Formation of meat productivity and quality of meat of young cattle of the Aberdeen-Angus and Blanc-Blue Belge breeds

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Abstract. Beef differs from meat from other types of animals in quality, taste and versatility in cooking. The reduction in livestock numbers leads to a negative trend in beef production; therefore, crossing beef cattle with Holstein bulls was the optimal solution. However, reducing the number of young animals for fattening does not improve the quality of their meat. In this regard, assessing the efficiency of beef production, depending on the period of cultivation and slaughter, taking into account quality indicators, is relevant and has practical value. Of particular importance is the study of the meat characteristics of bulls of modern meat breeds, in particular Blanc Blue Belge and Aberdeen Angus, in the conditions of the Central Black Earth zone of free-stall housing using existing stationary premises. The research was carried out in accordance with the plan of research work at the Department of Private Animal Science of Voronezh State Agrarian University in LLC "SHP Novomarkovskoe" Kantemirovsky district of the Voronezh region. During the study, the features of the formation of meat productivity of bulls and heifers of the Aberdeen Angus breed in comparison with the Blanc Blue breed were studied Belge. The results obtained were analyzed in terms of live weight and average daily gains of these breeds. The data obtained were presented in the form of diagrams reflecting changes in live weight during the periods of growing, growing and fattening. Significant differences in the chemical composition of meat of the Aberdeen-Angus breeds were also identified and Blanc Blue Belge based on the protein and fat content in the meat of these breeds.

1 Introduction

The main reserve for raising cattle and reducing the cost of raising it, as well as improving the quality of meat, is reducing the time for raising and fattening young animals of all breeds of livestock. To do this, it is necessary to create conditions for the use of biological opportunities for the growth and development of young animals, satisfying their needs and maintaining the stability of metabolic processes, since a younger organism reacts more actively to positive changes and, accordingly, the resulting growth pays for feed faster and more efficiently [1-3] . The cattle breeds used differ from each other in a noticeable variety

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of biological characteristics aimed at their use, which is expressed in live weight, level of productivity and quality of the resulting meat products [4-5]

There are more than 1000 breeds of livestock in the world. Of the existing variety of breeds, about 250 have become more widespread. A little more than 50 breeds of cattle are used in our country. Approximately 40 of them are bred for milk production and used for milk production and 13 breeds and 7 types are used for targeted meat production. For a long time in the Russian Federation, meat was obtained from cattle of combined breeds and dairy breeds. In this connection, the amount of meat obtained from specialized beef cattle was insignificant and amounted to about 2% of total beef production [6-7]. Currently in Russia, special attention is paid to breeding beef cattle. Breeding bases are created either by attracting and breeding the best specialized breeds, or by breeding their own beef cattle on their basis. Thus, in several districts of the Voronezh region, breeds such as Blanc Blue Belge and Aberdeen Angus were imported for breeding beef cattle [8-9]. At the moment, these beef cattle breeds are the main ones in their cultivation and production of high-quality meat from them. The produced meat has higher quality characteristics compared to combined livestock [10]. That is, these breeds differ in the formation of muscle tissue. Due to differences in its structure, the meat of these animals can be used for a wider range of purposes [11].

We can conclude that the population requires both dietary meat and meat containing uniform fat deposits in the pulpy part, that is, marbled meat. Thus, these breeds have the ability to satisfy human needs in various categories of meat.

The main indicators of meat quality are its physical and chemical properties. Meat is assessed according to such indicators as: pH value, water and fat holding capacity, viscosity, water activity. pH is one of the main indicators that characterizes meat by its freshness, tenderness, elasticity (consistency) and storage ability. The ability of meat proteins to retain moisture, called moisture-holding capacity, depends on the pH of the meat and is also a characteristic of its freshness. These characteristics of meat are determined by such factors as the age of the animal, the ratio of water and fat, the depth of the autolytic processes of meat, the conditions of freezing and long-term storage, the ability of proteins to swell [12-13].

The greater the value between the pH and the isoelectric point, the higher the water-binding capacity of proteins, that is, the more COOH and NH2 groups are ionized and charged. Consequently, when an animal does not go through the adaptation phase before slaughter, but is in a stressful state, the process of autolysis in meat accelerates, while the pH shifts towards an acidic environment and approaches the isoelectric point within 1 hour. Meat obtained from such an animal is characterized by loss of meat juice, decreased hydration, and at a pH of 5.2-5.5 it becomes watery [14].

Consequently, not only the natural properties of proteins influence their ability to retain water, but also the pH values of the environment, as well as indications of the isoelectric point [15].

Understanding the biological patterns of growth and development of livestock is of great importance not only in theory, but also in the practice of modern zootechnical science [16].

2 Materials and methods

Scientific and economic experience in assessing the characteristics of the formation of meat productivity of the Aberdeen Angus and Blanc Blue Belge breeds was carried out at the Novomarkovskoye Agricultural Enterprise LLC, Kantemirovsky district, Voronezh region, using the method of pair-analogues. 2 groups of bulls and 2 groups of heifers were formed.

Blanc-Blue Belge bulls and heifers were in the first group, and Aberdeen-Angus in the second. The groups will include 11 heads of heifers and 12 heads of bulls.

Experimental animals were weighed monthly from birth until the end of fattening for bulls and until transfer to first-calf cows for heifers. Weighings were carried out in the morning, two hours before feeding and watering.

The control slaughter of bull calves was carried out when the Aberdeen-Anguss breed reached a live weight of 509.67±14.84 kg, and the Blanc-Blue Belge 614.08±7.68 kg. For control slaughter, 3 bulls were selected.

The material for assessing the quality of meat was the cutting of the longissimus dorsi muscle of these breeds.

The research was carried out in the laboratories of the Voronezh State Agrarian University named after Emperor Peter I. The assessment was made taking into account existing GOSTs: The mass fraction of moisture was determined according to: "GOST 33319 Meat and meat products. Method for determining the mass fraction of moisture.", the mass fraction of ash was determined according to "GOST 31727 Meat and meat products. Method for determining the mass fraction of total ash.", The mass fraction of protein was determined according to "GOST 25011 Meat and meat products. Methods for determining protein," the mass fraction of fat was determined according to "GOST 23042 Meat and meat products. Methods for determining fat," and a method for measuring the mass fraction of amino acids by capillary electrophoresis using the "Kapel" capillary electrophoresis system."

The organoleptic properties of meat were assessed by appearance.

The purpose of the study was to compare the chemical characteristics of the meat of the longissimus dorsi muscle of Aberdeen Angus and Blanc Blue Belge bulls. The research results were analyzed.

3 Results and Discussion

Our study found that Blanc-Blue Belge and Aberdeen Angus bulls differ significantly in growth rates at different age periods. Blanc Blue Belge bulls and heifers outperformed Aberdeen Angus bulls and heifers throughout the entire experimental rearing period (from birth to 20 months for bulls and 18 months for heifers).

As can be seen from Figure 1, the live weight at birth of Blanc-Blue Belge bulls was 49.8 kg, which is 23.2 kg (47.2%) higher than that of the Aberdeen-Angus breed. A similar pattern in the dynamics of live weight was observed in these experimental groups during the 20-month growing period. The difference in live weight of the analyzed bull breeds was significant ($P < 0.001$) and was higher in Blanc-Blue Belge bulls. At 20 months of age, the average live weight of Blanc-Blue Belge bulls was 614 kg, which is 104.4 kg higher than that of Aberdeen-Angus bulls. As can be seen from Figure 2, the live weight of Blanc-Blue Belge heifers was 47.8 kg, which is 22.6 kg higher than that of Aberdeen-Angus heifers. Over the entire growing period, the greatest differences in the dynamics of live weight between experimental heifers were observed at the age of 16-18 months. Thus, at the end of the 18-month growing period, the live weight of Blanc-Blue Belge heifers was 472.4 kg, which is 92.6 kg more than that of Aberdeen-Angus heifers. The difference in live weight of heifers of the experimental groups in all age periods of rearing was significant. ($P < 0.001$)

Analysis of sex differences between heifers and bulls showed a clear advantage in live weight of bulls of both breeds. However, no large differences in live weight were detected between heifers and bulls of the Aberdeen Angus breed. Thus, the live weight of heifers at birth was 25.2 kg, and that of bulls - 26.7 kg. However, at older ages, Aberdeen Angus bulls were significantly superior to heifers. Thus, at birth they exceeded the live weight of

heifers by 3.2 kg, at 7 months - 17.7 kg (P < 0.001), at 12 months - 26.8 kg (P < 0.001) and at 18 months - 72, 1 kg (P < 0.001).

A similar pattern of sex differences in live weight was observed between bulls and heifers of the Blanc-Blue Belge breed. However, in terms of live weight at birth, a significant difference was observed between bulls and heifers of this breed: the live weight at birth of Blanc-Blue Belge bulls was 49.8 kg, which is 2.0 kg higher than that of heifers, and the difference was significant (P <0.05). The difference in live weight for 1 month of life in bull calves was 7.2 kg, at 7 months - 38.1 kg, at 12 months - 61.2 kg and at 18 months - 87.4 kg. This difference is statistically significant (P < 0.01).

Thus, Black-Blue Belge bulls and heifers significantly exceed their Aberdeen-Angus peers in live weight.

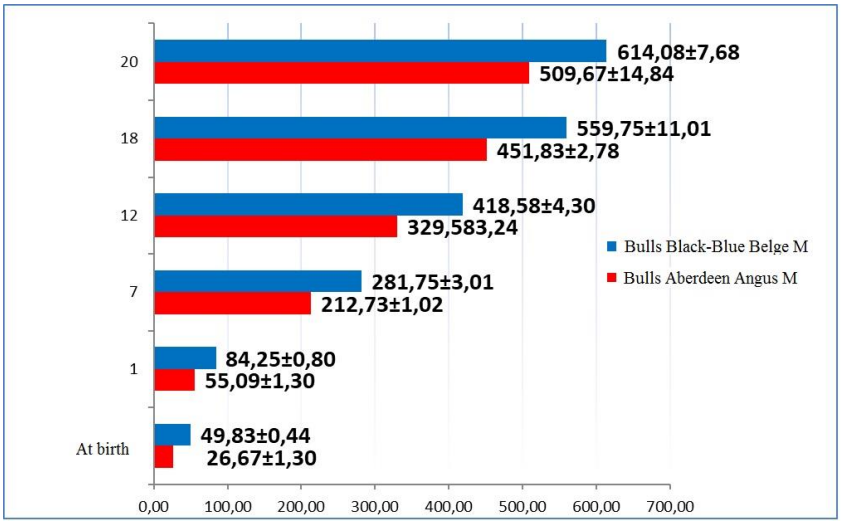

Fig. 1. Diagram of live weight dynamics of experimental bulls.

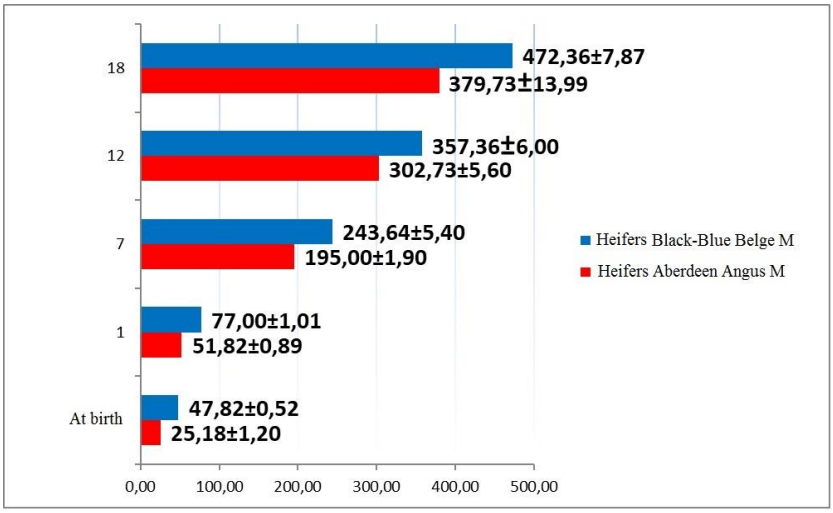

Fig. 2. Diagram of live weight dynamics of experimental heifers.

An important indicator when assessing meat productivity and growth intensity is the average daily gain of animals. Figures 3-4 show that the average daily gain of Blanc-Blue Belge bulls and heifers was higher than the average daily gain of Aberdeen-Angus bulls and heifers throughout the entire analyzed period. Thus, the average daily gain of Blanc-Blue Belge bulls in the first month of life was 1147.2 g, which is 211.1 g higher than that of Aberdeen-Angus bulls ($P < 0.001$). It should be noted that these were the highest average daily gains throughout the entire period of growing, growing and fattening. At 7 months of age, the average daily gain of Blanc-Blue Belge and Aberdeen Angus bulls was 1030.6 g and 872.2 g, respectively; at 12 months - 908.3 g and 738.9 g; at 18 months - 713.9 g and 627.8 g; at 20 months 894.4 g and 980.6 g.

Thus, in all age periods except 20 months, Aberdeen Angus bulls were inferior to Blanc Blue Belge bulls in terms of average daily gain. The higher average daily gain of Aberdeen-Angus bulls at 20 months is explained by the fact that the Aberdeen-Angus breed intensively deposits fat not only on the surface of the carcass, but also between the muscles and cells, forming “marbling”, while the Blanc-Blue Belge breed deposits less fat and continues to build bone and muscle tissue. This is due to the continued growth of bone and muscle tissue.

Analysis of sex differences between heifers and bulls of the analyzed breeds shows a higher average daily gain in bulls of both breeds. Significant differences in average daily gain between heifers and Aberdeen Angus bulls are observed at the age of 2-8 months and 13-18 months. At the age of 9 to 12 months, the average daily gain of bulls was higher than that of heifers, but the differences obtained were not significant.

Analysis of the average daily gains of Blanc-Blue Belge bulls and heifers showed significant differences at the age of 1-7 months and 10-14 months. The greatest sex differences in average daily gain between bulls and heifers were observed at the ages of 4 and 13 months, and it was during these months that the bulls had the highest average daily gain.

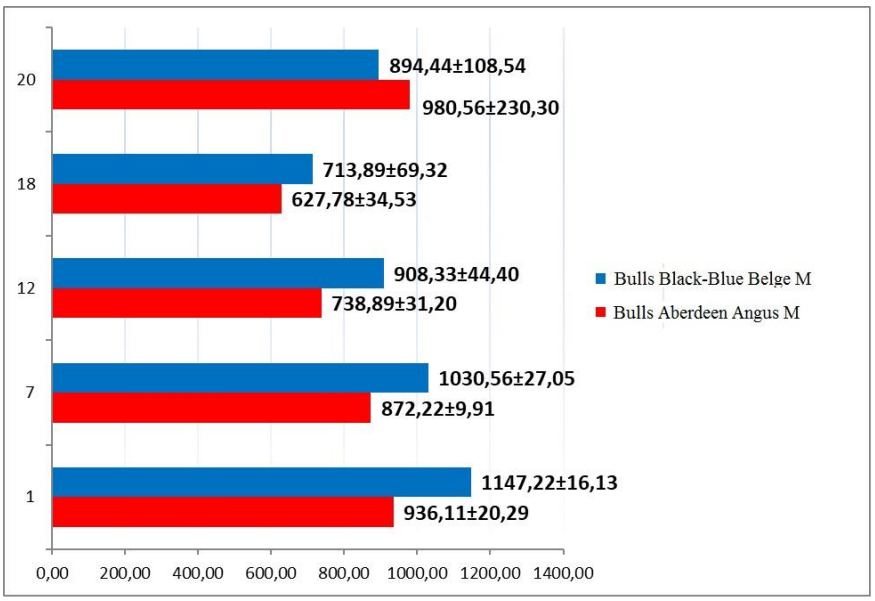

Fig. 3. Diagram of the dynamics of average daily gains in experimental bulls.

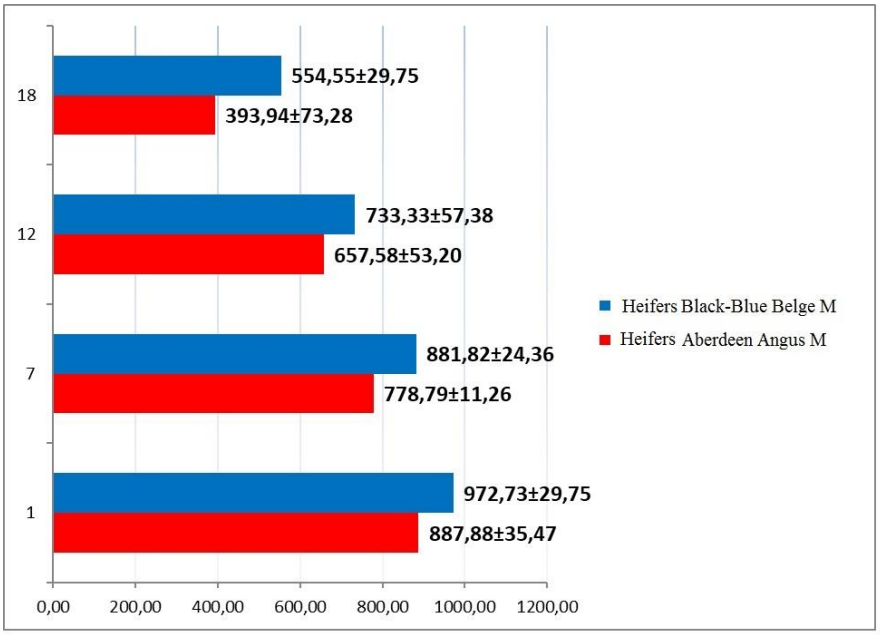

Fig. 4. Diagram of the dynamics of average daily gains of experimental heifers.

As a result of raising young animals of the Aberdeen Angus and Blanc Blue Belge breeds, beef was obtained and its chemical analysis was carried out, the results of which provide an objective assessment of the quality of the meat under study. Thus, the Blanc Blue Belge has the highest mass fraction of moisture compared to the Aberdeen Angus breed, as well as the mass fraction of protein and total ash. However, the mass fraction of fat in Aberdeen Angus animals is higher. The difference in indicators between Aberdeen Angus and Blanc Blue Belge can be reduced to the following values: total ash - 1.84%, mass fraction of protein - 26.34%, mass fraction of fat - 32.47%, mass fraction of moisture - 3.67%.

In Blanc Blue Belge the mass fraction of moisture is 5.93±0.07%, while in Aberdeen Angus this indicator is 2.27±0.77%. Accordingly, the difference is 3.67%. As can be seen from the above figures, the Blanc Blue Belge contains a significantly higher amount of moisture compared to the Aberdeen Angus breed, which affects the texture of their meat. The mass fraction of total ash in Blanc Blue Belge is 4.72±0.06%, and in Aberdeen Angus animals this percentage is 2.88±0.23. The difference between them is 1.84%. Thus, the higher mass fraction of total ash in Blanc Blue Belge is most likely due to differences in metabolism or feeding.

The mass fraction of protein in the Blanc Blue Belge is 87.41±0.32%, the same figure in the Aberdeen Angus breed is 61.08±3.08%. The difference is 26.34%. The increased protein level of the Blanc Blue Belge compared to the Aberdeen Angus breed affects meat texture and nutritional value.

The mass fraction of fat in the Aberdeen Angus breed is 34.30±4.22%, and in the Blanc Blue Belge - 1.83±0.07%. The difference is 32.47% in favor of the Aberdeen Angus cattle breed, which affects the juiciness of the meat, its taste, and nutritional value.

So, based on the conducted research, we can conclude that the meat of Blanc-Blue Belge bulls is dietary, and Aberdeen-Angus bulls are prone to higher fat deposition in muscle tissue, which makes it possible to obtain marbled beef.

4 Conclusion

In the course of the studies, the breed, sex and age distinctive features of the formation of meat productivity of bulls and heifers of the Blanc-Blue Belge and Aberdeen-Anus breeds were identified. Taking into account these features of the formation of meat productivity in production conditions will significantly increase the productivity of quality and, consequently, reduce the costs of their cultivation.

And also, in order to produce high-quality beef meat, we offer the use of specialized meat breeds of cattle: Aberdeen-Angus and Blanc-Blue Belge for breeding under industrial technology of free-stall housing. The Blanc Blue Belge breed is a breed that produces dietary beef, the Aberdeen Angus breed produces high quality marbled beef.

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