

Research on the productivity and interior of fattening bulls

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Abstract. The results of studies of the productivity and interior of young cattle of the Charolais breed fattened in CJSC Firm of Agrocomplex named after N.I. Tkachev, Vyselkovsky district, Krasnodar Territory. With a live weight before slaughter of 560.4 ± 16.7 kg, carcasses with a slaughter yield of 68.0% were distinguished by high rates of meat: the yield of boneless beef for baby food was 81.0%. At the age of 18 months animals had the highest content of total protein in the blood serum. In comparison with 12-month-old, bulls of 18 months old sowed higher live weight values, as well as higher albumin fraction indicators. The same trend was observed for the protein index (Albumin/Globulin - A/G) - an indicator of the state of protein metabolism (0.72 - at 12 months and 1.23 - at 18 months). An increase of 3.8% in the amount of lysozyme in the blood serum of bulls at the age of 18 months was established. compared to 12 months. ($p < 0.05$). Key words: young cattle, blood composition, immunity, age.

1 Introduction

The quality of beef is largely determined by the breed of livestock. The meat productivity of animals is closely related to the interior of the breed [1]. Knowing these patterns and factors affecting meat productivity, it is possible to properly organize the rearing and fattening of animals with well-defined meat qualities and obtain meat raw materials suitable for the production of baby food. Charolais breed of bulls in the number of beef cattle in the Krasnodar Territory is more than 15%. As of January 1, 2020, the Charolais breed of bulls in the beef cattle population of the Goryacheklyuchevsky district was 18.5%. The producers of beef from bulls of the Charolais breed, claiming the highest growth rates, include Agrocomplex, named after. N.I. Tkachev, Vyselkovsky district.

Among the methods that make it possible to objectively assess the level and direction of metabolism, the interior qualities of animals, a prominent place is occupied by the study of blood [1, 2, 3]. Blood characterizes the biochemical processes occurring in the body and reflects the reaction of the animal to the impact of various favorable and negative external factors, including feeding safety and nutritional value of the diet, housing conditions, fattening technology, castration, etc. [4, 5].

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Having a relatively constant composition, blood is at the same time a labile system that, to one degree or another, affects the metabolic processes occurring in the animal body [5,6]. The morphological and biochemical composition of the blood of animals varies depending on the conditions of housing and feeding or the type of fattening and affects productivity [3,7]. For example, there is a direct relationship between the level of total protein in the blood serum and the productivity of young animals [8,9].

This is confirmed by the indicators of protein fractions of blood serum. So, at higher values of growth intensity in bulls, the indicators of the albumin fraction were also higher [10,11]. Serum protein and its fractions play an important role in the body of growing bulls. Determining the total amount of proteins and their fractions reflects the state of the internal environment of the body. Blood serum proteins are in constant relationship with animal tissue proteins. At the same time, proteins have specific physicochemical and biological properties and are responsible for various functions in the life of the organism. Albumins create colloid osmotic blood pressure, which regulates the balance of water and electrolytes between plasma and tissues. They contribute to the dissolution and transport of anions, transfer soluble metabolic products from one tissue to another. Globulins transport lipids, estrogens, carotenoids, fatty acids, iodine, iron, etc. Globulin fractions take part in enzymatic and hormonal reactions. Normally, the content of protein fractions in the blood serum is as follows: albumins - 35 - 60 g/l and globulins 25 - 35 g/l, of which α 1-globulins 2.5 - 5%, α 2-globulins 7 - 13%, β -globulins 8 - 14% and γ -globulins 12 - 22%. In absolute units, the concentration of α 1-globulins is 2.0-5.0, α 2-globulins 4.0-7.0, β -globulins 5.0-9.0 and γ -globulins 8.0-17.0 g/l [12].

The albumin/globulin index ranges from 1.5 to 2.3. Of the factors of natural resistance of the body, bactericidal, lysozyme activity of blood serum is indicative. It is known that the serum bactericidal activity (SBA) is an indicator of the natural ability of blood to self-purify. It varies depending on gender, age, season, and other factors [13-15].

Lysozyme breaks down the bacterial cell wall in the presence of a complement and antibodies and β -lysine destroys the cytoplasmic membrane of bacteria. Activation of nonspecific immunity is a criterion for adaptation of the body to environmental factors.

The study of hematological indicators of blood composition and resistance, as the main characteristics of the interior of young cattle, makes it possible to establish the level and direction of metabolism and immunity (biological status) of bulls fattened for meat for baby food in the farms of the raw materials zone - suppliers. In this regard, the study of hematological parameters in bull-calves of the Charolais breed, adapted in the raw material zone of the Tikhoretsky Branch of the Children's Canned Meat Plant of JSC DANONE RUSSIA, is of particular interest.

2 Materials and methods

The calves of the Charolais breed were kept in CJSC Firm of Agrocomplex named after N.I. Tkachev, Vyselkovsky district, Krasnodar Territory suckling under cows up to 8 months of age according to the "cow-calf" system [8], including keeping calves in a summer-type room equipped with a recreation area on deep straw bedding, linear feeders for hay and haylage, as well as feeding and drinking station. The calves were provided with free access to the walking and fodder yard to the nursing cows.

The conditions of feeding and keeping from 8 to 18 months contributed to the maximum manifestation of the genetic potential of the meat type during the entire fattening period. The main factor determining the formation of meat productivity of young beef cattle is the level of energy nutrition. The operation of this factor is based on the principle of increasing the efficiency of feed utilization with an increase in the energy level of nutrition and productivity of animals. Feeding was carried out according to the principle of complete

feeding (8.6 g of metabolizable dietary protein per 1 MJ of metabolizable energy) in accordance with the program for obtaining an average daily gain in live weight of at least 1.2 kg. For feeding animals, the farm had the necessary stocks of concentrated, roughage and succulent feed of its own production. In winter, the animals received cereal-alfalfa haylage, corn silage, compound feed, and premix (Table 1).

Table 1. Basal diet and its nutritional value for Charolais bulls, n=12.

Index	Age, months			
	8-12	13-14	15-16	17-18
Legume-grass hay, kg	2.5	2.5	3.0	3.0
Corn silage, kg	7.0	7.0	7.0	8.0
Compound feed, kg	2.5	2.5	3.0	4.0
Alfalfa haylage, kg	3.0	4.0	5.0	5.0
Straw, kg	0.5	1.0	1.5	1.5
Molasses, kg	0.15	0.15	0.20	0.25
Protein-vitamin-mineral premix, kg	0.7	0.8	0.9	0.9
Table salt, g	41.0	44.0	46.0	49.0
Phosphate, g	19.0	20.0	23.0	25.0
Premix, g	40.0	43.0	45.0	49.0
The diet contains:				
EFU	7.3	7.9	8.6	9.4
Metabolizable energy, MJ	73	79	86	94
Dry matter, kg	7.6	8.4	9.9	10.2
Crude protein, g	1082	1108	1216	1315
Digestible protein, g	868	926	972	1038
Crude fibre, g	1760	2054	2225	2480
Starch, g	914	998	1063	1182
Sugar, g	530	580	633	705
Crude fat, g	226	249	272	304
Calcium, g	47	52	56	62
Phosphorus, g	32	38	41	43
Magnesium, g	21	24	28	30
Sulphur, g	26	30	33	36
Potassium, g	66	79	85	95
Copper, g	76	85	93	102
Iron, mg	370.0	400.0	560.0	670.0
Zink, mg	242	276	307	358
Cobalt, mg	5.1	5.5	6.4	7.1
Manganese, mg	37.8	41.6	45.3	50.2
Selenium, mg	1.5	2.5	2.8	3.0
Iodine, mg	3.7	4.3	4.4	4.9
Carotene, mg	176	185	196	221
Vitamin D, thous. IU	3.5	3.8	4.2	4.6
Vitamin E, mg	273	292	326	362

In the finishing period, more concentrates were introduced into the diet (up to 4 kg of compound feed) at the expense of the reduction of bulky feed.

In the period from 12 to 18 months, the experimental bulls were kept loose in a section for 12 animals. The diet provides a gain in live weight of 990 - 1200 g. Slaughter was carried out for 18 months bulls of the Charolais breed that have reached slaughter conditions (n=3).

To assess the interior of Charolais bulls, hematological values were determined according to standard methods [5]. The content of erythrocytes, leukocytes, hemoglobin, total protein, protein fractions, SBA, and serum lysozyme activity were determined. We studied changes in the morphological parameters of the blood of bulls at 12 months and at slaughter - at 18 months.

Meat of bulls was sampled for analysis in accordance with GOST (State Standard) 7269-79. The protein content was determined according to GOST 25011-81, p. 2, fat - according to GOST 23042-86, p. 2, trace elements, including heavy metals - according to GOST 26931-86, GOST 30178-96, GOST 26934-86, GOST 26930-86, Methodological Instructions (MI) 5178-90; prohibited pesticides, antibiotics MI 4.2 026-95; MI, 4.18 / 1890-91).

Results changes in live weight in experimental animals for the reference period of fattening are shown in Table 2.

Table 2. Growth indicators of fattening bulls of the Charolais breed; n=12.

Index	M±m
Live weight at birth, kg	36.5±5.6
Live weight at 8 months, start of fattening, kg	237.4±14.5
Live weight at 12 months, start of fattening, kg	344.6±15.7
Live weight at 18 months, end of fattening, kg	564.3±16.3
Average daily live weight gain in the period of 8-12 months, g	878.6±47.8
Average daily live weight gain in the period of 12-18 months, g	1201.5±17.8
Average daily live weight gain in the period of 8-18 months, g	1040.05±15.7
Feed conversion ratio per 1 kg of weight gain in the period of 8-18 months, EFU	7.78

The daily live weight gain in the period from weaning to 12 months was 878.6±47.8 g, which is explained by the stress of the animals. During the period of 12-18 months, the average daily gain in live weight reached the planned one and amounted to 1201.5±17.8 g.

With a live weight before slaughter of 560.4 ± 16.7 kg, the carcass slaughter yield was 68.0%; the yield of boneless beef from chilled carcasses was 81.0%; bone yield was 13.1%; the yield of raw visceral fat was 5.8% (Table 3).

Table 3. Morphological composition of carcasses of the Charolais breed at the age of 18 months. (n=12).

Index	M±m
Pre-slaughter weight, kg	560.4±16.7
Fresh carcass weight, kg	380.8±6.2
Slaughter yield, %	68.0
Weight of chilled carcass, kg	373.5±6.2
Yield of boneless beef, kg	302.6±5.0
suitable for baby food, %	81.0
Bones and tendons, kg	48.8±3.2
%	13.1
Visceral fat, kg	22.1±2.1
%	5.8

The development of muscle tissue of fattening bulls is closely related to the development of the skeleton, however, the mass of bone tissue and tendons is low - 13.1% with a chilled carcass weight of 373.5 ± 6.2 kg.

Physicochemical composition of samples of the longissimus muscle of Charolais bulls at the age of 18 months is presented in table 4.

Table 4. Physicochemical composition of longissimus dorsi of the Charolais bulls, n=12.

Index	Quantitative composition
Moisture content, %	69.8
Protein content, %	19.9
Including collagen + elastin	1.88
Fat content, %	9.17
Ash content, %	0.97
Colour intensity, ext. *1000	82.1±0.4
pH	6.1±0.01
Tryptophan, mg/100 g of neat	298.5±0.1
Oxyproline, mg/100 g of meat	46.26±0.2
PQI (protein quality index)	6.5

The protein quality index (PQI - the ratio of the essential amino acid tryptophan to the nonessential hydroxyproline) of the longissimus muscle was 6.45.

It should be noted that the tissue of the longissimus muscle of carcasses from Charolais bull-calves contains macroelements indispensable for the child's body: potassium, phosphorus, sodium, magnesium, calcium and trace elements: zinc, iron, copper, manganese, iodine, selenium and cobalt (Table 5).

Table 5. Mineral composition of the longissimus muscle of Charolais bulls, n=12.

Element	M±m
Potassium, g/kg	2.125±0.8
Phosphorus, g/kg	1.275±0.01
Sodium, g/kg	0.555±0.2
Magnesium, g/kg	0.235±0.1
Calcium, g/kg	0.095±0.01
Zink, mg/kg	17.315±1.10
Iron, mg/kg	19.970±1.4
Copper, mg/kg	11.350±0.1
Manganese, mg/kg	0.170±0.02
Iodine, mg/kg	0.053±0.01
Selenium, mg/kg	0.062±0.01
Cobalt, mg/kg	0.021±0.01

The content of the limiting amino acid lysine for the child's body in the longissimus muscle of Charolais bulls was 20.0 g/kg of natural beef (Table 6).

Table 6. Amino acid composition of longissimus dorsi in Charolais bulls, g/kg natural muscle (n=12).

Amino acids	g/kg
Lysine	20.03
Phenylalanine	6.745
Leucine	11.515
Isoleucine	7.83
Methionine + Cystine	7.125
Valine	8.57
Arginine	13.175
Threonine	10.845

Histidine		8.755
Tryptophan		2.87
Total Essential Amino Acids	g/kg	98.46
	%	49.48

This is the highest level of lysine compared to other meat cattle breeds, in which the content of the essential amino acid lysine is no more than 19.0%.

The content of essential amino acids in 100 g protein of the longissimus muscle of Charolais bulls was 49.48%, which confirms the high biological value of beef in accordance with the FAO / WHO maximum value of 43.10 g.

The results of the study of blood cells, the biochemical composition of blood serum, the immune status of bulls fattened for the production of baby food showed that these interior indicators depend on age. Changes in the morphological composition of the blood were within the physiological norm (Table 7).

Table 7. Morphological composition of the blood of Charolais bulls, n=12.

Index	Age, months	
	12	18
Hemoglobin, g/l	109.45±0.03	101.43±0.02
Erythrocytes, 10 ¹² /l	5.79±0.04	5.24±0.02
Leukocytes, 10 ⁹ /l	6.87±0.05	6.14±0.03

Age-related changes in the morphological composition of the blood of bulls at the age of 12 and 18 months were established. With age, the concentration of formed elements (erythrocytes, leukocytes) and hemoglobin in the blood decreased ($p<0.5$).

The content of total protein in the blood serum at the age of one and one and a half years was high, which confirms the optimal level of feeding. Total protein increased by 18 months by 2.3% as compared to 12 month old bulls.

At the same time, the ratio of albumins to globulins increased with age from satisfactory - 0.7 to optimal - 1.23. A decrease in the globulin fraction in percentage terms with a high level of total protein indicates an increase in immunity. Humoral factors of the body's immune defenses are various proteins that are soluble in the blood and body fluids. The indicators of humoral natural immunity include bactericidal and lysozyme activity of blood serum, etc. The indicators of humoral immunity in the studied blood samples of bulls were within the physiological norm (Table 8).

Table 8. Biochemical composition of blood and indicators of humoral natural immunity in 12 month. and 18 month old bulls of the Kalmyk breed ($X\pm S_x$).

Biochemical composition of blood serum	Age	
	12 months	18months
Total protein, g/l	82.18±0.13	84.10±0.24
Albumins, g/l	34.4±0.13	46.40±0.21
% to total protein	41.9	55.2
Globulins, g/l	47.7±0.43	37.70±0.43
% to total protein	58.1	44.8
albumin/globulin	0.72	1.23
Lysozyme, mcg/ml	4.94±0.07	5.13±0.03
SBA, %	69.51±0.25	72.32±0.08

When comparing two ages (12 and 18 months) of bulls, it was found that the indicators of humoral natural immunity changed with age. There was an increase in the bactericidal activity of blood serum at 18 months by 4.0% ($p<0.05$).

An increase in the amount of lysozyme in the blood serum was also found - by 3.8% at the age of 18 months compared with the age of 12 months ($p < 0.05$). This is due to the fact that the protective properties of the body are formed gradually, with age. There is a direct relationship between the level of total protein in the blood serum and the productivity of young animals. This is confirmed by the indicators of protein fractions of blood serum.

3 Conclusion

Research conducted at CJSC Firm Agrocomplex, named after. N.I. Tkachev, Vyselkovsky district, Krasnodar Territory, on bulls of the Charolais breed showed that they differed in growth rates (average daily gains for the period of the experiment 1040.05 ± 15.7 g), and at the end of the experimental period they reached a live weight of $564.3 \pm 16, 3$ kg. In the period of 12-18 months, Bulls had significantly higher average daily gains (1201.5 ± 17.8 g) compared to the period of 8-12 months. Bulls of the Charolais breed were characterized by the ability to grow intensively for a longer period and give high gains with little reservation of fat, an important factor for obtaining beef for baby food. The content of essential amino acids in 100 g of protein of the longissimus muscle of Charolais bulls was 49.48%, which confirms the high biological value of beef. At higher values of live weight, 18-month-old bulls of the Charolais breed also had higher indicators of the albumin fraction than 12-month-old bull-calves. The same trend was observed in the protein index (A / H) - an indicator of the state of protein metabolism (0.72 - at 12 months and 1.23 - at 18 months). Fattening Charolais cattle for the production of baby food is optimal. The system of loose moderately intensive fattening of bulls on walking grounds allows fattening animals to a live weight of more than 500 kg in a year and a half and obtaining meat raw materials that meet the requirements for baby food.

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