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# Initial Dynamics of Carbohydrate Components in the Blood During Intensive Physical Loads

**Naila Bayramova**
*Baku State University, Baku, Azerbaijan*
*naile.allahverdiyeva16@gmail.com*

**Abstract**

Blood glucose and lactic acid (lactate) levels were determined in 3-month-old rabbits at the intervals during the day after 1 hour of immobilization and 10 minutes of forced running on the treadmill. The research showed that blood glucose in intact rabbits fluctuates in the norm with a weak rhythm throughout the day. Immobilization has little effect on this dynamics, while running load leads to a significant decrease in the amount of blood glucose in the first hours, during which the amount of lactate in the blood increases significantly. These indicators quickly normalize such dynamics of important carbohydrate components of the blood are of adaptive importance for the immature animal body.

**Key words:** immobilization, forced running, blood, glucose, lactate, daily dynamics

## Introduction

Blood as a multicomponent and multifunctional internal environmental fluid, plays an exceptional role in the human and animal organism, actively participates in a number of its adaptive reactions (Alimov, 2016, Morman, 2000). Among the multifunctional chemical components of blood, one of the substances of special physiological importance is considered to be glucose (sugar) of carbohydrate origin. In stressful situations, during the effects of physical loads and other extreme factors (lack of exogenous $O_2$, low temperature, etc.), blood glucose is an extremely important energy substrate for tissues, especially the brain, heart, and working skeletal muscles, as an "emergency fuel" (Aghayeva, 2015; Aliyev, 2017; Drozdov, 2015; Lehninger, 1985; Powers and Vaskson 2008).

The lactic acid (lactate), one of the many metabolites accumulated in the blood, is of particular interest in biochemical, physiological and clinical terms due to a number of properties. This metabolite is one of the end products of semi-disintegration reactions (glycolysis) of glucose in tissues, it is highly formed in the brain, muscle, has a toxic effect, enters the blood from cells through a special mechanism, causes fatigue in the body, is partially metabolized in the liver, can be reabsorbed by tissues as a residual energetic material (Avital, 2008).

For experimental physiology, labour and sports physiology, medical physiology, the question of the effect of physical loads on the blood system, the amount of glucose and lactate, which are its main indicators, remains relevant. The purpose of our research is to study the initial changes in the side homeostatic levels of those substances in immature experimental animals subjected to vigorous physical exertion. There is very little experimental evidence in the literature on this issue. In our previous research, some experimental facts on this issue have been presented (Bayramova, 2022; Hajiyev and Bayramova, 2021).

**Material and methods**

The objects of the research are 3-month-old Chinchilla breed rabbits. They were fed in vivarium conditions with standard feed rations, divided into control and experimental groups. In one experiment, the animals in the group were held for 1 hour in a tightly closed position, one by one lying on their backs on a specially prepared plastic board. This was a physical load of a rigid immobilization nature applied to the animal. Another experiment involved the group placing animals one by one on the treadmill. The animal was made to run hard from its place by rotating it for 10 minutes at a speed of 40-45 revolution/minute. This was a physical load of forced running applied to the animal.

From every 3–month-old rabbit subjected to control and physical load, 0.5 to 1.0 ml of blood was taken for analysis. The blood was drawn off the ear vein of the animal. This is the method that causes the most minimal injury to the animal, complies with bioethical requirements.

In control animals, blood sampling was performed during the day in the morning, afternoon, and evening, in experimental animals 1, 3 and 6 hours after physical load.

Glucose (sugar) and lactic acid (lactate) were prescribed as carbohydrate components in the blood. The amount of glucose in the blood was studied on a portable glucometer (FIA Biomed Blood Glucose Meter, Germany), the amount of lactate in the blood was studied by colorimetric method (Filippov, 1984).

The numerical materials of the research were statistically processed (Lakin, 1980). The reliability of the results of the experiments according to the control indicators was determined according to the Student’s t-tests, expressed at $p<0.05$ and $p<0.01$ levels.

**Results and discussion**

Table 1 shows the dynamics of blood glucose during the day in intact 3-month-old rabbits. It is clear from these materials that blood sugar homeostasis is a highly variable physiological parameter.

**Table 1. Daily dynamics of blood glucose in normal intact 3-month-old rabbits (M±m, n=5, glucose in mg/dL)**

| Objects of research | Glucose determination periods (hours) | | |
|---|---|---|---|
| | 10-11 | 13-14 | 16-17 |
| 3-month-old rabbits ( control) | 84,0 ± 2,3 | 91,6± 3,3 | 82,4± 2,4 |
| Average value 86,0±2,6 | | | |

As can be seen from the table, blood glucose in normal immature rabbits has a somewhat rhythmic dynamics, its maximum is observed at noon.

As an experimental method and physical load, immobilization has long been used in experimental physiology. It should also be noted that for some laboratory animals, it is not physiologically appropriate to stay tied on the back for a long time, it is accompanied by a considerable amount of nerve and muscle tension in the body, the urgent secretion of some hormonal agents, a number of metabolic changes, may play as stressor and emotiongenic factors (Elisa et al., 2008). Our experiment shows that this physical load also affects the level of glucose in the blood (Table 2). However, it was found that this effect is weak, noticeable in the first hour after immobilization.

**Table 2. Changes in blood glucose homeostasis in 3-month-old rabbits after immobilization and forced running loads (M± m, glucose, mg/dL)**

| Types of physical loads | Glucose determination periods (hours) | | |
|---|---|---|---|
| | The 1$^{st}$ hour | The 3$^{rd}$ hour | The 6$^{th}$ hour |
| Immobilization, number of animals, n= 5 | 79,2 ± 2,3 | 82,4± 2,0 | 80,3± 1,8 |
| Forced running, number of animals, n= 5 | 73,5 ± 3,7* | 77,8± 3,4* | 81,6± 3,2* |

Note: * - Compared with the average control indicator (Table 1), the statistical reliability of the experimental indicator is $p<0,05$.

Intensive 10-minute running load on treadmill leads to a faster decrease in blood glucose in 3-months-rabbits at in the first time (in the 1st and 3rd hours). When we pay attention to the Figures of this experiment in Table 2 and compare them with the indicators we received in intact animals (Table 1), the rhythm underlying the daytime dynamics of blood glucose in normal 3-month-old rabbits weakens under the influence of intense physical load. It can be assumed that this effect may be due to the large expenditure of energy, dermal glucose, spent on muscle activity in young animals during forced jogging in treadmill.

Figure 1 shows the initial dynamics of lactate in the blood of 3-month-old rabbits that performed fast running movements on a treadmill.

The results of the research showed that after short-term intensive running on a treadmill, indoors and in a narrow area, the level of lactate in the blood increases in a statistically reliable manner compared to the control indicator, and only after a long period of time, it decreases to the normal level. This can be clearly seen from the results we obtained. In intact 3-month-old rabbits, the amount of lactate in the blood is 4.6 ± 0.48 mg%. It was 6.9 ± 0.43 mg % in the first hour after the experiment, and 4.4 ± 0.30 mg% in the 6th hour.

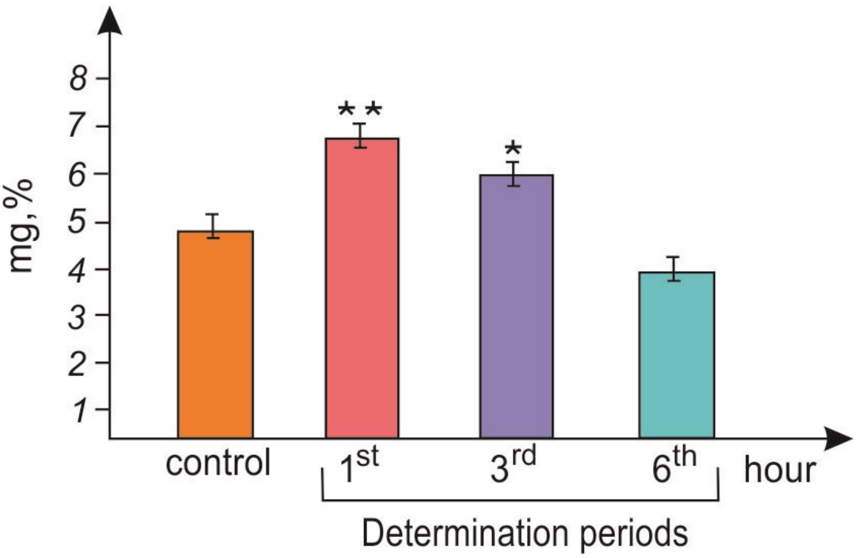


**Figure.1.** Early dynamics of lactate in the blood of 3-month-old rabbits that performed 10 minutes of forced runnimg on a treadmill. ** - p<0.01, * - p<0.05

We will see a correlative relationship if we compare the dynamics of glucose and the dynamics of lactate in the blood of 3-month-old rabbits during a forced jogging in treadbahn. Therefore, if in the first case blood glucose decreases significantly in the first period, then in the second, on the contrary, it increases. The fact is that the muscles of the skull, which work intensively during running, spend a lot of glucose, at which time glycolysis in the muscles intensifies, as a result, the amount of lactate that passes into the blood increases. In this case, adaptation in the dynamics of lactate is associated with its decrease to the norm (Shakhnova, 2000).

## Conclusion

This complex experimental study allows us to come to the following conclusions:

1. One-hour immobilization load has little effect on glucose homeostasis in the blood in 3-month-old rabbits in the first period;

2. Ten minutes of intensive running leads to an initially sharp decrease in blood glucose, an increase in lactate. There is a reverse correlation between these two dynamics.

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