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Research Article

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Experimental research into the influence of wheat oligo-peptides on protein in skeletal muscles under high intensity exercise

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ABSTRACT

Purpose: Exploring and discussing the influence of wheat oligo-peptides on the metabolism of protein in wistar rats' skeletal muscles and its mechanism. Method: 24 male wistar rats are classified at random into a normal control group (Group A, n=8), an exercising group (Group B, n=8) and an exercising+wheat oligo-peptide group (Group C, n=8). Results: after doing exercises, the content of protein in the wistar rats' skeletal muscles falls (P<0.05); after the rats are supplied with wheat oligo-peptides, the content of Pro and Myo in the wistar rats' skeletal muscles significantly rises (P<0.01). Conclusions: high intensity exercises may inhibit the synthesis of protein in the skeletal muscles; the wheat oligo-peptide may effectively relieve the reduction of the content of protein in the wistar rats' skeletal muscles arising from heavy load exercises, and has the functions of relieving the physical fatigue and improving the oxygen deficiency tolerance.

Keywords: Wheat oligo-peptide; Skeletal muscle; Myosin; Promoting the synthesis of protein

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INTRODUCTION

Wheat oligo-peptide is made from gluten flour through the processes of pulp conditioning, enzymolysis of protease, separation, filtration, spraying, drying and so on. On September 5, 2012, the wheat oligo-peptide was approved as a kind of new food according to the Declaration on Approving the Medium and Long-Chain Fatty Acid and Wheat Oligo-peptide as A New Kind of Food and so on (WSBGG2012NO16)published by the Ministry of Health of the People's Republic of China. According to related researches, the wheat oligo-peptide may promote the synthesis of protein[1]. There have been few reports about the intervention of wheat oligo-peptide in the synthesis of muscle protein and its regulation mechanisms. In this research, the protein in the skeletal muscle and Myosin are measured by supplementing the wheat oligo-peptide to reflect the metabolism of protein in the skeletal muscle and to discuss the intervention of wheat oligo-peptide in the synthesis of protein in wistar rats' skeletal muscles.

EXPERIMENTAL SECTION

1 Selection of materials and method

24 clean grade male wistar rats 10 weeks old (weight: 300～350g) are selected and purchased from the animal experimentation center of Norman Bathune College of Medicine Jilin University [Permit No. SCXK(J)2012-0003]. The rats are classified into a normal control group (Group A, n=10), an exercising group (Group B, n=10) and an exercising+wheat oligo-peptide group (Group C) [2]. They are raised in different cages, 8 ones in each cage at the temperature of 22±3°C in natural light. The pads are replaced once every day to keep the cage dry. The rats are fed at 9pm every day with the feed for rats purchased from Shanghai Bio-TECH.

1.2 Experiment Plan

The exercise is swimming under no load for 6 days every week. In the first 2 weeks, training for adaptation to special environment is conducted, and the duration is gradually increased to 90 min within the two weeks, the training lasts for nine weeks in total. During training, attention shall be paid to the rats to prevent them from drowning, the water in the pool shall be kept clean, and the pool is rectangular 90 cm×80 cm×55cm, 45 cm deep with the water temperature of 31±2°C. The training is conducted in the afternoon every day. The rats from Group B and Group C will have wheat oligo-peptide solution freshly prepared based on the dosage of 500 mg/kg of the weight. The wheat oligo-peptide is provided by Zhongshi Duqing (Shandong) Biotech Co., Ltd. The experiment is completed in the lab of the Sports Institute of Changchun Normal University[3].

1.3 Material Selection

The animals have a rest for one day after the last high intensity exercises, and they shall not be fed 12 hours and injected with 50mg sodium pentobarbital solution of 2% into their abdomens per kg of the weight before they are sampled. The gastrocnemius muscles of right rear limbs are taken from the three groups, fat and visceral fascia are removed, and put into the liquid nitrogen for storage[4]. 400mg muscle tissue is taken, cut into tiny pieces and then moved into the glass homogenizer, 3ml pre-cooled physiological saline is added; tissue homogenate of 10% is prepared by grinding, and centrifugalize at the speed of 3000r/min at low temperature for 10 minutes, the supernatant is taken and stored at the temperature of -40□ to get ready to measure Pro and Myo in the skeletal muscles.

1.4 Measurement of the indices

BCA method is used for measuring the content of Pro in the skeletal muscles, and the assay kit is purchased from Beijing Solarbio Technology Co., Ltd.

RESULTS

2.1 Change in the wistar rats' weight

Seen from Table 1, there is no significant difference in the wistar rats' weight between the groups before the experiment. Upon completion of the experiment, the weight of the wistar rats from Group B(high intensity exercises) significantly falls compared with Group A (control) and Group C (wheat oligo-peptide)($P<0.01$). The weight of the wistar rats from Group A and Group C does not fall significantly without significant difference.

Table 1 Comparison of Wistar Rats' Weight from Three Groups at Different Stages

Group	Sample size（n）	Before	After
A	8	318.6±22.46	351.5±20.19
B	8	316.9±26.15	257.8±25.11**
C	8	317.1±23.98	319.2±28.89

*Note: **P < 0.01, Group B is significantly different from Group A and Group C.*

2.2 Change in the content of Pro and Myo in the wistar rats' skeletal muscles

Table 2 Comparison of Levels of Pro and Myo in the Skeletal Muscles from the Groups

Group	Sample size（n）	Pro（mg/g)	Myo(mg/g.pro)
A	8	96.1±15.32	16.7±2.67
B	8	74.9±14.56	12.1±1.78**
C	8	95.9±17.09	17.7±2.55

*注：**P < 0.01, Group B is significantly different from Group A and Group C.*

Seen from Table 2, there is no significant difference in the Pro content of wistar rats compared with that of Group A and Group C ($P>0.05$), however, the content of Pro and Myo in the skeletal muscles of wistar rats from Group B falls significantly ($P<0.01$).

DISCUSSION

Wheat oligo-peptide is a kind of micromolecular peptide substance prepared by using the modern biological enzymolysis technology, and is the same as the oligo-peptide from other proteins. Wheat oligo-peptide also has several physiological adjustment functions, such as enhancing immunity, oxidation resistance, protecting intestinal mucosa and resisting fatigue arising from exercises. It is applicable to the development of the health food that have similar functions.

3.1 Influence of high intensity exercises on the content of Pro and Myo in the skeletal muscles

Apoptosis is the active dying course of cells regulated by genes, and is an indispensible constituent in the life of multicellular organisms, it is a normal physiological process. Apoptosis is a growth process of cells and the same as the proliferation, growth and differentiation of cells. All of activities of human bodies are completed through contraction and stretching of muscle tissues, and long-term high intensity exercises may cause damage to the cells of skeletal muscles[5]. When the exercise load exceeds the physiological adjustment capacity of organism, apoptosis occurs and the dead cells increase, leading to the death of skeletal muscle cells, which is the fundamental reason for the fall of ability to do exercises. Accordingly, undoubtedly, the damage to the muscle tissues arising from high intensity exercises will affect human beings' functions to move and seriously affect the sportsmen's and manual workers' ability to work.

According to the research, the weight of wistar rats from Group B is significantly lower than that from the control group, and it means that the weight of wistar rats reduces significantly through six weeks' high intensity exercises, and its content of Pro and Myo in the skeletal muscle is significantly lower than that of Group A and Group C. It further means that high intensity exercises may inhibit the synthesis of protein in the wistar rats' skeletal muscles, leading to the significant reduction of Pro and Myo content.

3.2Influence of wheat oligo-peptide on the Pro and Myo in the wistar rats'skeletal muscles that have done high intensity exercises

According to the research results, wheat oligo-peptide may inhibit the synthesis and metabolism of protein in the wistar rats' skeletal muscles. Wheat oligo-peptide is a functional oligo-peptide produced from wheat protein through the hydrolysis involving enzymes[6]. The molecular weight of the oligo-peptide is small, and the process of enzymolysis is often associated with important restructuring, and some hydrophobic areas originally buried inside the protein moles are exposed and acquire new nutritional functions and biological characteristics. It means that the wheat oligo-peptide plays an active role in improving the level of protein in the rats' skeletal muscles that have done exercises, and may relieve the fall of the level of protein in the skeletal muscles caused by long-term heavy load exercises, and has the function of keeping the skeletal muscles contracting, improving the organisms' ability to do exercises as well as improving the anti-fatigue effect.

CONCLUSION

The wheat oligo-peptide supplemented provides sufficient nitrogen for the synthesis of protein in the rats' skeletal muscles that have done high intensity exercises, and ensures the smooth synthesis of protein on one hand, and the wheat oligo-peptide may remove the free oxygen radicals generated during exercises as it has the anti-oxidation function and may protect the skeletal muscle tissues from being damaged. In addition, wheat oligo-peptide may contain some bioactive substance, and may adjust the environment inside the organisms doing exercises to promote the biologic synthesis of protein in the skeletal muscles. Accordingly, wheat oligo-peptide may have the functions of biologic active peptides, and the synthesis and metabolism of protein in the skeletal muscles of wistar rats that have done heavy load exercises may be promoted by supplementing the wheat oligo-peptide during heavy load exercises, and it has the very important functions of relieving the fall of the level of protein in the skeletal muscles caused by heavy load exercises.

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