

# Meat productivity and biological value of meat in bulls of various breeds

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**Abstract.** Our study presents the results of a comparative assessment of meat productivity and biological value of meat in bulls of various breeds. The work was carried out at OJSC named after N.E. Tokarlikov of the Almetyevsk region of the Republic of Tatarstan using industrial technology in three groups (18 heads in each group): I - Simmental, II - Black-and-White and III - Hereford. Relatively high rates of meat productivity and qualitative characteristics of the meat were determined in Hereford bulls: meat weight was 1.7 and 4.5% more compared with Simmental and Black-and-White peers. The meat index in animals of the meat direction (4.59) is higher by 7.5 and 5.5% compared to analogues of I and II groups. The specific gravity of the protein did not have significant differences (18.60-19.05%). At the same time, a higher level of fat was noted in meat from beef cattle - by 1.05 and 1.51%. They also favorably differed in essential amino acids content in the proteins of muscle tissue. Their amino acid score was above 100%. A more balanced ratio of essential amino acids was established in individuals of beef cattle when calculating the biological value of the protein. Meat from animals of Hereford breed was differed by relatively high level of non-essential amino acids - 318.8 mg per 1 g of protein, which is 1.3 and 10.4% more than in the peers of the first two groups.

## 1 Introduction

Beef production in Russian Federation is mainly carried out through dairy, combined and partly from beef cattle with different biological potential. This is reflected in the growth rate, the level of meat productivity and quality indicators, as well as the conversion of feed nutrients [2, 6].

The quality and biological value of meat are determined by its morphological composition, quantitative content and ratio of the main components, characterizing the quality indicators, the composition and the level of essential amino acids. The meat quality

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depends on many paratypical factors during its production, however, first of all, it should be considered a hereditary trait [1, 3, 7, 8].

An imbalance in the amino acid composition of a protein leads to a failure in the proteins synthesis of organism. In particular, the lack of an essential amino acid inhibits the use of other amino acids in the process of protein biosynthesis. Excess promotes the formation of highly toxic metabolic products that are not used for the synthesis of amino acids, which can adversely affect the quality of muscle tissue [4, 5, 11].

Thus, further deeper research is needed in order to determine the quality indicators of meat in animal of various bio-potentials.

## **2 Materials and methods**

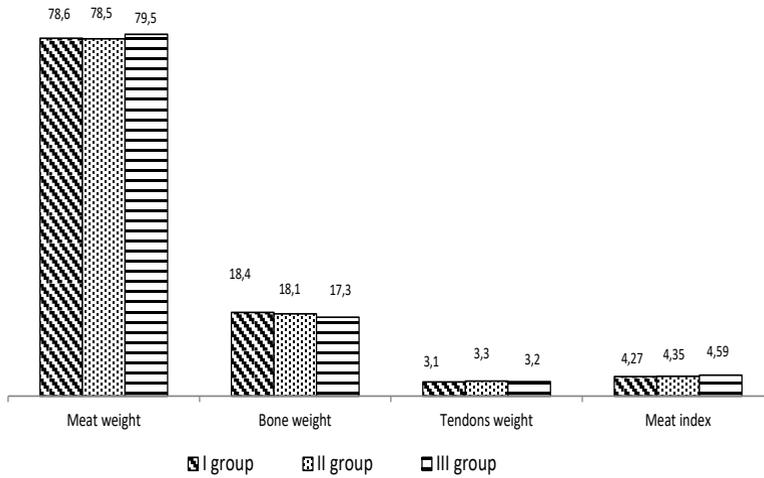
The purpose of this study was to estimate the meat productivity and biological value of meat in bulls, depending on the direction of their productivity.

The problem solving was carried out by conducting an experiment at the industrial fattening complex of OJSC named after N.E. Tokarlikov, Republic of Tatarstan. For this, three groups (18 heads in each) of bulls with different directions of productivity were formed: Simmental (I), Black-and-White (II), Hereford (III). The experimental animals were reared in an industrial complex during the experiment from 6 to 15 months of age. All technological processes associated with the maintenance and feeding of animals were carried out in accordance with the program adopted at this company, and the diets of experimental bulls were balanced according to detailed nutritional standards [8, 9]. The microclimate in the habitats of individuals was regulated by heating and ventilation systems in the given parameters.

A control slaughter of animals was carried out at a meat processing enterprise in accordance with the methodological recommendations of VNIIMS (1984) in order to estimate meat productivity, quality indicators of meat and the biological value of muscle tissue. The amino acids content was determined in the longissimus dorsi muscle (using capillary electrophoresis Kapel 105/105M).

## **3 Results and discussion**

The study of the meat productivity in bull-calves with different bio-potentials reared under industrial technology made it possible to determine the distinctive features in the qualitative composition of the carcass (Fig. 1).

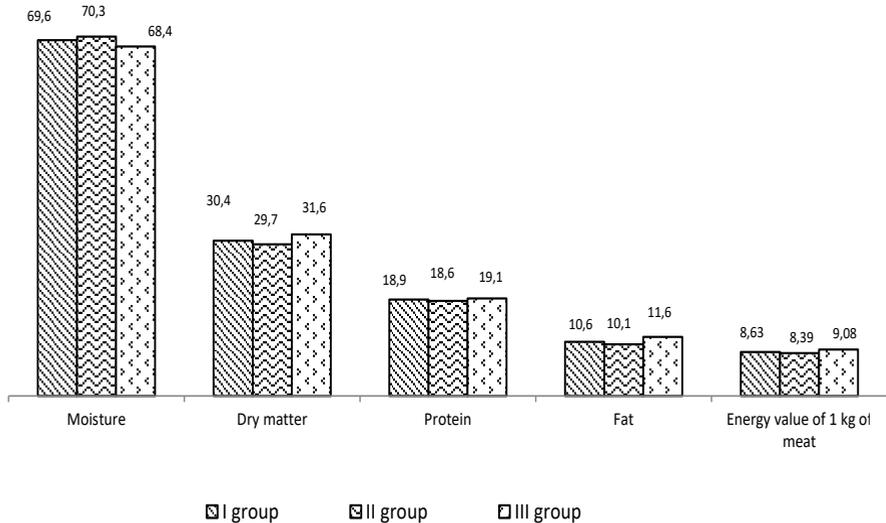


**Fig. 1.** Morphological composition of carcasses in bulls, %

Hereford bulls held a relatively advantageous position in terms of meat and bones yield among the studied groups of individuals. In particular, the relative meat weight was 0.9 and 1.0% ( $P < 0.05$ ) more, and the bone tissue was 1.1 and 0.8% less compared to Simmental and Black-and-White peers. A higher level of meat index was noted in Hereford bulls - 4.59, which is 7.5 and 5.5% more than in peers of other studied groups.

Beef bulls were distinguished by a higher yield of valuable grade of meat. The meat weight of the highest and first grades were 4.5 and 8.4% higher in them compared to animals from I and II groups.

A comparative estimation of the quality indicators of meat revealed a significant differences in the level of dry matter and its main components between the studied groups of individuals (Fig. 2).



**Fig. 2.** The chemical composition of meat, %

An analysis of the qualitative structure of meat indicates that meat from experimental bulls can be attributed to the average degree of physiological maturity, with the best indicator in Hereford individuals. It should be noted the slight fluctuations in protein - 18.6-19.1%, but beef animals differed in a relatively high level of fat content in the fleshy part of the carcass - 11.6%, which is 1.0 and 1.5% ( $P < 0.05$ ) higher than in the peers of the first two groups. This is reflected in the energy value of 1 kg of meat. Bulls from III group had an advantage in this indicator in comparison with Simmental and Black-and-White animals by 5.2 and 8.2%.

An analysis of the amino acid composition of muscle tissue in animals of various directions of productivity states that it depends on the genetic potential of individuals (Fig. 3).

According to the research results, the content of essential amino acids per 1 g of protein in the muscle tissue from Hereford bulls corresponded to the FAO/WHO standard [15]. At the same time, a deficiency of leucine, methionine and phenylalanine was revealed in Simmental and Black-and-White animals. They were inferior to this standard by 1.0 and 5.4; 4.0 and 7.4; 13.3 and 18.2%, respectively, and they were lower in leucine by 2.7 ( $P < 0.01$ ) and 9.8% ( $P < 0.001$ ), methionine - by 4.5 and 8.0% ( $P < 0.01$ ), phenylalanine - by 14.8% and 19.5% ( $P < 0.001$ ) to the level of meat bulls.

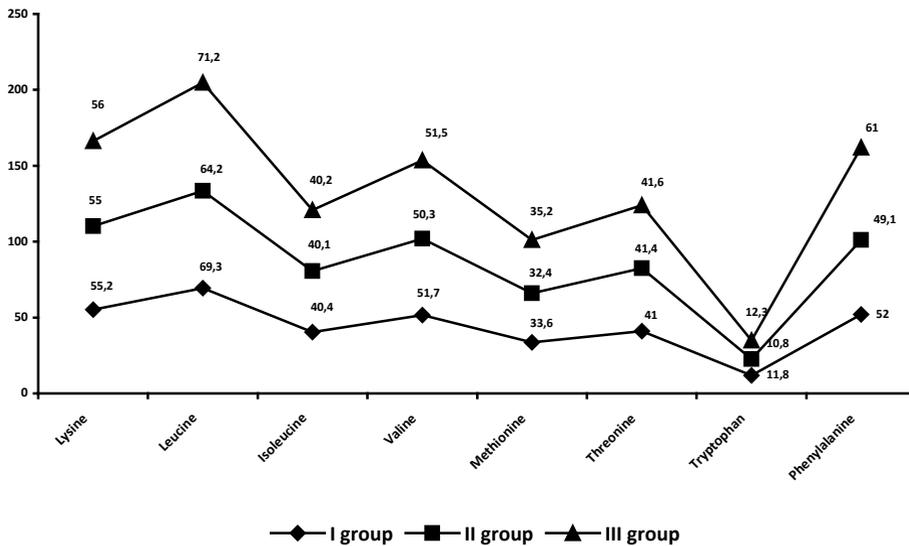


Fig. 3. Amino acid composition in longissimus dorsi muscle, mg

The biological value of proteins mainly depends on the content and ratio of their essential amino acids [7, 10, 11, 13].

Amino acid score is the main criterion characterizing the biological value of proteins (Table 1). If the amino acid score is below 100%, then this amino acid is limiting.

The analysis data showed that beef proteins in individuals from I, II groups contain the following: leucine - 99.0 and 91.7, methionine - 96.0 and 92.6 and phenylalanine - 86.7 and 81.8%. The completeness of protein utilization is limited due to the lack of acids, which leads to a decrease in biological value of muscle tissue.

Table 1. Biological value of proteins in muscle tissue of bulls

Amino acid	Group		
	I	II	III
	Amino acid score - an indicator of its difference, %		
Lysine	100.4 – 0.4	100.0 – 0.0	101.8 – 1.8
Leucine	99.0 – 1.0	91.7 – 8.3	101.7 – 1.7
Isoleucine	101.0 – 1.0	100.3 – 0.3	100.5 – 0.5
Valine	103.4 – 3.4	100.6 – 0.6	103.0 – 3.0
Methionine	96.0 – 4.0	92.6 – 7.4	100.6 – 0.6
Threonine	102.5 – 2.5	103.5 – 3.5	104.0 – 4.0
Tryptophan	118.0 – 18.0	108.0 – 8.0	123.0 – 23.0
Phenylalanine	86.7 – 13.3	81.8 – 18.2	101.7 – 1.7
Sum of differences	43.6	46,3	36.3
Difference coefficient	5.45	5,79	4.54
Biological value	94.55	94,21	95.46

Comparative characteristics of the biological value of protein showed that Hereford animals have a more optimal ratio of essential amino acids.

Another element of dietary protein quality is the amino acid score difference coefficient, which shows the average excess amino acid score of essential amino acids compared to the lowest score of any essential amino acid [14].

The analysis of biological value of protein indicates that a relatively low level of the sum of differences in the amino acid score was noted in the Hereford bulls - 36.3%, which is 7.3 and 10.0% less compared to Simmental and Black-and-White breeds. They also occupied a more advantageous position in terms of the amino acid score difference coefficient - 4.54%, which is lower by 0.91 and 1.25% than in animals from I and II groups, indicating that individuals of this direction of productivity were distinguished by a more optimal ratio essential amino acids. Black-and-White individuals were characterized by a lower biological value among the studied groups of animals.

Organism also needs non-essential amino acids. They perform very important functions and can be synthesized in the body. Such amino acids as glycine, cystine and tyrosine play a physiological role no less than essential amino acids. It should be noted that endogenous synthesis provides only minimal requirements. In this regard, it is advisable to carry out the main intake of non-essential amino acids by means of proteins in composition of food [15,16].

A relatively high level of non-essential amino acids (318.8 mg) was noted in Hereford animals. They exceeded peers of I and II groups by 1.3 and 10.4%, respectively, in terms of their content in muscle tissue.

## 4 Conclusion

Based on the results of this study, it can be stated that genetic characteristics of animals significantly influence the level of meat productivity and meat quality. In general, the analysis of the biological value of meat indicates that beef with a well-balanced amino acid composition was obtained from Hereford bulls.

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