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The Research on the Impact of Maca Polypeptide on Sport Fatigue

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Abstract: In order to study the effect of maca polypeptide on sport fatigue, this paper selected 40 male mice, and they were randomly divided into group A, B, C and D. group A, B and C were fed food with different concentrations of maca polypeptide, and group D was control group. After two weeks of feeding, measured physiological indexes of mice, including blood glucose, urea nitrogen and creatinine. At last gived the experimental results, as well as the analysis. Experimental results show that maca polypeptide can improve the ability of anti-fatigue mice, and in a certain concentration range, the higher the concentration, the better the resistance to fatigue.

Keywords: Anti-fatigue, maca polypeptide, sport fatigue.

1. INTRODUCTION

Maca is a cruciferous plant originated from South America in the Andes [1]. Leaves are oval. Its roots like small round turnip. It is edible, and it is a pure natural food, rich in nutrients, has the "South American ginseng" reputation. The most common is yellow root, and its shape and taste are best. maca is rich in high unit nutrients, nourishing the physical of human body. Maca is origin of high altitude mountain [2]. It is suitable for growing in the land of high-altitude, low latitude, high diurnal temperature, slightly acidic sandy loam and sunny. It is located in the Andes of South America, is cultivated in Peru and Central and South. In Yunnan and Xinjiang region of China, there are kinds of large area land suitable for it.

Maca by color can be into white, yellow, purple and black. The darker the color, the better the quality, and the higher the active ingredient. Purple maca is relatively scarce. The black is more precious rare, is the best of breed maca [3].

Maca has more stringent requirements on the climate, with the average temperature of 5 to 10. Maca is suitable for growing in cool, large temperature difference between day and night climates. Yunnan is suitable for planting in 2800 ~ 3500 meters above sea level. If altitude drop, the temperature is too high, maca plant respiration rate is large, nutrient consumption is large, accumulate is not enough, so root cannot be enlarged, affecting production, while increasing pests and diseases [4].

Maca growth and development needs more humid environment, where annual rainfall should be 800 ~ 1000mm, and relative humidity is 60 to 80%. From July to November the soil moisture should be 20% to 30%. When soil moisture is below 20%, it will affect the growth and development of maca, ultimately affecting production. But too much water can easily lead to the occurrence of root rot diseases.

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Maca is fond of strong light, to try to cultivate in the sunny, under conditions of insufficient light. Under conditions of insufficient light, maca production is low, and quality is poor. Experimental studies show that fewer than 70 percent shade conditions, maca plant is dying [5].

It requires slightly acidic sandy soil and loose soil. The best choice is good drainage, a small slope and soil fertile land.

The rest of the paper is organized as follows. In Section 2, exercise fatigue is summarized briefly. In Section 3, experiment materials and methods are described. In Section 4, experiment results are discussed. Finally, a conclusion is provided in Section 5.

2. EXERCISE FATIGUE

Organism athletic ability is affected by training level, physical condition, sports environment, dietary nutrition and mental state, and many other factors. Regular exercise and physical activity can help blood circulation, enhance physical fitness. Conversely, prolonged exercise or overworked may become a factor [6]. Exercise-induced fatigue is due to physical and mental stress for a long time, the body has not effectively rest and adjusts, causing organism nervous, endocrine, immune dysregulation of various system functions [7].

After the big intensity and large amount of exercise training, athletes often have varying degrees of overtraining response, decreased exercise capacity, loss of appetite, sleep disturbances, tired of training, poor excitability, general fatigue, depression and other symptoms [8]. Be seen, decreased exercise capacity caused by muscle maintaining a certain state and keeping systolic and diastolic is the main factor of sports fatigue. Multi-organ, multi-system dysfunction is the essence of sports fatigue.

3. EXPERIMENT MATERIALS AND METHODS

3.1. Experimental Animals

Select 40 healthy male mice, weighing 182 to 229 g.

3.2. Animal Grouping

This study uses totally 40 male mice. The mice were randomly grouped, divided into 4 groups of A, B, C and D.

(1) Group A is the sports experimental group with 5g / L maca polypeptide content;

(2) Group B is the sports experimental group with 10g / L maca polypeptide content;

(3) Group C is the sports experimental group with 20g / L maca polypeptide content;

(4) Group D is the general sports experimental group.

3.3. Animal Feeding

All animals were feeding in the laboratory with room temperature 24±3℃, illumination from 08:00 to 19:00, and housed separately (10 mice each cage). Supply conventional cylindrical feed and distilled water. Animals are free to eat and drink. Sawdust bedding changed every three days. Adaptive swimming training for two weeks, each group of experimental animals are housed separately, with free food and water. Group A, B and C are feed food with seted maca polypeptide content in the morning and evening every day. Table **1**.

Table 1. The weight test results after the mice were grouped.

The group	Number	Weight (g)
A	10	23.26±1.10
B	10	22.86±2.51
C	10	23.94±2.05
D	10	23.12±3.10

3.4. Detection Items and Significance

(1) Blood glucose and glycogen

Sugar is the main component of human food, accounting for more than 50% of the total food. Providing energy is the most important physiological functions of sugar. Sugars, protein and lipid polymers plays an important role in the regulation of cell-cell interactions or between cells and other biological substances. Glucose metabolism mainly refers to a complex series of glucose chemical reactions in the body. When sufficient oxygen, glucose aerobic oxidation, complete oxidation of and . In hypoxia, glycolysis occurs, generating lactic acid. Glucose can also be anabolic, aggregated into glycogen stored in the liver or muscle tissue.

Sugar means blood glucose. The main organ of blood sugar regulation is the liver. Blood sugar levels are fairly constant, which is the result into and out of the blood glucose homeostasis. Blood glucose are up-taken by the surrounding tissue and liver tissue. When strenuous exercise, need to consume a lot of energy substances sugar. Fatigue movement consume a large amount of glucose and glycogen, so carbohydrate reserves decline, decreased ability to regulate hormone.

(2) Urea nitrogen (BUN)

Urea (a molecule urea containes two nitrogen atoms, so called urea nitrogen) is the final product of an amino acid catabolism *in vivo*. Its molecular weight is only 61 and does not bind to plasma proteins, it can be freely filted by glomerular. 40% to 60% urea entering the primary urine is reabsorbed in the tubules and catheter. Its reabsorption and water reabsorption in the site are subject to the anti-diuretic hormone regulation. Various reasons cause increased secretion of antidiuretic hormone, blood urea increased. Enhanced protein degradation can occur non-renal blood urea increased. Sports fatigue causes elevated blood urea nitrogen, may be due to stress increased cortisol, plasma amino acids in muscle decline, increased muscle protein breakdown, and other factors lead to decreased kidney function [9, 10].

(3) Creatinine (CR)

Creatinine is the common indicators to understand renal function. Most of the creatinine are filted by glomerular into the primary urine, not to be tubular reabsorption. Serum creatinine increased, suggesting that there has been severe renal impairment. Creatinine is often combined with urea nitrogen indicators to analysis renal impairment in clinical.

3.5. Statistical Methods

Data is expressed in the form of Mean±SE, and data accuracy level is 0.02. The formula of mean is as follow:

$$E(x) = \frac{1}{n}\sum_{i=1}^{n} x_i \tag{1}$$

Standard error estimates formula is as follow:

$$\sigma_s = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n} v_i^2} \tag{2}$$

$$\sigma = \sqrt{\frac{1}{n}\sum_{i=1}^{n} \delta^2} \tag{3}$$

3.6. Analysis of Results

(1) Urea nitrogen (BUN)

BUN values of group A, B and C were compared with the urea nitrogen value of D. The urea nitrogen value of group A is higher than urea nitrogen value of group D, and there is no significant difference in statistics (P> 0.05); The urea nitrogen value of group B is higher than urea nitrogen value of group D, and there is significant difference in statistics (P< 0.05); The urea nitrogen value of group B is higher than urea nitrogen value of group D, and there is significant difference in statistics (P< 0.01) too (Table **2**).

BUN values of group A and B were compared with the urea nitrogen value of C. The urea nitrogen value of group A and B is lower than urea nitrogen value of group C, and there is significant difference in statistics (P< 0.01); The urea nitrogen value of group B is lower than urea nitrogen value of group C, without significant difference in statistics (P>0.05) (Fig. (**1**)).

Table 2. The mice BUN test results for each group after the test.

The group	Number	BUN (mmol/L)
A	10	11.89±1.02
B	10	13.04±1.25
C	10	14.13±1.24
D	10	10.26±1.56

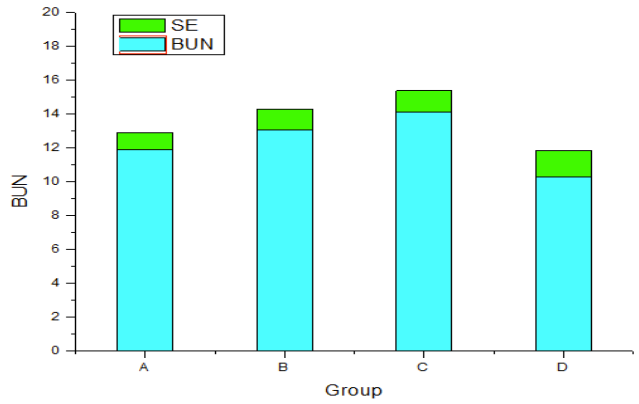

Fig. (1). The mice BUN test results for each group after the test.

The urea nitrogen value of group A is lower than urea nitrogen value of group B, without significant difference in statistics (P>0.05). Above showed, the BUN values of group A, B and C with maca polypeptide are higher than the urea nitrogen value of D, showed that maca polypeptide can effectively reduce the urea nitrogen due to exercise-induced fatigue generated.

(2) Creatinine (CR)

The CR values of group A, B and C were compared with the CR value of D. The CR value of group A and C is higher than CR value of group D, and there is no significant difference in statistics (P> 0.05); The CR value of group A and B is higher than CR value of group D with significant difference in statistics (P<0.01). (Table **3**).

CR values of group A and B were compared with the CR value of C. The CR value of group A is lower than CR value of group C, and there is no significant difference in statistics (P>0.05); The CR value of group B is higher than CR value of group C with significant difference in statistics (P<0.05).The CR value of group A is lower than CR value of group B significant difference in statistics (P<0.01). (Table **4**).

The above analysis shows the CR values of group A, B and C with maca polypeptide are higher than the CR value of D, meaning that maca polypeptide can effectively increase the CR [11].

The blood glucose values of group A, B and C were compared with the blood glucose value of D. The blood glucose value of group A, B and C is lower than blood glucose value of group D, with significant difference in statistics (P<0.01).The blood glucose value of group A is higher than blood glucose value of group B, with significant difference in statistics (P<0.05). (Fig. (**2**)).

Table 3. The mice CR test results for each group after the test.

The group	Number	CR (umol/L)
A	10	48.55±3.25
B	10	49.28±2.48
C	10	51.49±3.22
D	10	46.84±2.71

Table 4. The mice blood glucose test results for each group after the test.

The group	Number	Blood glucose (mmol/L)
A	10	6.78±0.46
B	10	7.92±0.42
C	10	9.05±0.57
D	10	5.41±0.60

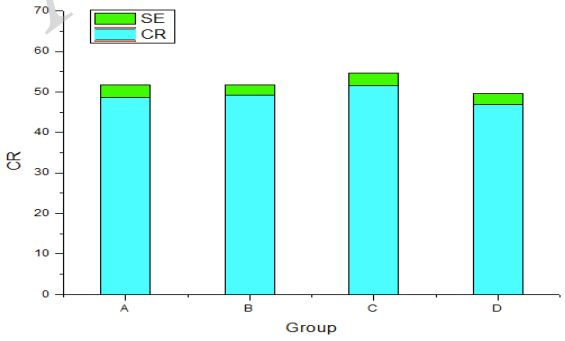

Fig. (2). The mice CR test results for each group after the test.

(3) Blood glucose

The above analysis shows the blood glucose values of group A, B and C with maca polypeptide are higher than the blood glucose value of group D. (Fig. (**3**)).

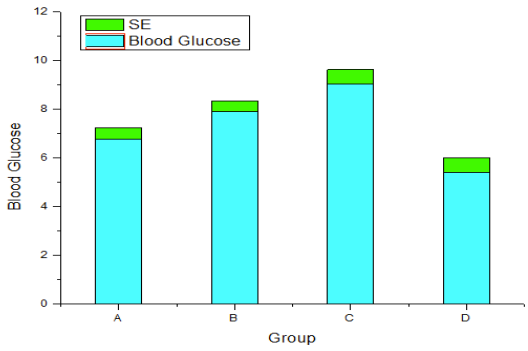

Fig. (3). The mice blood glucose test results for each group after the test.

CONCLUSION

In order to study the effect of maca polypeptide on sport fatigue, this paper selected 40 male mice, and they were randomly divided into group A, B, C and D. group A, B and C were fed food with different concentrations of maca polypeptide, and group D was control group. After two weeks of feeding, measured physiological indexes of mice, including blood glucose, urea nitrogen and creatinine. At last gived the experimental results, as well as the analysis. Experimental results show that maca polypeptide can improve the ability of anti-fatigue mice, and in a certain concentration range, the higher the concentration, the better the resistance to fatigue.

CONFLICT OF INTEREST

The author confirms that this article content has no conflict of interest.

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