Efficiency of industrial crossing of meat, dairy and combined cattle

Ivan F. Gorlov*, *Aizhan* A. Kaidulina, *Vladimir* S. Grishin, *Natalia* A. Tkachenkova, *Julia* D. Grebennikova, *Egor* V. Chernikov, and *Elena* Yu. Lazareva

Volga Region Research Institute of Manufacture and Processing of Meat-and-Milk Production, Marshal Rokossovsky, 6, Volgograd, Russian Federation

Abstract. The scientific article presents the results of a scientific experiment conducted to study the quality indicators of beef obtained from interbreeding of cattle of meat, dairy and combined breeds in the conditions of the Volgograd agricultural enterprise JSC "Berdievsky Elevator". The resulting crossbred bulls at the age of 9 months were divided into 4 groups of 10 heads each according to the principle of pairs of analogues: I experimental group of ½ crossbreed (Kazakh white-headed x Russian brown), II experimental group of ½ crossbreed (Kazakh white-headed x Aberdeen-Angus), III experimental group of ½ crossbreed (Aberdeen-Angus x red steppe), IV experimental group of ½ crossbreed (Simmental x red-mottled). The formed groups of animals were put on fattening up to 16 months of age. The growth dynamics of bulls and the qualitative characteristics of beef were evaluated.

1 Introduction

The volume of meat produced by all farms at the end of 2022 amounted to 11.5 million tons. As a result, pork production will amount to 4.5 million tons, poultry meat – 5.2 million tons, lamb – 211 thousand tons. And only in the meat industry, volumes will fall to about 1.57 million tons (Figure 1).

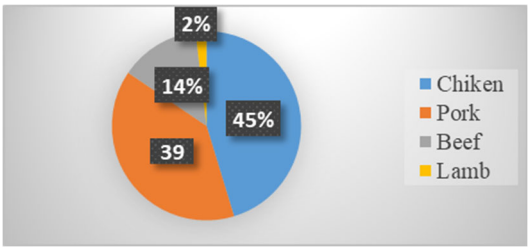

Fig. 1. Total production of the main types of meat (poultry, pork, beef, lamb) in all categories of farms in Russia in 2022 in slaughter weight.

* Corresponding author: niimmp@mail.ru

Thus, as in recent years, poultry meat continues to dominate meat production in Russia, but pork is the key to growth. The search for effective ways to increase beef production in our country is crucial for domestic animal husbandry in this regard [1, 2, 3].

The use of productive dairy and dairy-meat breeds of cattle in Russia, as in many other European countries, is the basis of beef production. In many countries, meat production will still largely depend on these breeds. [4, 5, 6].

There is still a small proportion of beef cattle in our country. According to calculations, the importance of breeding specialized beef cattle breeding will increase with the increase in cow yields, the expansion of specialization and the intensification of dairy farming [7, 8, 9, 10, 11].

Due to the trend of increasing the number of dairy cows and reducing the number of combined breeds, many countries have begun to look for strategies to increase production and improve the quality of beef. Industrial breeding of part of cows and heifers with producers of highly productive meat breeds to obtain mixed young animals of high meat productivity for fattening is one of the ways to successfully increase the meat productivity of dairy cattle in commodity [12, 13, 14].

2 Materials and methods

The experiment was carried out at JSC "Berdievsky elevator" in the Ilovlinsky district of the Volgograd region. The object of the study was crossbreed bulls of meat (Kazakh white-headed, Aberdeen-Angus, Russian komolaya), dairy (red steppe) and combined (Simmental, red-mottled) breeds. The test was conducted in 2022 (Fig. 2). According to the principle of pairs of analogues, four experimental groups of ten animals were formed in each: 1 experimental group of ½ crossbreed (Kazakh bald x Russian brown), 2 experimental group of ½ crossbreed (Kazakh bald x Aberdeen-Angus), 3 experimental group of ½ crossbreed (Aberdeen-Angus x red steppe), 4 experimental group of ½ crossbreed (Simmental x red-mottled).

Fig. 2. The number of crossbred bulls on the paddock.

The purpose of the experiment was to study how hybrid young animals obtained as a result of industrial crossing of meat, dairy and combined cattle grow and develop, as well as how productive their meat production is.

According to the control weighings, the dynamics of live weight, average daily and absolute gains were studied; Meat productivity was studied based on the results of control slaughter of animals at 16 months of age. The chemical analysis of the obtained beef was studied by the following methods and methods: determination of humidity GOST 9793-2016;

fat GOST 23042-2015; protein GOST 25011-2017; ash GOST 31727-2012; amino acid composition, according to the method of measuring the mass fraction of amino acids, by the method of CE on the installation "Kapel-105M".

3 Results and discussion

At the age of 8 months, crossbred bulls began to form groups reflecting the average Western indicators. During the formation of groups, the average live weight of experimental young animals ranged from 232 to 240 kg (Table 1).

Table 1. Dynamics of live weight and absolute gain, (n=10).

Age, months.	Group			
	I	II	III	IV
8	237.9±2.95	240.8±1.62	232.8±1.98	238.6±1.59
9	275.0±1.89	273.5±1.67	262.6±1.31	266.1±1.45
12	395.0±1.93	375.4±1.73	356.0±2.15	352.8±2.76
14	469.0±2.90	437.4±1.37	416.1±1.32	410.1±2.16
16	538.6±1.95	495.7±1.10	479.9±2.04	463.0±2.24
Absolute gain. kg				
8-9	37.1±0.90	32.7±1.31	29.8±1.42	27.5±1.48
9-12	120.0±1.15	101.9±1.60	93.4±0.95	86.7±1.62
12-14	74.0±0.85	62.0±0.65	60.1±0.81	57.3±1.39
14-16	69.6±0.70	58.3±0.47	63.8±0.53	52.9±0.59
8-16	300.7±2.47	254.9±1.57	247.1±2.42	224.4±1.86

As the crossbred youngsters grew, the differences in live weight between the groups increased, but it should be noted that the bulls of groups I and II had the greatest live weight throughout the experiment. In other words, at the age of 12 months, the live weight of mixed young animals of groups I and II was 395.0 and 375.4 kg, respectively. This is 39.0 (9.87%) and 19.4 kg (5.17%) more than group III bulls, and 42.2 (10.68%) and 22.6 kg (6.02%) more than group IV bulls. After the end of the experiment, the tendency of superiority of calves of groups I and II over their experimental peers from groups III and IV persisted. Thus, crossbreeds from group I weighed 16 months more than peers from groups III and IV by 58.7 (10.90%) and 75.6 kg (14.04%), and bulls from group II weighed 16 months more than peers by 15.8 (3.19%) and 32.7 kg (6.60%).

On average, the absolute increase in live weight of experienced young animals during the observation period was 300.7 kg per head in group I, 254.9 kg in group II, 247.1 kg in group III and 224.4 kg in group IV. With an average daily increase of 683.5 g over the entire period of the experiment, the crossbreeds of group I showed the greatest intensity of growth throughout the entire growing period (Figure 3).

According to the results of the control slaughter, it was found that the crossbred young animals from all groups had relatively high slaughter qualities.

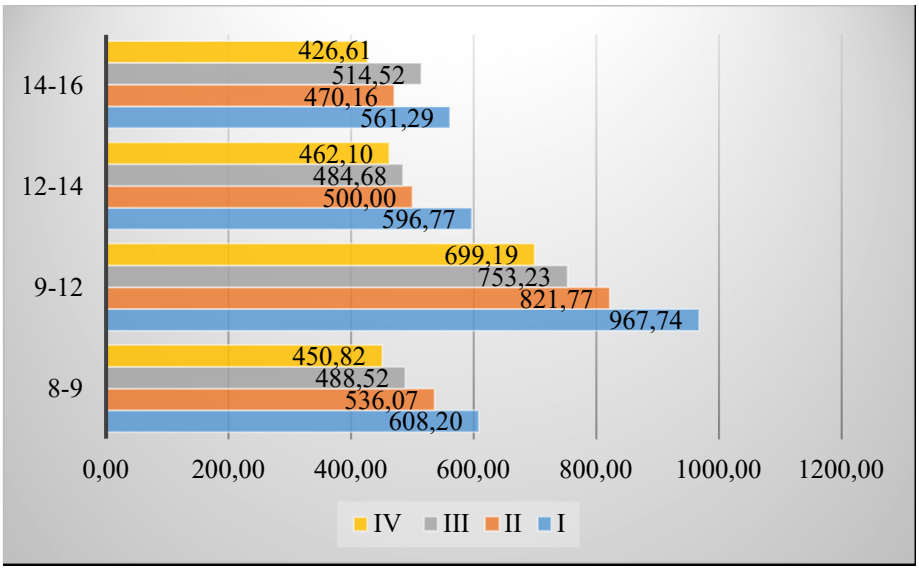

Fig. 3. Average daily growth of experimental crossbred young.

However, bulls from group I showed the highest values for most indicators (Table 2). Thus, the difference between their pre-slaughter weight and the weight of peers in groups II, III and IV was 41,0 (7,91%), 55,3 (10,67%) and 70.0 kg (13.51%), respectively. Bulls of group I gave the heaviest carcasses weighing 305.3 kg, which is 28.6 kg (9.37%) more than mixed young animals of group II, 45.6 kg (14.94%) III, 55.0 kg (18.02%) IV, respectively. The advantages were also in favor of crossbreed young animals of group I in terms of slaughter weight and slaughter yield. As a result, the best slaughter qualities were possessed by the bulls of group I, and the animals of group II were in the middle. This leads us to the conclusion that the joint breeding of different meat breeds had a certain benefit.

Table 2. Results of the control slaughter of bulls, (M±m).

Indicator	Group			
	I	II	III	IV
Pre-slaughter weight, kg	518.±2.67	477.3±1.86	463.0±1.00	448.3±1.33
Carcass weight, kg	305.3±1.67	276.7±1.20	259.7±1.67	250.3±1.64
Carcass yield, %	58.9	58.0	56.1	55.8
Fat mass, kg	11.5±0.18	9.7±0.33	8.7±0.33	8.0±0.25
Fat output, %	2.2	2.0	1.9	1.8
Slaughter weight, kg	317.8±1.67	286.3±1.45	268.3±1.85	258.0±1.58
Killer exit, %	61.3	60.0	58.0	57.5

The yield of the meat part (Table 3) is the main indicator by which the value of the carcass can be objectively assessed. Crossbred young animals of the I experimental group outperformed their peers of the II group in terms of pulp productivity by 24.2 kg (9.34%), 38.0 kg (14.66%), 44.9 kg (17.32%). However, a higher yield of pulp was observed in the IV group of mixed bulls – 85.6%, which is 0.7% more than in bulls of groups I and II, and 0.4% more than in bulls of group III.

Table 3. Morphological composition of carcasses of experienced bulls, (M±m)

Indicator	Group			
	I	II	III	IV
Weight of chilled carcass, kg	305.3±1.67	276.7±1.20	259.7±1.27	250.3±1.64
Pulp weight, kg	259.2±1.28	235.0±1.00	221.2±1.37	214.3±1.92
Pulp yield, %	84.9	84.9	85.2	85.6
Bone mass, kg	38.1±0.49	35.5±0.29	33.6±0.78	32.7±1.01
Bone yield, %	12.5	12.8	13.0	13.1
Tendon mass, kg	8.0±0.20	6.2±0.17	4.8±0.44	3.3±0.46
Tendon output, %	2.6	2.2	1.9	1.3
Pulp yield per 100 kg of carcass weight	58.9	58.0	56.1	55.8
Meat index	6.80	6.62	6.58	6.57

The amount of pulp produced per kilogram of live weight before slaughter serves as a measure of how fast the animal's muscle tissue grows. When compared with peers of groups II, III and IV, it was higher in group I bulls by 0.9, 2.8 and 3.1 kg, respectively.

The meat index was also higher in animals belonging to group I. They were respectively 2.65, 3.24 and 3.38% higher in this indicator than analogues of groups II, III and IV.

The results of chemical analysis of representative average samples show that the meat of bulls of all groups is physiologically mature (Table 4). The ratio of moisture and dry matter in the pulp is ideal for slaughtering cattle. The meat of the bulls of the I experimental contained more dry matter. According to this indicator, they outperformed hybrid analogues of groups II, III and IV by 0.94, 2.97 and 4.60%, respectively.

The bulls of group III outperformed their peers of groups I, II and IV, respectively, in terms of the amount of fat in the carcasses by 1.61, 3.22 and 5.96%.

Table 4. Chemical composition of the average beef sample (n=3).

Indicator	Group			
	I	II	III	IV
Moisture, %	68.04±0.45	68.34±0.41	68.99±0.72	69.51±0.37
Dry matter, %	31.96±0.22	31.66±0.35	31.01±0.72	30.49±0.37
incl.: fat	12.22±0.11	12.02±0.14	12.42±0.42	11.68±0.22
protein	19.15±0.13	19.03±0.50	18.21±0.19	18.05±0.14
ash	0.58±0.02	0.62±0.06	0.39±0.11	0.76±0.04
Tryptophan, mg%	466.24±2.33	446.97±1.62	437.99±0.03	437.66±1.93
Oxyproline, mg%	144.01±2.94	137.32±1.56	150.74±1.34	159.97±0.33
Protein-quality indicator	3.24	3.26	2.91	2.74

The total protein content of beef is well known. In this regard, we calculated the protein quality index for the study of the biological value of meat. Crossbred youngsters of group I had the highest content of tryptophan in the average pulp sample (466.24 mg%), and peers of group IV – oxyproline (159.97 mg%). Bulls in group I were richer in tryptophan than their peers in groups II, III and IV, by 19,27 (4,13%), 28,25 (6,06%) and 28.58 mg% (6.13%), respectively. Bulls of group II had the highest value of BCP – 3.26. In general, the value of BCP for groups was in the range from 2.74 to 3.26.

4 Conclusion

The breed affiliation significantly influenced the growth, development and meat qualities of the experimental bulls. According to most of the considered indicators, the local young,

obtained from crossing the parents of meat breeds, significantly exceeded the mixed young, obtained from dairy and mixed breeds. The use of the genetic potential of beef cattle breeds in this regard is crucial for the development of beef cattle breeding in the Russian Federation.

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