Technological platform of the development of beef cattle breeding in food supply system

T A Kurzyukova, T A Udalova and O Y Frolova
Krasnoyarsk State Agrarian University, Mira street, Krassoyarsk, 660049, Russia

E-mail: kurz.t@yandex.ru

Abstract. An effective method of increasing the meat productivity of livestock in herds is the industrial crossing of part of cows and heifers with producers of highly productive meat breeds. For the experiment, according to the principle of analogue pairs, 2 groups of newborn gobies were formed taking into account the live weight of the animals. The first group included Hereford bulls, the second group consisted of crossbred bulls (♀ red-motley x ♂ Hereford). We studied the productive qualities of gobies by the dynamics of growth in live weight of gobies. To assess the meat qualities, a control slaughter of experimental gobies was performed. Domestic bulls exceeded (P <0.05) pure-bred calves in live weight. For the growing period (from 6 to 12 months of age), the difference in live weight between the bulls of the first and second groups was 24.3 kg or 7.5 percent (P <0.1). When feeding on natural pastures for 90 days, the difference in live weight between the groups was between the first and second - 29.1 kg (7.3%). As a result of the experiment, the cost of production of 1 kg of beef obtained from cross-breed gobies is 1180.2 rubles lower. The profitability of growing crossbred bulls is 11.2 orders of magnitude higher. In order to increase meat productivity and improve meat quality in commodity cattle breeding, it is advisable to practice rearing and feeding of young animals obtained by crossing red-motley cows with Hereford bulls in order to raise fattening young animals using intensive technology of meat cattle breeding.

Meat is extremely important in human nutrition. It contains proteins, fats and minerals, as well as vitamins A, D and group B. The nutritional value of meat depends on its content of complete proteins (globulin, albumin, myotin, etc.). Beef in Russia remains the main type of meat in terms of production and consumption, so the sustainable development of the industry puts the task of maintaining the regulatory structure of nutrition in accordance with medical standards. The reduction in the number of cattle in the country in the nineties further exacerbated this problem: dependence on imports of meat and meat products increased significantly. All this necessitates the accelerated development of beef cattle breeding in accordance with the regional objectives of food supply. Over the past decade, positive changes have occurred in the meat industry in the Krasnoyarsk Territory. A subprogram of beef cattle breeding was developed, which is based on the development of a number of Siberian scientists [1, 2].

Given the prospects and possible risks of the development of beef cattle breeding, it can be assumed that the development of the industry should be based, first of all, on the implementation of large-scale projects based on competitive world-class meat breeds and less-used pasture cattle breeding resources. This will make it possible to fully realize the least expensive intensively grazing technology for the production of high-quality beef. Unlike countries with developed beef cattle breeding, the specifics of the Russian beef market allows for a long-term basis to significantly increase its production with reliance
on the domestic market. This, in turn, leads to the creation of new jobs and the formation of effective employment of less skilled labor in the countryside, and in the social aspect it is one of the essential resources for the development of rural areas. The meat productivity of animals of one breed or another is due to morphological and physiological characteristics, which are formed and developed under the influence of heredity, feeding conditions and keeping animals during their rearing. Intra-breed selection of cattle should be aimed at increasing the maturity of animals, increasing the intensity and energy of growth, improving the payment of feed for products, as well as improving the quality of beef with its nutritional and culinary properties. Therefore, to plan and conduct a complex of breeding measures, it is necessary to study the number of animals bred in specific economic conditions. The experience of advanced farms indicates that with a correct assessment of the genetic potential of animals and compliance with a correctly selected production technology, one can achieve high results in specialized beef cattle breeding.

In this regard, we have set the following tasks:

- to study the dynamics of live weight of purebred and cross-breeding young cattle by age periods in production conditions;
- evaluate the meat productivity of young animals of different groups;
- to identify the economic efficiency of raising livestock of different genotypes.

The main methods for increasing the meat productivity of livestock are as follows:

- intrabreeding selection;
- industrial crossbreeding of cattle of various breeds;
- creation of highly productive populations and new livestock breeds;
- intensive rearing of young animals, fattening, feeding of livestock;
- the use of animal growth stimulants, etc.

An effective method of increasing the meat productivity of livestock in herds is the industrial crossing of part of cows and heifers with producers of high-yielding meat breeds in order to obtain cross-breeding young animals for fattening with high indicators of meat productivity. By crossing producers of meat breeds with dairy cows, it is possible to obtain crossbreeds for the creation of specialized herds of beef cattle, using the best crossbred heifers and equipping them with highly productive broodstock of beef cattle.

Crossbreeding is the most common cattle breeding method to date, which improves existing and creates new cattle breeds. Crossbreeding, as a rule, achieves two goals. The first is the creation of a more perfect hereditary generation that surpasses the parental individuals in the phenotypic manifestations of a number of characters based on the heterosis effect. In this case, maximum manifestations of the effect of dominance and epistasis, which cannot be obtained with purebred breeding, can be achieved. The second goal is the crossbreeding of different breeding characteristics and severity of different breed characteristics to create one new breed, which will combine the best features of two parental individuals. For some breeds, interbreeding has always played a significant role in connection with the manifestation of positive effects. These include the increase in livestock productivity due to the effect of heterosis, the greater viability of the offspring as a result of crossbreeding, as well as the possibility of combining and combining the desired properties from various animal lines, which allow a competitive product to be produced in the meat market. Crossbreeding of different breeds does not create new genes in the offspring and does not lead to a change in the frequency of occurrence of the desired genes compared to parents, but creates new genotypes combining the genes of maternal and paternal breeds.

The effectiveness of the use of heterosis in livestock has long been widely studied in many countries. However, despite the positive results that have been accumulated in our country in breeding meat breeds, this work has not received widespread production due to the insignificant presence of specialized meat
breeds in our country. More widely used are the existing producers of meat breeds for crossbreeding with dairy and dairy-meat cows with the cultivation of the resulting offspring for meat [3, 4].

The wide distribution range of Hereford cattle is explained by its excellent acclimatization abilities, which make it possible to tolerate extreme climatic conditions equally well: from severe frosts to tropical heat. When crossing with other breeds, herefords convey good adaptability and resistance to winter conditions, fecundity with limited feeding capabilities, and also average live weight in adulthood.

Industrial crossbreeding is used mainly in livestock farming. As a result of industrial mating, cows are inseminated with sperm from bulls of meat breeds, resulting in offspring with improved feeding qualities, from which later it is possible to obtain high-quality meat products. One of the goals of industrial crossbreeding is to achieve the effect of heterosis in the 1st generation of crossbreeds. Industrial crossbreeding is not used for breeding livestock. Increased meat productivity is shown by almost all cross-breed animals obtained by industrial crossing between breeds of meat and dairy.

The level of productivity of beef cattle in each case with a change in the animal and a change in live weight. With the normal development of the animal index, its vital values correspond to the highest standards, and low development - low. Small live weight is an indirect indicator of the reduced abilities of the animal, and large, along with other indicators, will indicate the possibility of high productivity. The choice according to the constitution and appearance is based on the existence of a certain connection between the external structures of the animal and its economically useful attributes. When choosing cows and heifers of meat breeds, preference is given to animals with a wide, deep and round body, lush muscles, a wide loin with well-developed muscles of the back torso.

In an experimental farm, the distribution of bulls and cows by live weight is an important characteristic (tables 1 and 2).

**Table 1.** The distribution of bulls by live weight and their characteristics according to the assessment of the exterior and physique.

| Indicator                                      | Group of bulls by age, heads |
|------------------------------------------------|-------------------------------|
|                                                | 2 years old | 3 years old | 4 years old | 5 years old and older | Totally in the herd |
| Total bulls, heads                            | 5            | 1            | 2            | 8                      |
| Live weight, kg:                              |              |              |              |                        |
| 501-600                                       | -            | 2            | -            | -                      |
| 601-700                                       | -            | 3            | -            | -                      |
| 701-800                                       | -            | -            | 1            | 1                      |
| 801-900                                       | -            | -            | 1            | -                      |
| Bulls with live weight, respectively, classes electronic record and elite, heads | -            | 5            | 1            | 2                      |
| Average live weight, kg                       | -            | 635          | 741          | 759                    |
| The average rating of the exterior, score     | -            | 89           | 85           | 85                     |
| The average height in the sacrum, cm          | -            | 136          | 136          | 139                    |

From table 1 it follows that the bulls used in the farm have live weight corresponding to the elite class. The bulls are tall, the average rating for the exterior was 87 points, which also corresponds to a high rating class. The main task of selection according to the constitution and the exterior is to strengthen and consolidate in the herd the strength of the constitution, the required body size and proportionality of physique.
From the data of table 2 it is seen that almost 73% of the cows have live weight corresponding to the standard of class 1 and above, and the number of animals weighing over 500 kg is 51% of the total number of cows, more than 600 kg is 3.5%.

| Age group of cows | Total cows, heads | Of these, have live weight in kg, heads | The number of cows with live weight, corresponding to 1 class | Average live weight, kg |
|-------------------|--------------------|----------------------------------------|-----------------------------------------------------------|-------------------------|
|                   |                    | 351 - 400 | 401 - 450 | 451 - 500 | 501 - 550 | 551 - 600 | more than 600 |
| In the herd       |                    |           |           |           |           |           |               |
| 2 years old       | 32                 | 5         | 18        | 9         | -         | -         | 27            | 443         |
| 3 years old       | 16                 | -         | 5         | 7         | 4         | -         | -             | 16          | 488         |
| 4 years old       | 23                 | -         | 2         | 11        | 7         | 3         | -             | 21          | 496         |
| 5 years old +     | 159                | -         | -         | 56        | 61        | 34        | 8             | 103         | 558         |
| In the herd       | 230                | 5         | 25        | 83        | 72        | 37        | 8             | 167         | 482         |

Including tribal core:

|                   |                    | 3 years old | 4 years old | 5 years old + |
|--------------------|--------------------|-------------|--------------|---------------|
|                    |                    | 2           | 18           | 49            |
|                    |                    | -           | -            | -             |
|                    |                    | 1           | -            | -             |
|                    |                    | -           | -            | -             |
|                    |                    | -           | 8            | -             |
|                    |                    | -           | 10           | -             |
|                    |                    | -           | -            | 5             |
|                    |                    | 1           | -            | -             |
|                    |                    | 9           | 15           | 38            |
|                    |                    | 1           | 15           | 38            | 6           |
|                    |                    | -           | -            | 6             | 66           |
|                    |                    | -           | -            | -             | -           |
|                    |                    | -           | -            | -             | -           |
|                    |                    | 2           | 191          | 195           |
|                    |                    | -           | 196          | 201           |

At the same time, 69 animals were selected for the livestock. The milk yield of meat breeding cows is a determining breeding trait in a comprehensive assessment (from 23 to 35% of the total points) and serves as the main condition for obtaining high gain of young animals on suction.

Therefore, the milk yield of cows is conditionally determined by the mass of calves at 8 months of age after weaning them from their mothers (table 3).

| Year | The average live weight of calves at weaning at 8 months, kg |
|------|------------------------------------------------------------|
|      | The average live weight of calves at weaning at 8 months, kg |
|      | 1 | 2 | 3 and older | Average |
| 2016 | 187 | 191 | 195 | 191 |
| 2017 | 191 | 196 | 201 | 197 |

Table 3 shows that over the past 2 years, the milk yield of cows on the farm leaves much to be desired, but there is a tendency to increase this important breeding trait.

For the experiment, according to the principle of analogue pairs, 2 groups of newborn gobies were formed taking into account the live weight of the animals. The first group included Hereford bulls, the second group consisted of crossbred bulls (♀ red-motley x ♂ Hereford). In the first and second groups, the calves were kept together with their mothers for up to 6 months, that is, they were raised in accordance with the “cow-calf” technology adopted in beef cattle breeding. Gobies of both groups were kept under the same conditions of feeding, care and maintenance in lightweight rooms. The feeding scheme provided for the organization of winter rearing of young animals with the maximum use of coarse and succulent feeds in combination with a small consumption of concentrates; upon reaching 320–350 kg, such young animals are put on intensive final fattening, lasting 80-90 days, or are fed on pastures (figure 1).
The first group included Hereford bulls, the second group consisted of crossbred bulls (♀ red-motley x ♂ Hereford). In the first and second groups, the calves were kept together with their mothers for up to 6 months, that is, they were raised in accordance with the “cow-calf” technology adopted in beef cattle breeding. Gobies of both groups were kept under the same conditions of feeding, care and maintenance in lightweight rooms. The feeding scheme provided for the organization of winter rearing of young animals with the maximum use of coarse and succulent feeds in combination with a small consumption of concentrates; upon reaching 320-350 kg, such young animals are put on intensive final fattening, lasting 80–90 days, or walk on pastures.

Productive qualities of gobies were studied by the dynamics of increase in live weight of gobies by periodic weighing in accordance with GOST 25967-83 “Breeding animals, agricultural. Methods for determining the parameters of the productivity of the meat direction,” which were carried out in the morning before feeding and drinking on the same scales - at the age of 0, 6, 12 and 15 months in two adjacent days with an accuracy of 0.5 kg. According to the weighing data, the absolute, average daily, and relative gains in live weight of the experimental young were calculated.

To assess the meat qualities, a control slaughter of experimental gobies was carried out with 3 typical heads from each group according to the VNIIMP technique (1965). During slaughter weighed: paired carcasses and internal fat. According to the weighing of carcasses and internal fat, the slaughter mass and the slaughter yield were determined. Then sawed them on the mid-sagittal plane into two equal half carcasses. The right half carcasses were deboned and vened, and the left carcasses were not manipulated.

Boning and venation of the right carcass was carried out with the release of muscle, bone, adipose and connective tissue. According to the deboning, the meat coefficient was calculated.

In the conditions of a private business enterprise, we obtained the results of the dynamics of the live weight of gobies with different growing technologies. The change in live weight of experimental bulls grown according to different technologies is presented in table 4.
Table 4. The dynamics of live weight of bulls, kg.

| Age, months | Breed                  | purebred Hereford | ½ Hereford + ½ simmental |
|-------------|------------------------|-------------------|---------------------------|
| At birth    |                        | 26.7+0.33         | 27.9+0.46                 |
| 6 months    |                        | 172.4+1.60        | 181.4+1.51*               |
| 12 months   |                        | 324.9+2.62        | 349.2+3.57**              |
| 15 months   |                        | 396.7+3.77        | 425.8+4.98*               |

Note: * - P <0.05, ** - P <0.1, hereinafter.

As it can be seen from the data in table 4 at the age of 6 months the crossbred bulls exceeded (P <0.05) pure-bred calves in live weight. For the growing period (from 6 to 12 months of age), the difference in live weight between the bulls of the first and second groups was 24.3 kg or 7.5 percent (P <0.1). When feeding on natural pastures for 90 days, the difference in live weight between the groups was between the first and second - 29.1 kg (7.3%).

The increase in live weight of gobies for the period of growing, growing and fattening up to 15 months of age is presented in table 5.

Table 5. The increase in live weight of young animals.

| Indicator                  | Breed                  |
|----------------------------|------------------------|
|                            | Mm                     | ½ Hereford + ½ simmental |
| Absolute, kg               |                        |
| 0-6 months                 | 135.9±2.39             | 153.5±3.93**             |
| 6-12 months                | 152.5±3.31             | 167.8±4.89*              |
| 12-15 months               | 71.8±1.43              | 76.6±1.03*               |
| 0-15 months                | 370.0±4.33             | 377.9±5.71               |
| Average daily, g           |                        |
| 0-6 months                 | 755.0±9.3              | 932.2±12.1**             |
| 6-12 months                | 847.2±12.4             | 865.5±12.9*              |
| 12-15 months               | 798.0±12.1             | 851.1±13.2**             |
| 0-15 months                | 822.2±10.7             | 843.8±14.3               |

From table 5 it is seen that the largest absolute gain in live weight in the periods of growth was observed in crossbred bulls. So, in the period of growing from 6 to 12 months of age, the calves of the second group exceeded the calves of the first group in absolute growth by 15.3 kg, the average daily gain by 28.3 g (P <0.05), and during the fattening period from 12 to 15 months - 4.8 kg and 53.1 g, respectively. As a result, for the entire period of growing and fattening, the difference in these indicators between the animals of the two groups was 7.9 kg and 21.6 g, respectively, which is probably due to the manifestation of heterosis in the local offspring.

S.V. Shadrin, A.A. Golubkov, A.G. Kirikov (2011), while studying the influence of other breeds in the development of the red-motley breed, noted that the absolute increase in live weight of red-motley bulls from birth to 12 months of age was 317 kg, and the average daily gain during the growing period was 870 grams.

During the life of animals, meat productivity is judged by their live weight and fatness. However, the live weight and appearance of the animal do not give a complete picture of meat productivity and meat quality. The most accurate and objective data about them can be obtained only after the slaughter of animals. The result of the control slaughter showed a comparatively high slaughter quality of the experimental gobies of both groups (table 6).
Table 6. The results of the control slaughter of experimental animals.

| Group                        | purebred Hereford | ½ Hereford + ½ Simmental |
|------------------------------|-------------------|---------------------------|
| Slaughter live weight, kg    | 378.9             | 402.6                     |
| Weight of fresh carcass, kg  | 217.7             | 234.0                     |
| Mass of internal fat, kg     | 5.7               | 4.8                       |
| Slaughter weight, kg         | 212.9             | 228.3                     |
| Slaughter yield,%            | 56.2              | 56.7                      |

Hereford-Simmental bulls differed in the greatest pre-slaughter live weight, carcass weight and slaughter weight. So, according to this indicator, the bulls of the second group exceeded their peers by 23.7 kg or 5.9%. Hereford animals tend to have high internal fat content. So, Hereford bulls synthesized 15.8% of internal fat more than their cross-country peers. The slaughter yield of crossbred gobies was 56.7%, which is slightly (0.5%) higher than in purebred animals.

It is well known that the size and shape of the carcass, the ratio of muscle, adipose tissue, bones and tendons in it are the most important quality indicators of animal carcasses. The higher the meat content in the carcass and the lower the proportion of connective tissue, the higher the nutritional value of meat. After cooling, boning and venation of half carcasses were carried out, the morphological composition of the carcass and the ratio of muscle, fat, bone and connective tissue were determined. Indicators characterizing the morphological composition of carcasses of gobies are presented in Table 7.

Table 7. Morphological composition of carcasses.

| Indicator                  | purebred Hereford | ½ Hereford + ½ Simmental |
|----------------------------|-------------------|---------------------------|
| Chilled carcass mass       | 108.8             | 117.0                      |
| Muscle                    | 83.2              | 90.7                       |
| Fat tissue                | 2.9               | 2.7                        |
| Bone                      | 19.5              | 20.3                       |
| Connective tissue         | 3.2               | 3.3                        |
| Meat ratio                | 4.26              | 4.27                       |

An analysis of the data in Table 7 shows that in the half-carcasses of gobies of Hereford breed muscle tissue is 7.5 kg less than in the half-carcasses of crossbred gobies of the second group, the amount of adipose tissue was approximately the same, the content of bone tissue slightly exceeds the crossbred gobies (0.8 kg or 0.5%), there was no significant difference in connective tissue. The meat coefficient also did not have a significant difference between the studied groups.

The comparative efficiency of rearing young animals in a private business environment is presented in Table 8.

Table 8. Comparative efficiency of rearing and fattening of young animals using different technologies.

| Indicator                        | purebred Hereford | ½ Hereford + ½ Simmental |
|----------------------------------|-------------------|---------------------------|
| Slaughter weight, kg             | 217.7             | 234.0                     |
| Meat ratio                       | 4.26              | 4.27                       |
| Selling price of 1 centners of beef, rubles. | 22,000            | 22,000                     |
Costs per head per year, rub. & 34,312.1 & 34,312.1 \\
Cost of 1 centner of beef, rub. & 15,761.2 & 14,581.2 \\
Profit RUB & 6,238.8 & 7,418.8 \\
Profitability level of production,% & 39.6 & 50.8 \\

Analysis of the comparative efficiency of growing and fattening gobies shows that the cost of production of 1 kg of beef received from cross-breed gobies is 1180.2 rubles lower. The profitability of growing crossbred bulls is 11.2 orders of magnitude higher. In order to increase meat productivity and improve meat quality in commodity cattle breeding, it is advisable to practice rearing and feeding of young animals obtained by crossing red-motley cows with Hereford bulls in order to raise fattening young animals using intensive technology of meat cattle breeding.

References
[1] Lefler T F 1994 The influence of the genotype on the productive qualities of young animals // Intensification of livestock production in the Krasnoyarsk Territory Proceedings of Krasnoyarsk state agrarian un-ty (Krasnoyarsk) pp 52-4
[2] Mashanov A I and Proshko L A 2005 The current state of the meat industry and the prospects for scientific support of the meat industry Production of environmentally friendly products (problems and solutions) 1 74-7
[3] Kibkalo L I, Zherebilov N I, Ilyin N I and Korolev A A 2003 Interbreeding in cattle breeding (Kursk: Publishing house of Kursk state S.-kh. Ak.)
[4] Shadrin S V, Golubkov A A and Kirikov A G 2011 Growth and development of bull-calves of red-motley breed and its crosses obtained from crossing with Holstein and red-motley Swedish breeds Bulletin of KrasGau 1 23-4