Morphological changes in the muscle tissue of mice with the use of adaptogens

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Abstract. Due to the fact that it is important for athletes to restore the physiological functions of the body after physical exertion, it is necessary to develop corrective measures. One of such methods can be the use of adaptogen preparations of various origins. In this regard, the goal of our research was to study morphological changes in the body of laboratory animals during physical exertion and the use of biologically active substances. For this, the object of the study was mice, the subject of the study was an adaptogen of plant origin - tincture of safflower leuzea, and of animal origin - tincture of pantocrine. Distilled water was used in the control group of animals. Research data carried out for 28 days indicate that in the body of mice, over the limit loads lead to a violation of morphogenesis in a number of internal organs. It has also been established that the use of tincture of leuzea safflower and pantocrine before physical exertion allows you to correct and stabilize the physiological functions of the body of animals, and in particular, the physiology and morphogenesis of the skeletal muscles of animals. The best effect was manifested from the use of an adaptogen of plant origin.

1. Introduction

To stimulate physiological processes in the human body leading an active lifestyle, the urgent issue is to ensure the adjustment of the constancy of the internal environment [1–3]. After prolonged physical exercise, a violation of the constancy of the internal environment is recorded, which further leads to negative consequences. A number of researchers note the effect of super high loads on histological changes in a number of vital internal organs such as lung tissue, cardiac muscle tissue, kidney, liver, and also in skeletal muscle tissue. [4–8].

To reduce body fatigue and to activate physiological processes after prolonged physical exercise, researchers recommend using a pre-developed individual nutritional regimen [9–14].

Research results indicate that these substances accelerate the recovery process of the body, correlate its functional abilities, affect the structure of muscle fibers, kidneys, spleen, skeletal muscle, blood morphology, and histological structure in some organs [15–18].
Thus, we can say that many authors share the opinion that the acceleration of the body's recovery after physical exertion is possible through the intake of certain adaptogen drugs.

2. Condition, materials and methods
The study used observation methods, experimental, model, physiological, histological and morphological research methods, statistical analysis and generalization [17–20].

According to the methodological recommendations proposed in 1977 by Porsalt, the influence of the moral root and pantocrine on the performance of the organism of laboratory mice was studied during the period of twenty-eight days from the beginning of the experiment. The structure of internal organs was studied by methods generally accepted in histology. Histological sections were stained according to the technique developed in 1889 by Ira Van Gieson and stained by hematoxylin-eosin.

Modeling of physical activity was carried out in the conditions of the department of private animal breeding on laboratory animals in the amount of 60 ones. We formed groups identical to each other, taking into account age, sex and body weight (table 1).

| Group          | Drug              | Dosage and administration |
|----------------|-------------------|---------------------------|
| experienced 1 | tincture of leuzea| The dosage of adaptogens was calculated according to the method proposed by Clark on the basis of live weight of animals. Which amounted to 2 μl at the beginning of the experiment, subsequently increased the dosage to 6 μl for all experimental groups |
| control 2     | pantocrine tincture|                          |
| control       | distilled water    |                           |

Laboratory animals that participated in the experiment on the study of performance were in the conditions of the university vivarium, taking into account the recommendations of the rules for keeping experimental mice in accordance with the Directive 2010/63/EC.

3. Analysis and results
When studying the duration of physical activity of laboratory animals at the beginning of experimental studies, serious changes were not recorded for this indicator, which ranged from 49.60 to 51.60 seconds, at the end of the first week the modeling of the swimming activity expiration did not increase, after two weeks it sharply increased (figure 1).
Figure 1. Swimming activity of experimental mice after completion of the experiment.

The blood vessels were of varying size and moderate congestion. Perivascular edema was revealed. Dystrophic changes in muscle tissue were also observed (figures 2, 3).

Figure 2. Perivascular edema of the skeletal muscle tissue of an animal in the control group. Stained with hematoxylin-eosin. Micrograph. Ok. 10, about 20.
Figure 3. Perivascular edema of the musculoskeletal tissue of the animal of the control group. Stained with heme.-eosin. Micrograph. Good. 10, about 20.

The vessels of the animals receiving leuzea were characterized by edema; between the muscle fibers, erythrocytes were excreted outside the blood vessel. In this experimental model, the dystrophic changes in muscle cells were the smallest. The edema decreased (figures 4, 5).

Figure 4. Skeletal muscle tissue of an animal treated with safflower-like levzea. Stained with hematoxylin-eosin. Micrograph. Ok. 10, about 20.
Figure 5. Skeletal muscle tissue when giving animals safflower. Stained with hematoxylin-eosin. Micrograph. Good. 10, about 20.

In the group of animals receiving pantocrine, a decrease in the edema of the nucleus was noted, the number of erythrocytes released into the tissue was clearly visible and decreased. There was no complete recovery (figures 6, 7).

Figure 6. Skeletal muscle tissue of an animal receiving pantocrine. Stained by hematoxylin-eosin. Micrograph. Ok. 10, about 10.
In the experimental group, the proportion of leukocytes decreased at the end of the experiment, and increased in the control group.

Table 2. Morphological blood parameters of experimental mice after exercise and the use of adaptogens.

| Index                  | Research term | 7 days     |          | 28 days     |          |
|------------------------|---------------|------------|----------|------------|----------|
|                        |               | experienced 1 | experienced 2 | control | experienced 1 | experienced 2 | control |
| Red blood cells x 10^{12}/l |               | 7.18±0.360 | 6.87±1.8* | 6.93±0.62 | 7.02±0.41* | 7.41±2.1* | 6.01±0.52 |
| Hemoglobin, g/l        |               | 165±3.50 | 159±8.4 | 163±8.20 | 163±3.70* | 168±8.8* | 146±10.10 |
| White blood cells x10^9/l |               | 7.29±0.16 | 6.89±1.2* | 7.13±0.80 | 5.98±0.28* | 5.5±0.9 | 8.81±0.90 |
| Lymphocytes            |               | 66.05±3.60 | 66.19±9.70* | 67.14±3.10 | 71.30±5.00* | 71.98±9.10 | 65.40±2.90 |
| Neutrophils            |               | 32.50±0.70 | 31.80±0.90* | 33.01±0.70 | 23.01±0.63** | 18.01±6.00 | 12.90±1.70 |
| Neutrophils stab       |               | 4.96±1.20 | 5.96±0.90* | 4.30±1.01 | 2.48±1.00** | 2.60±1.10 | 3.68±0.33 |
| Neutrophils segmented  |               | 29.91±1.10* | 25.91±1.40 | 27.40±0.99 | 22.03±0.99* | 15.08±2.10** | 25.10±1.30 |
| Eosinophils            |               | 1.04±0.01 | 1.00±0.06 | 1.08±0.002 | 2.86±0.04* | 0.42±0.01 | 2.86±0.01 |
| Basophils              |               | 0.91±0.004 | 0.55±0.001 | 0.85±0.001 | 1.46±0.002* | 0.49±0.01 | 1.46±0.002 |
| Monocytes              |               | 1.08±0.01 | 1.2±0.001* | 1.10±0.002 | 1.57±0.03* | 1.38±0.02 | 1.57±0.001 |

4. Conclusion
To activate the physiological functions and resistance of the animal organism to maximum physical exertion, tincture of pantocrine and safflower leuzea can be used in the recommended doses. After prolonged physical activity when using adoptogens, a complete recovery of the body is recommended. We recommend using our research to develop recovery programs.
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