Productive and morphological features of sheep determined by biophysical methods

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Abstract. The main trend in sheep breeding is a steady increase in the volume of mutton production which determines the increasing demand for meat and wool. The development and application of effective methods for increasing and improving meat productivity is relevant. Biophysical methods used in animal husbandry is of interest. One of the methods is the impact of low-intensity laser radiation. Biophysical methods used in animal husbandry can activate biological reserves and realize the genetic potential of productive qualities. At the same time, it is necessary to consider morphological features of sheep exposed to low-frequency infrared laser radiation. The article studies quantitative and qualitative indices of meat productivity, the degree of internal organs development, and the chemical composition of muscle tissues. Intergroup differences in young sheep exposed to low-frequency laser radiation were found. Positive changes in the degree of internal organs and systems development in animals exposed to low-intensity infrared laser radiation were identified. They indicate the intensity of metabolic processes in the body, the positive productivity dynamics.

1. Introduction

Sheep breeding is one of the important branches of world livestock breeding. Currently, the main focus is on increasing meat productivity and improving product quality. Therefore, for more effective development, it is necessary to study new ways to increase productivity. Moreover, the maximum use of the biological potential of animals is important [1, 2]. Since in modern conditions the successful development of sheep breeding is determined by meat productivity, the development of methods for increasing and improving meat productivity is essential [3-6].

It is known that genetic and paratypic factors determine meat productivity which affects the intensity of tissue growth and development of young animals [7, 8]. Currently, attention is paid to various biophysical factors influencing the most important adaptive systems of the body, which ensures the activation of functional reserves [9-12]. Biophysical methods used in animal husbandry in the early period of development of an organism are very effective. This strengthens the immune system, which increases productivity [13-17].

One of the promising methods of stimulating productivity, increasing the resistance of animals, including sheep, is infrared low-intensity laser radiation.

Therefore, meat productivity and morphological characteristics of sheep under the influence of low-frequency infrared laser radiation are of particular interest.
2. Research purpose
The article aims to study the effect of low-intensity laser radiation of the infrared spectrum on the body of young sheep and their productive indicators.

3. Material and research methods
The studies were performed in Stavropol Territory under the conditions of the IV agroclimatic zone (Tsimlyansky experimental station). To assess meat productivity, meat quality, varietal, morphological and chemical composition of muscle tissues, the degree of development of internal organs was studied. The object was young meat-wool sheep aged 7 months. During the lambing period, three groups of lambs were formed: group I — control (without the use of laser radiation); Group II - experimental (exposed to laser radiation), Group III – experimental (lambs obtained from ewes exposed to laser radiation). In groups II and III, laser irradiation was carried out in the area of thymus innervation. The number of exposures was twice (on the 15th and 20th days), the duration of exposure was 1.5 minutes.

The exposure was carried out using a STP device whose effect is based on the use of low-intensity laser radiation (pulsed) near the infrared spectral device.

4. Results and discussion
The data on quantitative and qualitative indicators of meat productivity indicate the advantage of the experimental groups over the control group of sheep aged 7 months (Table 1).

Analyzing the results of the control slaughter of animals aged 7 months, it was found that animals of experimental groups II and III had a larger weight than sheep of the control group by 2.2 and 3.4%. The highest value of the pair carcass was characteristic of experimental groups II and III (2.3 and 5.3% higher than the indices of the animals of the control group). Different ability to synthesize internal fat had an impact on the size of carcasses of animals of experimental groups II and III, which ensured an increase in the slaughter mass by 2.4 and 5.6%. However, the greatest slaughter mass was observed in animals of experimental group III.

One of the main indicators of meat quality is the slaughter yield, the most objectively reflecting the ratio of carcass mass and internal fat to slaughter live weight. Animals of experimental group III were characterized by the greatest slaughter mass, which ensured the slaughter yield larger by 0.8 and 0.9 %, respectively.

Table 1. Meat quality, varietal and morphological composition of sheep muscle tissue

| Parameter                | Group          |
|-------------------------|----------------|
|                         | I control      | II experimental | III experimental |
| Pre-slaughter live weight, kg | 32.4 ± 0.29 | 33.1 ± 0.43 | 33.5 ± 0.46 |
| Weight of fresh carcass, kg       | 13.2 ± 0.35 | 13.5 ± 0.38 | 13.9 ± 0.47 |
| Mass of internal fat, kg          | 0.150 ± 0.01 | 0.170 ± 0.03 | 0.195 ± 0.03 |
| Slaughter weight, kg            | 13.35 ± 0.40 | 13.67 ± 0.46 | 14.1 ± 0.48 |
| Slaughter yield, %              | 41.2           | 41.3           | 42.1           |
| Grade 1 yield, %                | 86.4           | 86.8           | 87.0           |
| Grade 1 yield, %                | 13.6           | 13.2           | 13.0           |
| Pulp yield, %                   | 71.2           | 72.1           | 72.5           |
| Bone yield, %                   | 28.8           | 27.9           | 27.5           |
| Meat ratio                     | 2.47           | 2.58           | 2.63           |

The value of carcass and meat, its taste is determined by the development of individual parts. The size of parts, their gravity varies under the influence of various factors.

The data show that the animals of the experimental groups have a higher yield of first grade cuts. By the weight of one grade, their superiority over analogues of the control group was 0.4 and 0.6 %, which indicates an increase in quality of the carcass.
Certain differences between the groups were observed in the morphological composition of carcasses. Boning of carcasses allowed us to establish the ratio of pulp and bones. It was found that the mass of pulp ranged from 71.2 to 72.5%. The results of half carcass deboning revealed the best morphological composition in experimental groups II and III which exceeded that in the control one by 0.9 and 1.3%.

The meat ratio of animals of experimental groups II and III amounted to 2.58 and 2.63 c.u., which is 4.5 and 6.5% more than that of sheep of the control group.

The level of animal productivity is determined by the development and functional activity of internal organs. The morphological and physiological components of the systems of a living organism contribute to better development and improved productive qualities.

Considering the degree of development of internal organs, it was found that the lambs of the experimental groups had internal organs (heart, lungs, spleen, liver, kidneys) which were better developed (Table 2).

**Table 2. Morphological indicators of internal organs, the chemical composition of muscle tissue**

| Parameter                        | Group      |
|----------------------------------|------------|
|                                  | I control  | II experimental | III experimental |
| Mass of leaked blood, g          | 1.4±0.03   | 1.5±0.06        | 1.6±0.05          |
| Heart, g                         | 178.3±9.66 | 188.0±11.72     | 190.0±12.86       |
| Lungs and trachea, g             | 408.0±20.74| 419.0±20.80     | 427.0±25.17       |
| Spleen, g                        | 89.0±4.62  | 98.0±6.36       | 104.0±5.77        |
| Kidneys, g                       | 91.3±3.33  | 100.0±3.38      | 107.0±2.52        |
| Liver, g                         | 468.0±20.82| 508.0±26.59     | 512.0±23.44       |
| Net mass of stomach, kg          | 1.4±0.09   | 1.5±0.12        | 1.6±0.15          |
| Bowel Length, m:                 |            |                 |                  |
| thick section                    | 5.8±0.13   | 6.0±0.12        | 6.1±0.21          |
| thin section                     | 21.0±0.67  | 22.3±1.15       | 23.0±1.00         |
| total                            | 26.80      | 28.3            | 29.1              |
| Total moisture, %                | 67.74±0.67 | 68.0±0.90       | 68.17±0.78        |
| Dry matter, %                    | 32.26±0.28 | 32.0±0.27       | 31.83±0.27        |
| Crude ash, %                     | 1.38±0.12  | 1.25±0.14       | 0.97±0.12         |
| Crude protein, %                 | 24.0±0.50  | 23.95±0.54      | 23.91±0.64        |
| Crude fat, %                     | 6.88±0.28  | 6.80±0.20       | 6.95±0.27         |

One of the important signs is the blood of animals, as an indicator of the vital processes. It was found that the amount of circulating blood in the body of animals of experimental groups II and III is 7.1-14.3% higher than in the control group, which may indicate their large live weight and the best trophic tissue.

The movement of blood through the vascular bed is ensured by heart. It was determined that the mass of this organ in the experimental groups exceeds that in the control group by 5.4-6.6%.

Physiologically, the lungs and trachea perform the respiratory function and secretory-excretory functions, take part in metabolic processes, and heat regulation, have phagocytic properties. Since animals of experimental groups II and III were characterized by better lung development (by 2.7–4.6%), they required a greater supply of oxygen, which ensured the intensification of metabolic processes.

One of the main hemopoietic organs is spleen, in which red blood cells and leukocytes are destroyed and new cells develop. In terms of spleen mass, the difference was 10.1-16.8% compared with animals of the control group. Since the obtained data indicate the physiological norm of spleen, it can be assumed that the main functions are performed better in the experimental groups.

During the dissimilation, the decomposition products are formed. They are eliminated through complex specific processes, and the kidneys play a leading role. The most intense excretory work of kidneys was observed in animals of experimental groups II and III (9.5-17.2%).
The role of liver is diverse and significant due to many different functions: formation and secretion of bile, protection, neutralization of toxic substances, regulation of blood glucose levels, participation in blood formation, synthesis and deposition of glycogen, protein metabolism, etc. The liver was normal in animals of all groups (468.0-512.0 g), but its best development was observed in animals of the experimental groups, which exceeded the control group by 8.5-9.4%.

Since productivity depends on the digestive system, it is of particular interest to consider features of the digestive organs of animals exposed to low-intensity laser radiation, namely, the degree of development of stomach and intestines.

The best development of the gastrointestinal tract was observed in animals of the experimental groups. Thus, the young animals of the control group were inferior to animals of experimental groups II and III by the weight of stomach without contents by 7.1-14.3%, the length of the large intestine - by 3.4-5.2%, the length of the thin section - by 6.2-9.5%.

Summarizing the results obtained, it should be noted that the animals of the experimental groups were better by the degree of development of the internal organs and the gastrointestinal tract.

The nutritional value of meat depends on its chemical composition. Meat of the animals differs in the number of its chemical components (Table 2). Thus, the chemical analysis of muscle tissue showed that the greatest intergroup differences were manifested in the percentage of moisture and ash. In the muscle tissue of animals of experimental groups II and III, moisture was 0.26 and 0.43%. By the amount of protein and fat, no significant intergroup changes were identified.

The data on the chemical composition indicate that the effect of low-intensity laser radiation does not adversely affect the meat quality.

5. Conclusion
Comparison of quantitative and qualitative indicators of meat productivity of the animals aged 7 months revealed the advantage of a number of parameters (carcass weight, slaughter yield, yield of more valuable meat varieties, meat ratio) in experimental animals. Since quantitative and qualitative changes in experimental animals occurred in similar feeding conditions, we believe that in the sheep of the experimental groups, the conversion of nitrogenous feed substances, as well as their transformation into body proteins, were more intensive. The studies indicate the best degree of development of the internal organs of animals of the experimental groups and intensity of the metabolic processes which speaks for the positive dynamics in increasing meat productivity.

Thus, the data suggest a positive effect of low-intensity laser radiation on the sheep organism and a stimulating effect on their growth.

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