Low-intensity laser radiation effect on young sheep growth and development

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Abstract. Sheep breeding is very well developed in many countries such as Australia, New Zealand, England, China, Russia, and several others. The main concern of all producers of products is to profit from this livestock industry, and they do it but often do not pay attention to environmental aspects. In this work, proposed, along with the usual zootechnical and veterinary measures, to introduce into the production process the stimulation of the biological capabilities of animals inherent in nature itself. For this purpose, we used low-intensity laser radiation, which was applied to young sheep in the thymus' innervation area. So at four months of age were obtained increases in the live weight of rams. The experimental groups' animals exceeded the control group's animals by an average of 0.5 and 1.1 kg, and at seven months of age - by 0.8 and 1.3 kg, respectively, which indicates the positive effect of non-invasive laser radiation on animal organisms.

1. Introduction
Currently, the sheep breeding industry focuses on increasing meat productivity and improving product quality. The most important feature that determines meat productivity is live weight, which depends not only on hereditary and genetic characteristics, conditions of feeding, and maintenance but also on effective techniques and technologies to increase it.

As a non-invasive biostimulation method recently, low-intensity laser radiation is increasingly used, which allows to normalize the body's metabolic processes and thereby increase the growth rate of animals and reduce the incidence of young animals [1].

The benefits of using a laser for prophylactic purposes are confirmed in their studies by several authors, for example, it is reported that laser exposure to the mammary gland in cows 5-7 days before and ten days after calving contributes to an increase in the safety of newborn calves by 24.87 % [2].

A significant improvement in the indices of the organism's natural resistance, productivity, and the safety of young animals when using low-intensity laser radiation gives reason to classify it as a highly effective biologically active innovative biophysical method [3].

The stimulating effect of laser radiation is associated with a general biological and adaptive effect on protective and compensatory mechanisms at the cellular, tissue, and organ levels, contributing to self-regulation activation [4].
A positive effect of low-intensity laser radiation has been established, which has a stimulating effect on the growth of the body of sheep obtained from breeding "in itself" half-blooded rams and queens of the genotype (poll Dorset x North Caucasian meat-wool) [5].

2. Materials and methods

For the experiment had been formed three groups of animals. The control group I was without any additional treatment, the II and III groups with low-intensity laser radiation (LILR). The low-intensity laser radiation (LILR) was on the nerve center responsible for the thymus’ innervation, located in the first thoracic vertebra region. The second group treatment was 1.5 minutes. The treatment III group was before five days before lambing, and the time treatment was also 1.5 minutes.

Based on the economic significance of young animals' early maturity, the indicator of which is the live weight of lambs, and the average daily and relative gains determined on its basis, we studied these indicators in young animals using biophysical methods of exposure.

The research was at the experimental station of the All-Russian Research Institute of Sheep and Goat Breeding - a branch of the North Caucasian Federal Scientific Agrarian Center of the Federal State Budgetary Scientific Institution, a group of half-blooded ewes of the genotype (half Dorset x North Caucasian meat and wool), numbering 107 heads inseminated by rams of the genotype (Dorset x North Caucasian meat-wool). Ewes in the second half of pregnancy were divided into two groups: control (n = 67) without low-intensity laser radiation and experimental (n = 40) with low-intensity laser radiation. LILR was applied in the second half of the contraction between the last lumbar vertebra and the sacrum in the experimental group’s ewes. During the lambing period, obtained offspring of all three groups.

3. Results and discussion

Based on weighing the studied animals, it had been found that the live weight at birth was practically the same in all groups. However, there is a significant increase in this indicator at the one-month age: in lambs of group I by 7.1 kg, in lambs II and III - by 7.3 and 7.4 kg. A relatively high rate of increase in live weight in animals of different groups remained up to 4 months of age: 25.4 kg in the control young animals, 25.9 and 26.5 kg in the experimental. In subsequent age periods, the increase in live weight continued, both in control and in the lambs’ experimental groups (table 1, figure 2).

![Figure 1. Animals treatment by low-intensity infrared laser radiation.](image)

| Age   | Group     | I    | n   | II   | n   | III  | n   |
|-------|-----------|------|-----|------|-----|------|-----|
| At birth | I         | 4.9±0.18 | 20  | 4.8±0.20 | 21  | 5.0±0.14 | 24  |
| 1 month | I         | 12.0±0.16 | 19  | 12.1±0.18 | 21  | 12.4±0.17 | 23  |
| 2 months | I        | 17.2±0.17 | 18  | 17.4±0.17 | 20  | 17.8±0.18 | 23  |
| 3 months | I       | 22.5±0.20 | 18  | 22.8±0.19 | 20  | 23.3±0.21 | 23  |
| 4 months | I       | 25.4±0.19 | 18  | 25.9±0.22 | 20  | 26.5±0.21 | 23  |
| 5 months | I       | 27.4±0.18 | 18  | 28.1±0.22 | 20  | 28.6±0.23 | 23  |
| 7 months | I       | 32.8±0.34 | 15  | 33.6±0.37 | 17  | 34.1±0.39 | 20  |

Table 1. Dynamics of live weight of the studied young sheep, kg.
However, despite the general age-related regularity in the growth and development of the studied young animals, expressed in an increase in live weight, the experimental groups' II and III's lambs surpassed their control group peers. So, during the weaning period, the superiority of groups II and III in terms of live weight over the group I was 2.0-4.3% (P <0.001). A similar situation is observed after the weaning of lambs from their mothers - during the rearing period. So, at five months of age, young animals of groups II and III exceeded the control group's animals in terms of the studied indicator by 2.6-4.4%, at seven months by 2.4 and 4.0% (P <0.05; P <0.001).

To characterize the characteristics of young animals' development, to evaluate them by their productivity, to select the best animals in terms of growth energy, the indicators of absolute and average daily gains are important. In the first months of postnatal ontogenesis of the experimental groups' young animals, these indicators were characterized by a rather high value.

When calculating the absolute growth, it can be noted that the period from birth to 4 months turned out to be the most intensive in terms of growth and development of all groups of studied animals, which is a species pattern. Thus, in group I, the absolute increase was 20.5 kg in young animals of group II - 21.1; Group III - 21.5 kg. After four months of age, the growth rate noticeably decreased in control animals and experimental animals. However, behind the generality of the dynamics of age-related changes in the studied indicator in animals of different groups, a significant difference between the control and experimental animals was revealed and is manifested in all periods of ontogenesis. The superiority of lambs in groups II and III in the suckling period in terms of absolute growth over their peers in a group I was 3.0-4.9%, for the entire growing period (from birth to 7 months) - 3.2-4.3% (P < 0.01) (table 2).

| Age                  | I     | II    | III   |
|----------------------|-------|-------|-------|
| From birth. up to 1 month | 7.1±0.26 | 7.3±0.25 | 7.4±0.28 |
| From birth. up to 2 months   | 12.3±0.28 | 12.6±0.27 | 12.8±0.21 |
| From birth. up to 3 months    | 17.6±0.34 | 18.0±0.30 | 18.3±0.25 |
| From birth. up to 4 months   | 20.5±0.22 | 21.1±0.24 | 21.5±0.24 |
| From birth. up to 5 months    | 22.5±0.21 | 23.3±0.28 | 23.6±0.24 |
| From birth. up to 7 months   | 27.9±0.29 | 28.8±0.29 | 29.1±0.25 |
As for the average daily gains, attention is drawn to the ambiguity of their change, both in growing periods and compared groups. So, from birth to one month of age in young animals, fluctuations in the average daily gain were 236.7-246.7 g. Simultaneously, the most intensive growth of animals of all studied groups was noted precisely during this period. However, lambs II and III of the experimental group surpassed their peers in the control group by the value of the studied indicator by 2.8-4.2% (table 3).

In general, during the milk rearing period from birth to weaning, which is considered the most optimal for the growth and development of lambs, sheep of the II and III experimental groups grew more intensively. The average daily growth was 175.8 and 179.2, respectively. When comparing animals of different groups in terms of height, it was found that during the sucking period, more intensive growth of animals was observed in group III. Their superiority in average daily gain over animals of the control group was 8.4 g or 4.9%.

Table 3. The average daily gain in live weight of the studied young sheep, g.

| Age            | Group  |   |   |   |
|----------------|--------|---|---|---|
|                | I      | II | III|
| From birth. up to 1 month | 236.7±9.50 | 243.3±10.29 | 246.7±9.63 |
| From birth. up to 2 months  | 173.3±5.29 | 176.7±5.34 | 180.0±5.18 |
| From birth. up to 3 months  | 176.7±4.58 | 180.0±4.54 | 183.3±5.05 |
| From birth. up to 4 months  | 96.0±3.34  | 103.3±3.76 | 106.7±3.73 |
| From birth. up to 5 months  | 170.8±2.59 | 175.8±4.92 | 179.2±4.55 |
| From birth. up to 7 months  | 132.8±2.37 | 137.1±3.72 | 138.6±3.83 |

In the earlier period of sheep life (from birth to weaning), the highest growth rate occurs, consistent with the general laws of ontogenesis. After 4 months of age, with young animals' release to pasture, the growth rate noticeably decreased. First of all, it resulted from the change of the dairy-vegetable type of nutrition to the vegetable one after weaning from mothers. The low productivity of pastures and high ambient temperatures also had a negative impact. But despite these conditions, superiority young animals of experimental groups over control ones in terms of the studied indicator remained. The average daily gain of young animals in the II and III experimental groups was higher than the I group's lambs by 3.2-4.4%. The advantage in the growth of lambs was also preserved for the animals of the III experimental group.

Figure 3. Fattening animals, age 5.5 months.

4. Conclusion
Thus, data analysis on age-related changes in live weight, absolute and average daily gains indicates that the experimental groups' animals differed from the young in the control group in higher live weight and the number of gains. At the same time, the experienced young animals significantly exceeded the control group of sheep.
It can be assumed that the use of biophysical methods activated metabolic processes in the body of these animals, which had a stimulating effect on their growth and development. Consideration of these issues became the basis for the following studies.

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