood before and after exercise were tested by using a BTX-1800 hematology analyzer.

Blood lactic acid (Bla) concentration: Improved Barker-summerson method was used.

Blood Urea Nitrogen (BUN) and Creatine Kinase (CK): BUN content was measured by microcolorimetry and CK was measured by CK coupling ultraviolet double kit method (Marie and Jose, 2008). Kit was bought from Yulan Biological Technology Co., Ltd., Shanghai and used strictly following the direction.

Physical quality test: Index of physical quality test before and after the experiment has been shown in Table 1.

Statistical methods: Data were statistically analyzed by SPSS 17.0 software and were all presented by using mean±S.D. Difference between groups was analyzed by group data and significance level was $p<0.05$.

RESULTS

Whey protein drinks' influence on athletes' blood biochemical indexes: This study studied the whey protein drinks' influence on athletes' blood biochemical indexes and the experimental results have been shown in Table 2 and 3.

Table 2: Blood content comparison of two groups before and after exercise (mean±S.D., n = 8)

	Control group		Experimental group	
	Before	After	Before	After
Hb (g/L)	135.40±7.85	127.50±6.22*	134.50±1.78	137.15±0.83&
RBC (1012/L)	4.35±0.35	4.05±0.25	30.45±2.08	38.36±1.52
HCT (%)	30.72±0.35	34.20±2.63	30.45±1.68	32.94±1.12
MVC (f1)	70.35±6.05	76.25±6.83	72.34±0.21	71.86±3.08

*: $p<0.05$ in comparison before and after experiment; &: $p>0.05$ in comparison before and after experiment

The experiment showed that after 12 weeks' training, the change of blood indexes of athletes in control group were that HB level lowered ($p<0.05$), HCT increased ($p<0.05$) and RBC and MVC had no significant change ($p>0.05$). The change of blood indexes of athletes in experimental group were that HB level, RBC and MVC all had no obvious change ($p<0.05$) except for HTC which increased ($p<0.05$). Therefore, the results showed that the supplement of whey protein drinks during exercise could prevent the decline of HB level and maintain the function of erythrocyte.

Table 3 showed that after 12 weeks' training, the blood biochemical index changes of the control group before and after exercise are that CK and BUN all increased ($p>0.05$). However, after exercise, the experimental group athletes' CK and BUN all had no obvious change. Both groups had quantitative load exercise tests before and after exercise and the Bla of athletes in the control group tripled after exercise ($p<0.05$) while the Bla doubled in the experimental group after exercise ($p<0.05$), which means whey protein drinks could strengthen the aerobic capacity of athletes' skeletal muscle. Table 3 also showed that the blood glucose concentrations of control group before and after experiment were 4.06±0.55 and 3.25±0.58 mmol/L and lowered about 17% ($p<0.05$) than before. However, the blood glucose concentrations of experimental group before and after experiment were 4.34±0.65 and 4.56±0.52 mmol/L which increased about 3.5% ($p>0.05$). This showed that whey protein drinks could maintain the sugar content of blood during exercise because athletes that hadn't had whey protein drinks showed decline in the sugar content of blood.

Influence of whey protein drinks on athletes' body composition: This study studied the influence of whey protein drinks on athletes' body composition and the results have been shown in Table 4.

Table 4 showed that the fat free mass of experimental group increased 4.77% after experiment ($p<0.05$) and the percent of body fat reduced 8.36% ($p<0.05$). However, the fat free mass of control group increased 1.55% ($p>0.05$) and the percent of body fat reduced 1.02% ($p>0.05$). The results indicated that the supplement of whey protein drinks during exercise could stimulate muscle growth, reduce fat percentage of body and increase fat free mass of body.

Whey protein drinks' influence on athletes' aerobic capacity indexes: In the progressive increasing load training tests of two groups before and after the experiment, we found that training improved both groups' cardio-vascular function. After exercise, the heart rate recovery of both groups in the first minute had no significant difference. However, in the third and fifth minutes, there was significant difference between two groups ($p<0.05$) that the experimental group showed faster recovery of heart rate. The results showed that whey protein drinks were beneficial to the recovery of bodies after exercise.

Effect of whey protein drinks on athletes' physical qualities and competition results: The results of whey protein drinks' effect on athletes' aerobic capacity index have been shown in Table 5.

Table 3: Partial blood biochemical indexes comparison of two groups before and after exercise (mean±S.D., n = 8)

	Control group		Experimental group	
	Before	After	Before	After
Bla (mmol/L)	2.35±0.18	9.65±0.15*	2.52±0.21	7.02±0.15&
CK	302.25±78.90	372.50±54.20*	295.50±21.20	307.68±1.72&
BUN	3.02±0.95	3.62±0.25*	3.25±0.18	3.14±0.72&
Blood glucose (mmol/L)	4.06±0.55	3.25±0.58*	4.34±0.65	4.56±0.52&

*: $p<0.05$ in comparison before and after experiment; &: $p>0.05$ in comparison before and after experiment

Table 4: Body composition comparison of two groups before and after exercise (mean±S.D., n = 8)

	N	Fat free mass		Body fat (%)	
Control group	8	50.74±3.37	51.65±2.48	12.04±0.83	11.88±0.32
Experimental group	8	50.85±0.08	53.42±0.61*	14.98±2.03	16.45±3.85&

*: $p<0.05$ in comparison before and after experiment; &: $p>0.05$ in comparison before and after experiment

Table 5: Physical indexes of two groups before and after training (mean±S.D., n = 8)

	Control group		Experimental group	
	Before	After	Before	After
X1 (m)	2.23±0.90	2.35±0.03&	2.65±0.12	2.48±0.11○*
X2 (times)	31.12±0.35	33.35±4.75&	32.29±4.35	36.78±4.71⊙*
X3 (times)	35.78±2.12	38.36±2.24&	34.75±2.60	39.14±1.96○*
X4 (sec)	2.25±0.15	2.25±0.15&	2.26±0.18	2.21±0.16○*
X5 (sec)	20.80±0.72	20.65±0.75*	20.64±0.87	19.54±0.85⊙*
X6 (m)	2808.50±212.00	2834.50±252.10*	2848.60±272.90	2937.80±308.20⊙*
X7 (cm)	14.56±6.54	15.76±3.22&	16.28±6.78	16.89±1.83⊙&
X8 (sec)	9.95±0.55	9.65±0.45&	9.48±0.17	9.04±0.72○&

In self comparison, *: $p<0.05$ in comparison before and after experiment; &: $p>0.05$ in comparison before and after experiment; In comparison with control group; ⊙: $p<0.05$; ○: $p>0.05$

After the experiment, except for n which indicates flexibility (body anteflexion) had no significant change, other qualities of both groups all improved, which were X1 (standing long jump), X2 (push-ups), X3 (1 min sit-ups), X4 (Standing 3 m run), X5 (5*25 m shuttle run), X6 (12 min run) and X8 (Changing run). The X5 and X6 in the control group had statistical significance while others did not. However, in experimental group, all testing results had significant difference ($p<0.05$) except for X7 and X8 which has no statistical significance. The comparison of athletes' physical qualities after experiment between two groups showed that the aerobic capacity index of athletes in the experimental group increased. Therefore, whey protein drinks was beneficial for athletes' physical quality and physical ability and athletes' competition results in this sports meeting were better than before.

DISCUSSION

The development of modern sports is closely related to the study of nutrition and scientific and nutritional diet plays an important role in keeping athletes' health and improving competition results. Modern sports have characteristics like long time competition and big consumption of physical energy. Athletes cannot give full play to their abilities without good physical reserves. Therefore, taking the improvement of athletes' physical reserves during training as the breakthrough point, strengthen the supplement of nutrients to get good competition results. The observation and analysis of competition show that only athletes with good physical energies can have good competitive state. An athlete without well-reserved physical energy cannot compete normally in the competition and even cannot have stable state of mind. Good physical reserves are beneficial for overloaded training and competition and prevent body damage and reduce pain. The outstanding performance of athletes in the competition is mainly due to good physical reserves of them.

Researches show that athletes' physical power is consumed a lot during training and competition and lack of reasonable nutritional supplement will influent the recovery of bodies and causes fatigue and decline of athletes' body functions (Jianhua, 2004; Lei and Pu, 2000). Besides, nutrients from daily diet are not enough for sports, thus other extra nutrients should be supplied to meet the needs of high intensity and overloaded training as well as competition. Oligosaccharide is usually aggregated by two or more monosaccharides in the form of glucosidic bond connection. Protein is a must nutrient element for body metabolism as well as an elementary composition of body to keep basic vital movements, which has important relationships with many exercise-related factors like muscle contraction, substance metabolism and physiology function regulation, etc. Whey protein has many health advantages like high purity, low fat, low cholesterol, high digestibility and reasonable amino acid composition (Qun and Xinkai, 2004; Longjiang *et al*., 2005), which is applied widely to sports nutrients that used for supplying protein.

Jiexiu *et al*. (2004), Yuan *et al*. (2003) and Jianmin *et al*. (2006) studied sports anemia and found that the amount of free radicals in body would increase rapidly during exercise and it will cause damage to erythrocyte membrane, which would result in the increase of damaged erythrocyte and thus cause sports anemia. However, whey protein contains various antioxidative active constituents, such as lactoferrin. Besides, the lactoferrin in it can bond firmly with iron ions and prevent them from being utilized by bacteria. In the meantime, it can also catalyze free radicals to chelate with free iron ions and other divalent metal ions, which can effectively restrain the oxidation of metal ions. Therefore, iron saturation of lactoferrin is an effective way of iron transfer in diet (Yugang and Wei, 2008) and the supplement of lactoferrin can undoubtedly accelerate the iron metabolism of body. However, the exact mechanism of lactoferrin supplement to sports anemia needs further research.

The main limitations of this study are the lack of specimen and impossibility to divide group randomly. In the further research, more specimen need to be added and different kinds of sports drinks should be used to study their effect on athletes, thus to improve the competition results of athletes. Besides, there were two different result assumptions of experimental group, which is needed to be further studied to find out the effect of lactoferrin on athletes.

CONCLUSION

The supplement of whey protein drinks during exercise is beneficial for protecting red blood cells, preventing the decline of Carboxy Methylated Cellulose (CMC) and can also accelerate the recovery of body, reduce fatigue and maintain the microstructure of muscle.

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