Morphofunctional changes in the kidneys of mice with the use of adaptogens against the background of physical exertion

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Abstract. When performing maximum physical activity, the main role for maintaining motor activity and homeostasis of the animal body is given to the kidneys. In this regard, the purpose of our research is to study morphological changes in the body of laboratory animals during physical exertion and the use of biologically active substances. One of the first to carry out a comprehensive assessment of the histological changes in experimental animals when given adaptogens (tincture of moral root, pantocrine and a combination of the same drugs with oats) against the background of maximum loads. The dosage of adaptogens was calculated according to the method proposed by Clark, based on the live weight of the animals. Which was 2 μl at the beginning of the experiment, subsequently the dosage was increased to 6 μl for all experimental groups. The first group was given distilled water, and the experimental group received leuzea tincture and oatsol. Ovesol was poured in a dose of 4 μl from 22 to 26 days. The total duration of the experiment was 28 days. It was also found that the use of tincture of moral root (safflower leuzea) and pantocrine prior to physical exertion makes it possible to correct histological changes.

1. Introduction
Prolonged super high physical activity has a negative effect on the body of the animal and the person, and later becomes chronic. Researchers indicate the influence of physical activity on biological processes in the body [1–5]. To increase the recovery processes, a number of researchers suggest the use of adaptogens of various natures to improve physical qualities. These drugs make it possible to correct the functional capabilities of the body and have a positive effect on the hematological and biochemical parameters of the blood, as well as on the morphogenesis of internal organs. [6–13]. Scientists in this field recommend the use of specialized food additives and adaptogens of animal and plant nature to improve the physical capabilities of the human and animal organism [14–19].

2. Condition, materials and methods
The methodological basis of this work is a set of general biological and special methods, including empirical and theoretical research. In the course of the study, we used the methods arising from the tasks that were solved in the course of the work: observation, experimental, model, physiological, histological and morphological research methods, statistical analysis and generalization [3–11]. The essence of these
approaches is a systematic approach aimed at studying morphological changes in the body of mice, using adaptogens against the background of physical stress and, in general, with the coordinated functioning of all its constituent structures, which is the basis for determining the reliability of the research results. 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.

Table 1. Scheme of experimental studies to study the effect of physical activity and the use of adaptogen preparations on the body of animals.

| Group       | Drug                          | Dosage and administration                                                                 |
|-------------|-------------------------------|------------------------------------------------------------------------------------------|
| experienced 1 | tincture of leuzea           | The dosage of adaptogens was calculated according to the method proposed by Clark, based on the live weight of the animals. Which was 2 μl at the beginning of the experiment, subsequently increased the dosage to 6 μl for all experimental groups |
| experienced 2 | pantocrine tincture           |                                                                                          |
| experienced 3 | tincture of leuzea and Ovesolo | In the groups of combined use of adoptogen, oatsol was administered from 4 μl from day 22 to day 26. |
| experienced 4 | pantocrine tincture and Ovesolo |                                                                                          |
| 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
According to our data, after prolonged exertion, a decrease in the mass of mice internal organs was recorded, these mice were used in the experiment when giving biologically active substances. When studying the duration of physical activity in 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 and was even lower than before the start of the experiment and was within the range from 47.90 to 49.00 seconds. 14 days after the beginning of the experiment, the duration of swimming increased sharply in all groups, especially this indicator was significant in the second group of animals, where it increased by 128.40 seconds, in mice of the third group in this period it was 125.30 seconds., In the fourth group in this the period was 120.50 seconds. The indicators of the duration of swimming in the experimental groups in comparison with the control group increased by 97.0 seconds, respectively.

In the kidney of the control group, congestion was found. The erythrocyte release was observed in the cortex.
In the proximal and distal tubules, dystrophic changes were observed and accumulations of blood cells were determined (figures 1, 2).

**Figure 1.** Venous hymeria of the brain substance of the kidney of the animal of the control group. Hematoxylin-eosin stain. Micrograph. Ok. 10, vol. 40.

**Figure 2.** Venous hyperemia of the cortical substance of the mouse kidney of the Control group. Stained with heme.-eosin. Micrograph. Ok. 10, about. 40.
Mice of the experimental group, after physical exertion, have the preparation of Leuza safflower determined by the cortex and medulla. Pathological changes are less pronounced than in the control group of animals. The nephron consists of the renal corpuscle, the nephron tubules, loops, and the collecting duct are clearly visible. (figure 3).

**Figure 3.** Venous hyperemia of the cortical substance of the kidney when giving the animal a safflower levzea. Stained with heme.-eosin. Microphotography. Ok. 10, about. 40.

Clusters of lymphoid cells are also found. It was not possible to detect especially pronounced changes in the histostructure of the kidneys of the animals of the experimental group, who received the preparation pantocrine (figure 4).

**Figure 4.** Dystrophic changes in the cells of the tubules of the kidneyof mice in experimental group No. 3. Stained with gem-eosin. Micrograph. Ok. 10, about. 40.
The venous vessels are full-blooded, accumulations of erythrocytes were observed in the renal corpuscles, dystrophic changes were found in individual cells of the tubules, accumulations of lymphoid cells were found around the tubules of the nephron and blood vessels.

The microcircular bed of both the cortical and the medulla in the experimental group treated with pantocrine and ovesol preparations without pronounced changes. The cells show weak degenerative changes (figure 5). Mice of the experimental group that received preparations of Leuzea safflower and oatsol, have kidneys covered with a connecting capsule, under the capsule is the cortex, followed by the medulla. Nephron, consisting of the renal corpuscle, located in the cortex and nephron tubules (figure 6). The renal corpuscle consists of a vascular glomerulus and a glomerular capsule. The blood capillaries of the glomerulus are moderately congested, while the blood vessels surrounding the tubules of the nephron are characterized by hyperemia. The microcircular bed of both the cortical and the medulla remains without significant changes in comparison with the control group of animals. This part of the nephron passes into the distal section, formed by a single-layer cubic epithelium. The distal nephron flows into the collecting ducts, which are composed of a single-layer cubic epithelium. In all parts of the nephron tubules, the blood capillaries that surround them remain moderate plethora.

Figure 5. Small foci of lymphoid cells in the kidney of an animal receiving pantocrine and oatsol. Color gem. – eosin. Micrograph. Ok.10, about. 40.
Figure 6. Renal corpuscles and tubules of the nephron of animals treated with leuzea and oatsol. Hematoxylin-eosin stain. Micrograph. Ok. 10, about. 40.

Thus, the animals of the control group have stagnation accompanied by cell destruction which revealed in the kidneys after increased physical activity. After giving the drug of animal and plant nature and their combined form with oats, stagnant processes decrease.

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.

With the use of adaptogens of various nature against the background of increased physical exertion, it can reduce the degree of damage to internal organs. When the preparations were given, the least morphological disturbances were observed with the mice of the experimental groups.

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