Qualitative Characteristics of Mutton Obtained from Animals with Different Bioenergy Profile

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Abstract. Food security is one of the components of the stable economic development. Its main criteria are: availability and safety of raw materials and products of its processing for the population. Ensuring food security in Russia is possible only on the basis of innovative development of the agro-industrial complex and introduction of new methods based on the knowledge of physiology of productive animals into practice. In this regard, a promising direction is a study of product quality assessment using a bioelectric profile of superficially localized biologically active centers on the skin of sheep. Determination of meat qualities was carried out on young sheep at the age of 6-7 months old. Topographic search and measurement of the bioelectric potential level of SLBAC was carried out with an ELAP device. As a result of the studies, it was found out that at values of the bioelectric potential level of SLBAC from 58.2 μA and higher, the quality indicators of meat content are high. The correlation dependence threshold of the bioelectric potential level of SLBAC and the meat content is from +0.12 to 1.0. The bioelectric profile level of SLBAC can serve as a test for a live-animal assessment of the qualitative composition of mutton, with sufficient information content and meat producibility assessment.

1. Relevance
Food security is one of the components of the stable economic development. Its main criteria are: availability and safety of raw materials and products of its processing for the population. Ensuring food security in Russia is possible only on the basis of innovative development of the agro-industrial complex and introduction of new methods based on the knowledge of physiology of productive animals into practice [8,9,10,11,12,17,16,19]. Lately environmentally friendly methods of assessing quality of products, based on the use of bioenergy activity of superficially localized biologically active centers connected to the regulatory systems of the body are often used in the animal husbandry. Thus, the scientific research confirms facts that the level of bioelectric potential of superficially localized biologically active centers can be used to assess the slaughter qualities of cattle and pigs under the conditions of transport stress, as well as to apply acupuncture methods to eliminate negative consequences of the transport stress [7,14,18,19,22]. The previous studies defined a relationship between the bioelectric potential level of SLBAC and dry matter content in milk, technological characteristics of milk fat (fat content, its fatty acid composition and fat content, globule size) [20].

However, available sources contain no information about reliable and informative methods for assessing the quality of sheep raising product - mutton. In this regard, a promising direction is a study of product quality assessment using a bioelectric profile of superficially localized biologically active centers on the skin of the sheep.
2. Materials and methods

The research was carried out on rams of the Orel region farms. Experienced groups were formed on the basis of analogs. Localization and enumeration of the centers on the body of the sheep were adopted based on the research by L.D. Samusenko, A.V. Mamaev. (2015) [15]. Topographic search and measurement of the level of bioelectric potential of SLBAC was carried out with the ELAP-type device [3]. To study and assess the quality of meat productivity, SLBAC No. 13, 31, 61, 62, 64, 65, 80 were selected. To assess the carcase quality based on rib eye indicators, SLBAC No. 28, 31, 36, 37 were used. The area of the rib eye, cm, was determined by measuring the print of the transverse section of the rib eye between the 12th and 13th vertebrae on paper. A qualitative analysis of the meat parameters was carried out using samples taken from the rib eye: moisture, fat, ash and protein, according to generally accepted methods.

Weighing and control slaughter were carried out using the methodology of the All Russian Research Institute for Animal Husbandry 1978 [2,13]. The data were processed statistically using the t-test.

3. Research results

Technological conditions of cultivation and internal factors of the organism are reflected in the intensity of the course of metabolic processes in productive animals, which affects the dynamics of growth and is reflected in the degree of activity of the regulatory systems of the body associated with SLBAC [1,4,5].

As a result of the research, the data presented graphically in Figure 1 were obtained.

![Figure 1](image-url)

**Figure 1.** The relationship between the indicators of meat productivity and the level of bioelectric potential of the LBAC of sheep, M ± m.

As shown in Figure 1, animals with a high pre-slaughter weight - 38.63 kg had a high level of bioelectric potential of SLBAC - 58.2 μA, which significantly exceeded the control by 24.2%. The rams with a high level of bioelectric potential of SLBAC before slaughter had a slaughter weight of 11.3%, higher in comparison with the control, and 8.2% higher slaughter yield (** P <0.01; *** P <0.001 ). Animals with a high level of bioelectric potential of SLBAC, according to the assessment of the fatness category, corresponded to the characteristics of the first category.
One of the important criteria in assessing the quality of meat content of slaughter animals is the area of the rib eye. The generalized data of the study (Fig. 2) show a straight-line correlation of the absolute mass of the rib eye, the area of the rib eye and the level of the bioelectric potential of SLBAC. So in animals with a high level of bioelectric potential - 61.7 μA, live weight compared with animals with a low level of bioelectric potential was 7.2% higher, the absolute weight of the rib eye - by 17.6%, - by 12.8% (** P <0.001; *** P <0.001).

![Graph showing the correlation between bioelectric potential and rib eye parameters.]

**Figure 2.** Dependence of the level of the bioelectric potential of SLBAC and the quality of the meat of rams.

![Image of a rib eye with bioelectric potential levels marked.]

**Figure 3.** The rib eye of rams with a high level of bioelectric potential of SLBAC (the picture was taken by the authors).

To confirm the established dependence, the correlation coefficients were calculated (Table 1). The animals with a high level of bioelectric potential have a high positive threshold of dependence, that corresponds to the research made by L.E. Orme (1963) and S.V. Builova (1990) showing a high correlation of the area of the rib eye with the total weight of the muscle tissue of the carcase [1,21].
Table 1. Correlation of the dependence of the level of bioelectric potential of SLBAC and the quality of the meat content.

| Indicators                        | Group 1, low LBP (control) n=5 | Group 2, high LBP n=5 |
|-----------------------------------|--------------------------------|-----------------------|
| LBP of SLBAC, μA preslaughter live weight, kg | +0.98                        | +0.11                 |
| LBP of SLBAC, μA slaughter carcass weight, kg | +0.14                        | +0.56                 |
| LBP of SLBAC, μA slaughter yield, % | +0.28                        | +0.48                 |
| LBP of SLBAC, μA absolute rib eye weight, kg | -0.21                        | +0.12                 |
| LBP of SLBAC, μA area of the rib eye, cm² | -0.21                        | +0.12                 |

The chemical composition of the carcass pulp determines its technological qualities and purpose in further processing of raw materials, therefore, a chemical analysis of meat was carried out and studied, and compared with LBP of SLBAC [6] (Fig. 2).

Figure 4. Chemical composition of mutton with different levels of bioelectric potential of SLBAC.

All the experimental animals showed the previously established dependence. So, in the samples of meat of animals with high LBP of SLBAC there was by 10.2% high moisture content and by 48.0% lower crude fat content, relative to the control (* P <0.05). Reduced moisture content in meat indicates its functional and technological maturity, which is one of the elements of the lifetime assessment of the meat quality. Also, the relationship between the bioelectric potential of SLBAC and the amount of crude fat indicates an increased energy value of meat. The quantitative protein content in animal meat...
did not have significant differences. The distribution of ash elements in the meat of the experimental rams is similar to the distribution of protein.

4. Conclusions
1. It has been established that at values of the bioelectric potential level of SLBAC from 58.2 μA or more, the indicators of the meat productivity and meat quality are high.
2. The threshold of the correlation dependence of the average level of the bioelectric potential of SLBAC and indicators of the quality of meat content is from +0.12 to 1.
3. The level of the bioelectric profile of SLBAC can serve as a test for a live-animal assessment of the qualitative composition of mutton, with sufficient information content and meat productivity assessment.

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