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ATHLETES FATIGUE RECOVERY AND SPORTS NUTRITION ANALYSIS BASED ON SPORTS NUTRITION AND THE LOAD ADJUSTMENT METHOD

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ABSTRACT
This paper focuses on the relationship between exercise training, nutrition and immune function, and discusses the role of nutritional interventions to improve physical function. Movement of athletes immune suppression in order to promote further research in this field. The load adjustment is limited to the recovery of sports nutrition and training to adjust the load down to creatine kinase, blood urea nitrogen recovery index values are valid, but there was no significant difference. The large amount of exercise training and competition will make the Hb value decreased, BUN, CK rises, before the game to add protein powder and continuous glutamine, skeletal muscle cells can promote the synthesis of proteins, significantly improved body rowers function and promote recovery from fatigue after exercise load. Glutamine creatine powder and whey protein powder and sugar FDP viability as a nutritional supplement, from two months before to two weeks after the continuous application to help improve immune system function rowers and improve the quality of training and competition results.

1. Introduction

Sports training is a training-fatigue-recovery-training-fatigue and then recover, and finally the body ultra-compensation process (Rodriguez, 2009; Hausswirth, 2014; Kreider, 2003). In this cycle, training, fatigue and recover a part of one less, no fatigue training is meaningless training, also did not resume training is meaningless or even harmful training. Improve motor function level athletes in training - fatigue - Recovery cycle of circulation gradually increased(Van, 2006). So now resume training after the sports world increasingly valued in the international recovery team some well-known sports and training has been seen as equally important position, give the relevant sports nutrition and adjust the training load is restored after training the two most important means(Halson, 2014; Chaouachi, 2009).

Numerous studies show that when athletes large amount of exercise training or competition may cause suppression of immune function, so that the body of an increased risk of infection, particularly upper respiratory tract infection(Halson, 2014). Many factors can affect exercise-induced suppression, such as physical, psychological and environmental stress(Bettonviel, 2015; Mountjoy, 2014).Also, nutritional factors on immune function also play an important role(Zhang, 2015; Jeukendrup, 2014; Lewi, 2015; Hansen, 2016). A large number of epidemiological evidence and clinical data suggest that nutritional deficiencies can alter the body's immune system, increasing the risk of infection, which

affects the exercise capacity of athletes(Killer, 2015).

Exercise also decreased immune function long plagued sports coaches, athletes a thorny issue (Wehbe, 2015). The development and use of domestic and foreign sports nutrition supplements has made some achievements in sports practice also played a role, but these research and development work is relatively fragmented, difficult to solve all the problems from training to competition(Thomas, 2016). Rowing is a kind of high-intensity aerobic capacities, push forward vessels sailed into the competitive nature of sports projects under reasonable action technology(Bengtsson, 2013). Before training is an important part of the whole training cycle, its purpose is to adjust the state of the athletes, it is in the best competitive level in the game. Therefore, the Athletes before and after high intensity training or competition rational nutrition intervention, by immunological tests, and test some blood biochemical indices combined with subjective fatigue and training load athletes to analyze the reasonableness of the validation exercise program implementation, understanding functional status and degree of recovery of athletes, and the athletes next sports training arrangements, performance tuning and medical supervision have important guiding significance. This paper focuses on the relationship between exercise training, nutrition and immune function, and discusses the role of nutritional interventions to improve physical function and movement of athletes immune suppression in order to promote further research in this field.

2. Materials and methods

2.1. Relationship between exercise and immune function and disease

Usually exercise to increase body resistance is seen as an effective way to continue to adapt to environmental changes both inside and outside the body (Medina, 2014). In numerous studies on the integration of data analysis can be seen on the basis of a certain intensity of exercise or physical activity can enhance immune function, reduce the chance of infection and cancer; and excess or depletion of training and competition can lead to immune suppression and suffering increased risk of disease (Bieuzen, 2013). That exercise between immune function and disease infection and presented a linear relationship, we propose inverted J hypothesis. Figure 1 more clarity on the relationship between them is expressed, this theory certainly has been a lot of epidemiological data. But the change caused by the movement of immune function if the root causes of disease is susceptible rise remains to be further confirmed.

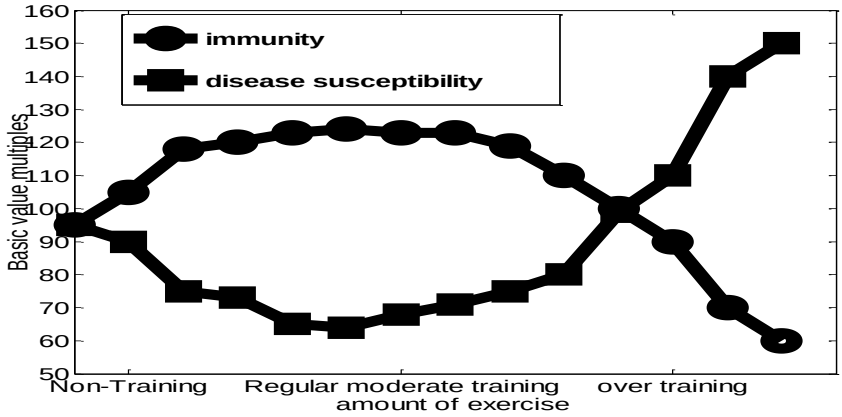

Figure 1. Inverted J hypothesis

2.2. Analysis of basal metabolic rate

Tomb base metabolic rate refers to the human body in a sober, supine, fasting and energy metabolic rate at 20 degrees Celsius. First law of thermodynamics has a profound impact on the application of biological organisms regard. First law of thermodynamics can be written as: open a total energy of the system is equal to the heat input increment ΔQ system plus the work force made to the system.

$$\Delta E = \Delta Q + \Delta W \quad (1)$$

According to this formula each star changes, we can describe the relationship between the energy of the whole body. Whether the individual is a rest or exercise, always keep the food stored chemical energy into other forms of energy required to maintain the body various organs, tissue and cell function, called catabolic processes in the body during the break the internal energy continue to decrease, AE, eight E is negative. To compensate for decomposition consume energy metabolism, you must eat food. Part of the catabolism of energy for the body to an external system to do work, and partly converted into heat .Q spread in vitro and W with the relationship between the time rate of change between the seven following formula:

$$\left[\frac{\Delta E}{\Delta t}\right] = \left[\frac{\Delta Q}{\Delta t}\right] - \left[\frac{\Delta W}{\Delta t}\right] \quad (2)$$

Measured by the respiratory oxygen consumption rate, the other is also known that consume a liter, if generated approximately 48 kcal of energy with oxygen, then the average catabolic rate can be written as:

$$\left[\frac{\Delta E}{\Delta t}\right] kcal / s = 4.8 \left[\frac{\Delta Q}{\Delta t}\right] L / s \quad (3)$$

2.3. Subjects and methods

We selected 16 rowers. City games were the 2007 and 2008 National Youth Championships athletes, including six athletes was the 2006 Provincial Games champion, the other two is the sixth City Games open single-stage double champion. All subjects volunteered to participate in the test, based on past medical history and a thorough physical examination to determine the subject and no history of cardiopulmonary exercise performance have not been taking drugs.

2.4. Experimental method

The 16 female rowers were randomly divided into experimental and control group 8. In the two months before the Qing Jin to two weeks after the implementation of sports nutrition interventions. Nutritional supplement program: ①Kang Bite glutamine capsules (Gln) - once a day, every 5; ②Kang Bite whey protein powder: once a day, each 30g, dissolved in warm water or milk taken: ③Kang Bite pure muscle acid powder (Cr): twice a day, 1--2 hours after half an hour before exercise and sports various; FDP vitality sugar: twice a day, two hours before training, immediately after training and the service once every four. Follow this nutrition intervention program, nutritional supplements given only to the experimental group, no difference in the athletes during the day, according to the experimental training program normal training, the experimental group and control group training program.

Data tests were conducted on the University Hospital of Wuhan Institute of Physical Roche INTEGRA 400 PLUS biochemical analyzer, CK and BUN kit provided by the Changchun City Department of Biological Technology Co., immunoassay kit provided by the Shanghai Fuxing Changzheng Medical Limited.

2.5. Sample collection and processing

The experiment was around women rowing team in preparing for the National Youth Championships conducted. Sampling time are in the great cycle training next morning 6-7 points, players awake in fasting venous blood 2.5ml sterile conditions in a quiet, anticoagulant tube save a 4 oC. Specimen: whole blood samples obtained after 20ul hemoglobin test, all remaining sample was centrifuged in serum, placed in -20 oC refrigerator spare to detect IgA, IgG, IgMCK, BUN. All subjects during three experiments to test the indicators, baseline: implementation of

nutrition interventions before (positive surgical winter training period); before Value: National Youth Championship the week before: the value of game: After the match resumed two weeks.

3. Results and discussions

3.1. The overall analysis of the experimental results

Rowers must not only have good explosiveness also requires good physical fitness. Athletes in the consumption of substances in the body is very large, two subjects per day minimum training sports teams. Athletes in training every day calories consumed by projections of about 20000J during normal training observation period, ordinary people 's daily life need about 10 times the heat. Training in energy consumption and in vivo in vivo synthesis of the material necessary to reduce substance may be the main cause of fatigue that results from functional index value point of view, after a long period of heavy load training will always be accompanied by a reduction in hemoglobin, red blood cells reduce hematocrit, decreased serum testosterone values such phenomena occur, and reduce these substances in the body that would cause a decline in production and athletic ability of fatigue, so make sugar, blood, provide high-quality protein, and promote material synthesis in vivo, to remove the body sports nutrition accumulation of various functions metabolites become major sports nutrition to promote physical recovery, the main measures issued corresponding function sports nutrition will become this observation after recovery from fatigue of athlete

Table 1. The indicator comparison of the athletes before recovery and intervention

Items	Guangdong provincial judo team			Shenzhen city judo team		
	Before recovery	1 week after intervention	difference	Before recovery	1 week after intervention	difference
HGB(g/L)	138±13	146±16	8±3	135±13	147±17	12±6
HCT(%)	38.2±2.5	41.0±2.2	3.0±0.1	37.0±2.1	42.0±2.2	5.0±1
Testostrone (nmol/L)	14.8±2.0	16.7±2.8	1.9±0.8	15.5±2.1	19.1±3.7	4.3±1.7
CK(U/L)	8.9±2.05	6.52±1.45	2.42±0.60	9.8±2.62	6.70±1.53	3.12±1.08
BUN (mmol/L)	8.7±2.3	7.1±1.9	1.6±0.4	8.5±2.0	6.6±1.5	1.9±0.5

Games lost time increase iron in the body, long-distance running parenteral iron loss will increase. During the observation period, Rowers training lasted fifty-six hours a day, the loss of iron in the body will be more consumption and shorter than normal and the movement of people, materials necessary for the synthesis of hemoglobin is iron in hemoglobin composed of four subunits each subunit has a prosthetic group containing iron, iron reduction will directly affect the synthesis of hemoglobin. After the analysis of various iron supplements, and blood Alzheimer fly sheet formulation more scientific, there are iron fumarate, folic acid, selenium, zinc, hemoglobin powder, vitamins, etc., they are synthetic hemoglobin and red blood cells essential substances, such as folic acid without it, differentiation and maturation of red blood cells cannot. Glucose on erythrocyte membrane has a protective effect, fructose as well as anti-lipid peroxidation, can stabilize the cell membrane to a certain extent, the absence of additional red blood cells can be funded for glycogen storage, it must always be sufficient

to absorb from the blood sugar in order to maintain functional activities, and therefore sugar on red cell life activities is very important.

Exercise is a lot of blood flow to skeletal muscle and other organs of the movement, will reduce the other body tissues and organs demand for sugar, and prolonged high load training may also lead to depletion of sugar, make red blood cells and other non-movement organ and tissue glucose deprivation the phenomenon is further exacerbated, increasing the impact on the red blood cell functional activity, it could lead to further reduction in the number of red blood cells, and therefore carbohydrate supplement may be one of a method to prevent the reduction of red blood cells. Waite sugar pump is a kind of complex sugars, dubbed by the fructose, the polysaccharides, oligosaccharides, and other sugars, easily absorbed by the body. Therefore, in this observation by carbohydrate supplement on erythrocyte membrane protection and reduction of red blood cell damage, and blood through the sheet and whey protein to provide raw materials for the synthesis of red blood cells to help speed up recovery and hemoglobin, hematocrit and the like. Bucks essence osmotic pump is the main component velvet active factor, the laser power saponin is a plant extract, both of which promote the synthesis of testosterone in the human body have a certain role, so as to enhance the concentration of testosterone, and therefore selected as the present observation complement testosterone supplements.

This observation athletes in hemoglobin, hematocrit, testosterone drops to normal after more than individuals taking these blood sports nutrition category, test results showed that the hemoglobin, hematocrit, testosterone has a certain improvement, difference before and after their recovery was significantly sex. Players hemoglobin, hematocrit, testosterone decline after more than normal individuals, not to take the appropriate sports nutrition, but reduce the intensity and amount of training load, the test results also show that hemoglobin, hematocrit, testosterone has increased, but the difference. It was not significant. Players in reducing the training load, the consumption of substances in the body also greatly reduced, and three meals a day diet can also provide the synthesis of hemoglobin, hematocrit, testosterone substances, so hemoglobin, hematocrit, testosterone values recovery is also possible. Hemoglobin decline caused training is of the sports anemia, anemia and exercise non-pathological, at no drug treatment, after a period of time generally may be restored to its original level. Reduce training load hemoglobin, hematocrit, testosterone relative recovery sports nutrition supplements not having the corresponding functions rise, probably when necessary supplements synthetic material timeliness and relevance of sports nutrition supplements is far less than the corresponding functions, so simply reducing the burden of training the body to adjust to relatively slow recovery, so the sports nutrition supplement related to hemoglobin, hematocrit, testosterone recovery faster more efficient more.

3.2. Blood index

As can be seen from Table 2, the experimental group and the control group in the late winter training hemoglobin index nutritional intervention values were within the normal range in both groups Hb values are not significantly different; the experimental and control groups. Before the game before Hb values were increased compared to the value of nutrition intervention, and there was significant difference ($P<0.05$) (Figure 2a). Fatty mean experimental group was significantly higher than the same period index ($P<0.05$) (Figure 2b); experimental group and the control group after the game Hb values were decreased compared to the value of nutrition intervention, and there is a significant difference ($P<0.05$), Hb and the average of the experimental group the control group compared to the same period index was a significant difference ($P < 0.01$).

Table 2. The effect on Hemoglobin BUN and CK level of nutrition intervention

	Group Type	HGB(g/L)	BUN(mmol/L)	CK(U/L)
Before Intervention	Exp group	143.0±0.90	8.12±0.44	148.22±0.22
	Control	131.0±0.45	7.21±0.23	146.64±0.17
Before Match	Exp group	158.7±0.87	7.16±0.59	109.26±0.24
	Control	154.0±0.87	7.01±0.13	92.33±0.13
After Match	Exp group	121.0±0.48	9.33±0.52	186.22±0.26
	Control	108.4±0.21	9.526±0.50	189.55±0.19

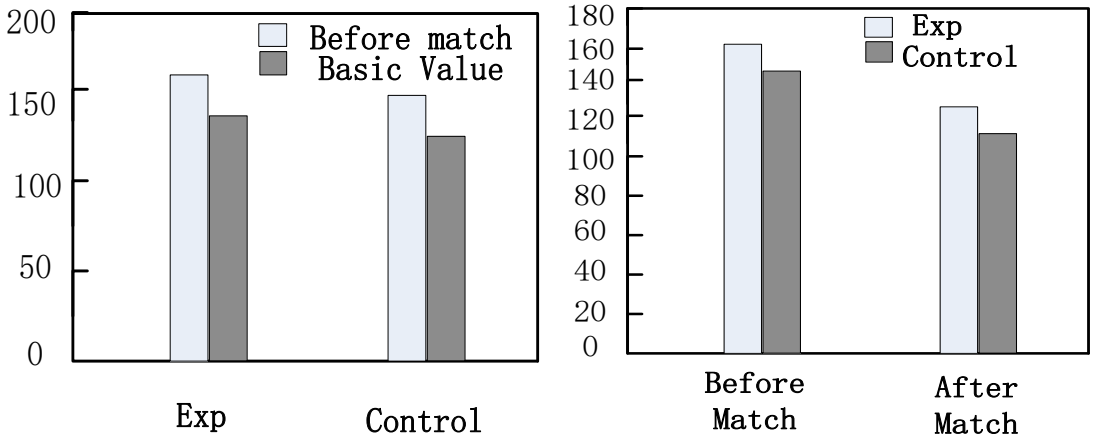

Figure 2. (a) Before the experimental and control groups after the game hemoglobin comparison between the left; (b) the experimental and control groups before Hb values and intervention values comparison chart

3.3. Immunoglobulin

As can be seen from Table 3, the entire test observation period, the immunoglobulin index lgA experimental group and control group were decreased compared to the value of the previous value before lgG and nutrition interventions, and there is a significant difference (P <0.05), before lgM values and nutrition interventions compared to the value also declined, but there was no significant difference. immunoglobulin before each index in the experimental group was not significantly decreased, compared with the same period in the control group were significantly different (P <0.05). After the match value lgh, lgG recovered to the level before the intervention, the experimental group after the game lgG values higher than the previous nutritional intervention and there is a significant difference (P <0.05), the experimental and control groups after the game IgM.

Nutrition interventions before the average value ratio decreased. and there was a significant difference (P <0.05), the experimental group after the game IgA, IgG value compared with the same period in the control group were significantly different (P0.05), IgM value compared with the same period in the control group, there was a significant difference (P <0.01).

Table 3. The variation of immune globulin level of experiment group and control

	Group Type	IgA(g/L)	IgG(mmol/L)	IgM(g/L)
Before Intervention	Exp group	2.01±0.42	8.34±1.06	3.48±1.15
	Control	2.00±0.40	8.14±0.39	2.87±1.20
Before Match	Exp group	1.87±0.39	7.72±0.28	3.34±0.89
	Control	1.68±0.68	7.19±0.72	2.86±0.94
After Match	Exp group	2.03±0.52	8.66±0.64	3.13±1.02
	Control	1.75±0.38	8.17±1.01	2.39±0.91

Sampler using a micro pipette at a concentration of 1.0 mg/ten kinds of stimulants hydrochloride standard ml solution of each of 0, 10, 50, 100 μl in 10 mlPyrex test tube, add 5ml H2O, with 1.4 backward approach to gas chromatographic analysis, The content of Y to X relative area plotted to obtain the regression equation shown in Table 4.

Table 4. The regression equations and correlation coefficients of 10 stimulants

stimulants	Regression equation	Correlation coeffient
Heptaminol	Y=0.0553x-0.0297	r=1
Methylamphetamine	Y=0.2168x-0.0531	r=1
Fenfluramine	Y=0.1017x-0.0631	r=0.9999
Cathine	Y=0.2157x-0.1625	r=0.9998
Ephedrine	Y=0.1972x-0.1993	r=0.9998
Amfepramone	Y=0.1114x-0.2102	r=0.9953
MDMA	Y=0.1450x-0.0484	r=1
Caffeine	Y=0.1296x-0.0482	r=1
Pipradol	Y=0.1242x-0.0026	r=0.9997
Strynchine	Y=0.0743x-0.0625	r=0.9997

3.4. Discussion and analysis

3.4.1. Nutritional intervention on athletes hemoglobin

In addition to nutrition and hemoglobin affected by general factors, but also affected by season training, training methods and techniques. Recent studies have shown that, Hb fluctuates with the large amount of exercise training in athletes during heavy initial training Hb decline, which is due to the large amount of exercise training accelerated red blood cell destruction, hemoglobin free out of the red blood cells involved in muscle protein synthesis and red blood cell, red blood cell destruction and hemoglobin decline is a reaction to the large amount of exercise training early. After a phase of training athletes to exercise gradually adapt, improve the functional state of athletes, Hb content will rise, then the athletes good performance status, race generally better results. Hb values in this study the training and control groups in each stage before the change is consistent with this conclusion, indicating that before the training program will be reasonable, the athletes did not appear tired.

The initial value of the nutrition intervention before the test, the experimental and control groups were within the normal range, there is no significant difference, indicating that the two groups of athletes for winter training load to stimulate better adaptability, Hb resume soon after the end of winter training normal level.

3.4.2. Nutritional intervention on athletes

Blood urea nitrogen BUN is catabolic end products of protein and amino acids and other substances, is the human body protein metabolism assessment index. Under normal physiological conditions, urea production and excretion in dynamic equilibrium, blood urea concentration is relatively stable. When normal quiet BUN value 1.7-7mmol/L, athletes quiet high blood urea concentration can be reached 5.5-7.0mmol / L, because of the influence of the training, body protein metabolism. BUN is an important indicator of assessment of training load and recovery of functional status, exercise load changes and relationship BUN load strength compared closely, when the greater load, BUN increased, the more obvious the next morning day also slow recovery. Under the same load conditions, the body's adaptability to load the worse after exercise is to generate the more BUN, quick recovery training status is good, slow recovery is poor. When the body adapt to environmental changes, BUN levels will rise, but the high level of training athletes reaction ridicule small scratch. BUN morning training period variation can be divided into three types: (1) BUN content in a slight increase in the normal range training period, indicating that exercise is not big enough or athlete training to improve the level; (2) training period began to rise, and then gradually recovered to near normal levels, indicating that a large enough amount of exercise, the body to produce adaptive response; (3) the training period BUN daily increased, indicating that excessive exercise, or after a period of training, the body has not been restored and training, body suited.

3.4.3. Nutritional intervention on athletes creatine kinase

Serum CK is an effective indicator of skeletal muscle load assessment. Exercise stress can cause CK values have increased, and serum CK activity increased with the magnitude of the relationship between physical activity very closely, elevated serum CK activity is not only related to the length of time span, and with the motion intensity. Under normal circumstances, muscle cells intact structure, function J under often makes CK rarely revealing the cell membrane, when strenuous exercise machine from CK cells poured into the blood, so serum CK activity in muscle cells can reflect the degree of adaptation for sports training. From the perspective of energy metabolism, muscle response to training stimuli generated more obvious, the other can understand in the case of excess muscle cells for energy, CK from the number of muscle cells into the blood whether the reduction. Therefore, according to 'serum CK parameters to adjust the intensity of training is scientific, serum CK measurement can provide important information for the coaches to understand the function of muscle training to adapt to the state level and athletes to ensure scientific training, can truly reflect the changes in serum CK muscle cell adaptation for sports training.

Most studies show that strenuous exercise serum CK activity increased significantly, exercise ultimate strength of CK activity can be increased to 500~ 1000 U/L, after exercise serum CK activity has increased in delayed characteristics, usually after exercise 16 -24d, reached the peak value. After the training of athletes in serum CK activity recovered rapidly, usually within 24 hours to return to normal, if you want a few days to return to normal levels, indicating that athletes may fatigue symptoms.

3.4.4. Nutritional intervention on athletes' immunoglobulin

Immune globulin is produced by the B lymphocytes. Present in the body serum, tears, saliva and other secretions of a class of glycoproteins. Antibodies can occur with a specific antigen immunoglobulin response, with many important functions, the most important is the ability to bind to the pathogen surface antigens, stimulating other immune cell differentiation and activation. Human-specific antigen depending on the molecular structure and stable region of their heavy chains, the immunoglobulin is divided into five categories,

namely Igh, IgM, IgG, IgE, IgD. In exercise immunology used in many of the former three, namely Igh, IgM, IgG, IgG which is the main component of serum immunoglobulins, most antibacterial antibiotics and antiviral IgG antibodies belong to, it is hot infection play the main force role: secretory Igh mucosal defense is the main material of the body of infection, the cells around it local immune system, protects against bacteria, fungi, viruses, and respiratory and gastrointestinal infections; IgM in the blood to prevent bacteria disease plays an important role.

Immunoglobulin IgA index value measured before nutritional intervention, the experimental group and the control group, IgG and IgM between two groups did not show significant differences. IgA youth tournament before the value of the experimental group and the control group, before IgG and IgM values in comparison with the intervention were significantly decreased ($P < 0.05$), showed that the high intensity training before reducing serum IgA, IgG, and IgM concentration, consistent with results of previous studies. Experimental group before immunoglobulins indicators IgA, IgG and IgM were no significant decline in the average, and significantly lower than those in the control group ($P < 0.05$), suggesting that, two months before the start of exogenous oral supplement Valley glutamine in the gut was effectively absorbed in part by the direct use of intestinal cells, intestinal cells can reduce plasma glutamine intake; the other part is absorbed into the bloodstream, increase plasma glutamine levels. Plus adding that creatine powder, whey protein powder and sugar FDP vitality, promote the repair protein athletes, accelerating resynthesis of energy, to reduce the degree of suppression of immune index, suppression of the immune shorten time, improve the B lymphocytes Immune Function.

4. Conclusions

Sports nutrition in the recovery after training hemoglobin, hematocrit, testosterone and other indicators to be significantly better than the load adjustment is limited to the recovery of sports nutrition and training to adjust the load down to creatine kinase. Blood urea nitrogen recovery index values are valid, but there was no significant difference. Before the large amount of exercise training and competition will make the Hb value decreased, BUN, CK rises, before the game to add protein powder and continuous glutamine, skeletal muscle cells can promote the synthesis of proteins, significantly improved body rowers function and promote recovery from fatigue after exercise load. Glutamine, creatine powder and whey protein powder and sugar FDP viability as a nutritional supplement, from two months before to two weeks after the continuous application to help improve immune system rowers and improve the quality of training and competition results.

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