Beef production in conditions of stable-pasture and industrial technologies in breeding farms

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Abstract. The article presents data on the comparative study of beef production in the conditions of stable-pasture and industrial technologies. For this purpose, in the first series of experiments in the breeding farms of Antonovskoye CJSC and Energia LLC, 40 black-and-white bulls (group 1), Kalmyk (group 2) and Hereford breeds (group 3) were formed. Black-and-white bulls were individually kept in a dispensary, 15-day-olds were grouped into 20-30 heads and were tied up in a calf coop using farm pastures. Calmyk and Hereford bulls up to 7-8 months of age were raised in both farms with mothers on full suckling. After weaning from mothers, 20 8-month-old bulls from each group were kept together, in conditions of stable-pasture technology with the expectation of obtaining 800-900 grams of daily gain. 20 8-month-old bulls of each group for the second series of tests were implemented for rearing at the Agro-Park-Razvilnoye industrial complex LLC and had free access to self-feeders with concentrates and coarse feed. In the first series, the daily increase was 749-804 g, and in the second series – 1275-1360 g, with an advantage in favor of gerefords. Therefore, the live weight of 18-month-old bulls, respectively, by birth was 619.0; 646.6 and 657.7 kg, or 178-192 kg more than with stable-pasture technology (P>0.999). At the control slaughter, the Herford bulls were highly reliably superior in both series of experiments in terms of carcass weight, muscle tissue and slaughter yield. However, the profitability of production in the first series of experiments is 1-2% higher, and the live weight is 29-30% lower.

1 Introduction

The increase in beef production is one of the most pressing problems of the agro-industrial complex of our country, since its demand is currently being met by 45-55% due to its own production. It is possible to compensate for the missing needs in beef by intensifying the cultivation of existing young animals and the development of the beef cattle industry, which

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is confirmed by the provisions of the Federal Scientific and Technical Program for the Development of Agriculture for 2017-2025 [1-4, 10]. These documents emphasize that the main functions of cattle breeding are to ensure employment of the population and supply it with dairy and meat products. Therefore, it inevitably becomes necessary to breed one and a half or two cows of meat breeds for one dairy. However, so far their ratio does not even reach the inverse proportion [3]. So, as of 1.01.2023, in the Rostov region there were only about 630 thousand head of cattle of meat breeds less than 30 thousand - 5% [6-9]. At the same time, in many regions of Russia and the Southern Federal District, beef production is used in breeding enterprises, in which stable-pasture technology with growth energy up to 900 grams per day is often used to keep cows and raise their offspring. More than 50% of the resulting young animals at the age of 6-8 months are sold for intensive rearing in large industrial complexes, providing a daily increase of 1200-1600 grams [2, 10-13].

The scientifically based concept of a promising increase in beef production in Russia [7] provides for an increase in the intensity of using the potential of meat productivity of young animals by at least 30-35% and accelerated development of beef cattle breeding [5, 8]. Using stable-pasture technology and large industrial complexes for this purpose. The expediency of increasing beef production in a market economy can only be due to sufficiently high production efficiency. Therefore, despite the existing serious competitive advantage, the efficiency of the beef cattle industry [4] will depend on the level of feeding and the quality of management decisions taken in the organization of the entire production process. The Kalmyk, Hereford and Aberdeen-Angus breeds are currently intensively used in beef cattle breeding in the Southern Federal District. At the same time, it is taken into account that genotypic and paratypic factors influence the milk production of cows and the growth energy of young animals. Their underestimation always negatively affects the manifestation of the genetic potential of livestock and cost recovery. Since the phenotypic diversity of traits in animals is due to the complex interaction of heredity and environmental conditions. Heredity determines, and living conditions carry out the development of the organism. In animals with approximately the same heredity, under the influence of different environmental conditions (feeding, care, maintenance, features of use, etc.), the formation of signs is not the same. one of the main factors determining the formation of dairy and meat productivity of livestock [2]. is the energy level of feeding. It is based on the principle of increasing the overall efficiency of feed use while increasing the energy level of animal nutrition. The manifestation of these patterns is due to the fact that the increase in productivity is not accompanied by a corresponding increase in energy expenditure on the vital activity of the organism. Therefore, the less nutrients of the feed are spent on the formation of growth and live weight, the higher the productivity, which is also interrelated with gender and age [1, 6, 8]. An important production factor that contributes to increasing the productivity of animals is the environment and microclimate of industrial premises. It contributes to ensuring the health, well-being of animals and the efficiency of service personnel. Deviation of the parameters of temperature, relative humidity, air velocity, etc. from the norm leads to a decrease in growth energy, the formation of meat productivity and, accordingly, to economic efficiency and payment for feed products [14,15]. Therefore, the purpose of our work was a comparative study of the influence of certain breed and technological factors on the growth energy and meat productivity of dairy and meat breed bulls.

2 Materials and methods

To conduct two series of scientific and economic experiments that we conducted in 2020 and 2021 in the breeding farm of CJSC Antonovskoye of Tsimlyansky, the breeding farm of LLC Energia of Proletarsky and the industrial complex of LLC Agropark-Razvilnoye of the Peschanokopsky districts of the Rostov region. For this purpose, in the first series of

experiments, 40 black-and-white (group 1) and Kalmyk (group 2) bulls were formed in the breeding farms of Antonovskoye CJSC, and 40 Kalmyk (group 2a) and Hereford breeds (group 3) bulls were formed in Energia LLC. From birth to the age of 15, black-and-white bulls were kept in individual cages in the dispensary, then they were grouped into 20-30 heads and until the age of 6-7 months they were tied up in sections of the calf house with access to the fattening site and the use of farm pastures in the warm season. Kalmyk and Hereford bulls up to 7-8 months of age were raised in both farms with mothers on full suckling and apart from mother's milk and pasture feed, no other top dressing was received. After weaning from mothers, 20 8-month-old bulls from each group were sold for rearing in the conditions of the Agropark-Razvilnoye LLC industrial complex. The selected bulls were kept in equal conditions of the same pen with free access to the recreation room and access to the feed yard to self-feeders with concentrates and coarse feed.

The remaining 20 bulls of the first and second groups were kept together, as well as the bulls of groups 2a and 3 were also kept together and in the conditions of stable-pasture technology, their feeding level was calculated to receive 800-900 grams of daily gain. In the second series of experiments, the formation of meat productivity in bulls of the marked breeds with stall-pasture and industrial technologies was studied. The live weight was assessed by individual weighing at one-day, 8, 12, 15 and 18 months of age. At the end of the experiment, at the age of 18 months, basic measurements were taken, physique indices were calculated on their basis, and 3 bulls from each group were selected for control slaughter. In which the pre-slaughter live weight, paired carcass, internal fat yield, slaughter weight, slaughter yield, morphological composition and bulk semi-finished products were individually taken into account. To do this, after 24-hour cooling at a temperature of 0-(+4 °) C and deboning of the left half-carcass, the absolute and relative content of muscle, fat, bone tissue, tendons and 11 names of large-sized semi-finished products were determined.

1. Tenderloin – the lumbo-iliac and small lumbar muscles, stripped of connective and adipose tissues.
2. The longest muscle of the back is isolated from the dorsal and lumbar parts, without a bone ligament, but covered with a shiny tendon and fat.
3. Hip part: the upper piece is the pulp separated from the iliac bone (the middle arch muscle without coarse tendons);
the inner piece is the pulp removed from the inner side of the femur (slender and fused adductor and semi-webbed muscles);
a side piece is a pulp removed from the anterior side of the femur, covered with a thin surface film (quadriceps muscle);
the outer piece is the pulp removed from the outside of the femur (fused biceps and semi-tendon muscles).
4. The scapular part is the pulp removed from the scapular and humerus bones (triceps muscle of the shoulder, acuminate and dorsal muscles of the scapula).
5. The scapular part is a layer of meat located on the spinous processes of the first three thoracic vertebrae and on three ribs, stripped of tendons and coarse films (supravertebral, ventral-toothed, part of the longest muscle and others).
6. Brisket - muscles (thoracic superficial and deep) separated from the breast bone, thoracic cartilage and from the 1st to the 4th rib.
7. The cut is a layer of pulp removed from the costal part, starting from the fifth to the thirteenth rib, (the widest muscle of the back, deep thoracic, part of the dentate-ventral and others).
8. Cutlet meat - pieces of meat pulp of various sizes and weights from the neck, as well as flank, intercostal meat, pulp from the tibia, radius, ulna and trimmings obtained by stripping large-sized semi-finished products and bones with at least 80% of muscle tissue.

According to the comparison of the cost of feed, labor, energy resources and other cost components with the receipt of funds from their sale, the payback and profitability of beef were determined.

3 Results

Under the conditions of stable-pasture technology, during the year, experienced animals consumed feed containing 3120 kg of dry matter with a total nutritional value of slightly more than 2,800 feed units, 30-31 thousand MJ of exchange energy and 270-292 kg of digestible protein. In the conditions of the industrial complex, coarse feed (barley and pea straw, mixed grass and alfalfa hay) and a mixture of concentrates (barley and corn by 40%, and wheat by 20%) were eaten to their heart's content from self-feeders. Spending on average, depending on the live weight and daily gain, 9-14 kg of dry matter and 92-141 MJ of exchange energy per head per day.

In the process of analyzing the results of rearing, it was revealed that despite the equal conditions of stall-pasture technology, dairy and meat bulls had different growth energy during the embryonic period and after their birth, which caused a different increase in live weight with age (Table 1).

Table 1. Dynamics of growth energy of bulls of different groups of the first series

Age, months.	Live weight, kg							
	Black and		Kalmyk		Kalmyk		Hereford	
	M±m	C_v	M±m	C_v	M±m	C_v	M±m	C_v
1 day	32,2±1.7	2,9	23,2±1,3	2,5	23,7±1,5	2,7	25,6±1,3	2,3
1	53,9±3,0	3,7	50,9±3,5	3,1	51,8±2,9	3,0	53,9±3,1	2,8
3	106,6±2,9	3,3	107,3±3,4	3,0	108,5±3,2	3,1	111,2±3,6	3,1
6	179,4±3,1	3,9	181,8±3,6	3,2	182,8±3,2	3,0	186,5±4,0	3,6
8	227,5±4,0	4,2	234,7±3,8	3,5	235,5±3,7	4,1	240,2±3,2	3,0
12	305,3±3,9	4,0	318.1□4,2	3,9	319,4±4,0	4,2	325,5±3,8	4,0
15	373,1±4.3	4,5	385,4□5,0	4,4	386,7±4,8	4,5	395,6±4,1	4,2
18	441,7±5,7	4,8	454,3±4,7	4,2	453,9±4,4	4,3	465,6±4,3	4,1

Black-and-white bulls at birth were almost 10 kg higher in live weight than their peers of other breeds, but subsequently their growth energy was inferior to them by 14-93 grams in almost all accounting periods (Table 2).

Table 2. Absolute and daily growth of bulls of different groups

Age, days	Absolute gain, kg				Average daily increase, g			
					1	2	2a	3
270	32,2	23,2	23,7	25,6	119	86	88	95
0-30	21,7	27,7	28,1	28,3	723	923	937	943
31-90	52,7	56,4	56,7	57,3	878	940	945	955
91-180	72,8	74,5	74,3	75,3	808	828	825	836
181-240	48,1	52,9	52,7	53,7	802	881	873	895
241-365	77,8	83,4	83,9	85,3	627	672	677	688
366-456	67,8	67,3	67,3	70,1	753	748	748	779
457-547	68,6	68,9	67,2	70,0	762	765	748	778
1-240	195,3	211,5	211,8	214,6	814	881	882	894
241-547	214,2	219,6	218,4	225,4	700	718	714	737
1-547	409,5	431,0	430,2	440,0	749	788	786	804

At the same time, the average daily increase in bulls of all groups increased sequentially during the first 90 days of the dairy period and was at the level of 723-955 grams, with a significant superiority in favor of peers of meat breeds. Therefore, at this age, with stable-pasture technology, they have the highest absolute increase and the lowest coefficient of variability of the live weight of bulls in each group. At an older age, the growth energy of bulls decreased by more than 100 g per day and over an 8-month period it was at the level of 814 grams in black-and–white and 881-894 (P>0.99) - in Kalmyk and Hereford breeds.

At the age of 240-547 days, the average daily increase in bulls of all groups was 700-737 g, which negatively affected the average growth energy for the 18-month period of development, which in black-and–white bulls was 749 g, and in Kalmyk and Hereford peers - 787 and 804 g (P>0.95).

The superiority in the growth energy of beef bulls over black-and-white ones with stall-pasture technology provided a different amount of live weight. In black-and-white bulls, it was 441.7 kg, and in Kalmyk – 454 kg and Hereford – 465 kg (P>0.95).

When rearing bulls of the same breeds from 8 to 18 months of age in an industrial complex, in which they had free acce

ss to self-feeders and could eat coarse and concentrated feed at will. Due to this, especially in the first months, which coincided with the winter period, their growth energy fluctuated at the level of 1414-1493 grams per day, which is more than 2 times higher than that of peers with stall-pasture technology. At the same time, the reliability of the difference in daily growth and live weight between peers of dairy and meat breeds have slightly increased than 2 times higher than that of peers with stall-pasture technology. At the same time, the reliability of the difference in daily growth and live weight between peers of dairy and meat breeds have slightly increased.

During the 10-month period of growing with industrial technology, the average daily increase was at the level of 1275-1360 grams (Table. 5) and the absolute increase in live weight in black-and-white bulls was 391.5 kg, and in Kalmyk and Hereford peers slightly more than 411 and 417 kg (P>0.95).

Table 3. Absolute and average daily growth of bulls of different group

Age, days.	Absolute gain, kg			Average daily increase, g		
	1	2	3	4	5	6
240-365	176,8	184,3	186,6	1414	1474	1493
366-456	111,0	117,1	119,2	1233	1301	1324
457-547	103,7	110,1	111,7	1144	1223	1241
240-547	391,5	411,5	417,5	1275	1340	1360

With such growth energy, bulls of all groups at the age of 18 months had a massive physique with well-defined measurements of straight and oblique trunk length, chest girth behind the shoulder blades and a half-grip of the ass (Table 5). Therefore, they have high indicators of format indices of physique (legginess, meatiness, massiveness). The higher indices of measurements and indices of physique were in the bulls of meat breeds, especially in the peers of the Hereford, which marks their better precocity (Table 4). In black-and-white bulls, lower indicators of format measurements were noted, but they were in the lead in measurements and indices characterizing breast development. Hereford gobies were the longest-bodied. They have measurements of oblique length and straight trunk length 15-20% more than that of bulls of other breeds.

Table 4. Change in the live weight of experimental bulls with industrial technology, kg (second series of experiments)

Age, months	Group (n= 15 in a group)					
	1		2		3	
	M±m	C_v	M±m	C_v	M±m	C_v
8	227,5±4,0	4,2	235,1±3,8	3,5	240,2±3,2	3,0
12	404,3□4,2	4,9	419,4±4,1	4,1	426,8±4,1	4,1
15	515,3□3,9	4,8	536,5±3,7	4,8	546,0±4,1	3,4
18	619,0□3,5	4,5	646,6±3,3	4,9	657,7±4,1	4,2

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Table 6. Measurements of the physique of 18-month-old bulls, cm

Name of measurements	G r u p p a		
	1	2	3
Height at the withers	134,4	135,2	145,3
Height in the sacrum	135,5	136,1	147,2
Height in the sciatic mounds	128,9	136,4	142,1
Oblique length of the trunk	159,5	164,8	188,1
Straight trunk length	150,4	159,8	180,2
Chest depth	74,6	68,8	75,3
The width of the chest behind the shoulder blades	43,2	42,3	48,2
Width in maklaks	57,2	51,8	64,2
Width at the hip joint	56,1	49,0	62,1
Width in the sciatic mounds	36,3	35,1	41,3
Chest girth behind the shoulder blades	189,9	188,3	207,2
Pastern girth	19,2	19,1	23,1

Horizontal butt half-girth	139,5	146,3	179,1

Table 7. Indices of the physique of bulls, %

Name of indexes	1	2	3	4
Long legs	47,9	48,0	47,2	44,1
Sprawl	119,1	121,6	121,4	129,4
Thoracic	60,7	60,0	59,7	60,3
Pelvic-thoracic	90,7	82,1	83,3	75,0
Overgrowth	101,9	100,8	101,2	101,3
Downed	112,9	115,0	111,8	110,1
Shilozadosti	66,1	67,7	68,5	70,3
Bony	15,8	15,2	14,9	15,0
Meat	72,9	73,6	74,8	83,4
Massiveness	138,9	139,1	138,3	142,0
Comprehensive	150,6	149,2	150,1	147,1

There were no interbreed differences in the values of the indices of bony and shilozadost. Indices of legginess, pelvic-thoracic, downness and complex characterizing the development of the thorax of the trunk and limbs. As the adult animal reaches the format, these indices gradually decrease, which to some extent indicates precocity. Since the smaller these indices are, the more these animals are long-bodied and correspond to the forms of adult individuals. In this experiment, bulls of Hereford and Kalmyk breeds are more precocious with a sign of long-bodied.

However, the bulls of the studied breeds in the second series of experiments had high growth energy, so their live weight at 18 months of age, respectively, by breed was at the level of 619.0; 646.6 and 657.7 kg, or 178-192 kg more than with stable-pasture technology ($P>0.999$). It is noteworthy that the 8-month-old bulls of dairy and meat breeds of domestic breeding that entered the feed complex had a high average daily increase with an excess in all accounting periods in favor of Herefords.

Therefore, at the age of 18 months, according to the pre-slaughter live weight of 637.9 kg, the superiority over the peers of the Kalmyk breed was 10 kg and over the black-and–white breeds - 37 kg, and when compared with the stall-pasture technology, the difference was 186-209 kg (Table 8).

Table 8. Slaughter rates of 18-month-old bulls

Name		Growing technology and group (n= 3 in a group)					
		Industrial			Stable-pasture		
		1	2	3	1	2	3
Pre-slaughter weight, kg		600,7±3,7	627,2±3,5	637,9±3,9	428,5±3,2	440,6±2,9	451,8±3,3
Mass of steamed carcass	kg	328,0±0,8	355,6±1,1	363,0±0,9	230,1±0,3	240,6±0,5	248,0±0,7
	%	54,6	56,7	56,9	53,7	54,6	54,9
Mass of internal fat	kg	22,8±0,7	24,0±0,8	25,3±0,9	11,6±0,8	12,2±	12,7±
	%	3,79	3,83	3,97	2,71	2,77	2,81

Slaughter weight, kg		350,8±1,7	379,6±1,9	388,3±1,6	241,7±1,1	252,8±1,1	260,7±1,3
Killer exit , %		58,46	60,52	60,87	56,41	57,28	57,70
Chilled carcass, kg		321,6±3,2	348,1±3,7	354,8±3,1	226,4±3,6	237,0±3,9	243,4±2,7
Mass of muscle tissue	kg	243,5±1,0	267,3±1,3	272,8±1,2	169,8±1,3	180,4±	185,5±
	%	75,7	76,8	76,9	75,0	76,1	76,2
Pulp yield , %		80,7	81,8	81,3	80,2	81,6	81,1
Mass of bones, cartilage and tendons	kg	62,1±0,5	63,4±0,7	66,3±0,3	44,8±0,2	43,6±0,3	46,0±0,5
	%	19,3	18,2	18,7	19,8	18,4	18,9

A similar pattern was manifested in terms of the mass of paired and chilled carcasses, internal fat, muscle tissue, bones, cartilage, tendons and slaughter yield. At the same time, it should be noted that 18-month-old bulls with industrial rearing technology had a highly reliable superiority over their peers of the stable-pasture in all absolute and some relative indicators of control slaughter. n addition, in the experiments of both series, black-and-white bulls were significantly inferior to their peers of meat breeds in terms of carcass weight, internal fat, muscle tissue, but superior in the yield of bones, cartilage and tendons. However, bulls of all groups, and especially Herefords, have a high slaughter yield, which in the first series was at the level of 56.4-57.7 and in the second – 58.4-60.8%, which indicates a high responsiveness of animals of these breeds to the intensification of production. In the process of analyzing the morphological composition, it was revealed that when the carcasses were cooled, their mass loss was at the level of 1.6-2.0% in the bulls of the first and second series of experiments. There were no significant differences between them in the yield of pulp, bones, cartilage and tendons. A highly reliable difference in these characteristics in absolute values for them and taking into account the breed, was manifested due to the difference in the mass of the carcass. Black-and-white peers took the last place in all slaughter indicators, morphological composition and mass of large-sized semi-finished carcasses, and Hereford bulls took the first place (Table 9).

Table 9. Bulk semi-finished carcasses, kg

Indicator	Growing technology and group					
	Industrial			Stable-pasture		
	1	2	3	1	2	3
Mass of chilled carcass	321,6±3,2	348,1±3,7	354,8±3,1	226,4±3,6	237,0±3,9	243,4±2,7
Cut	26,8±0,93	29,1±0,83	29,2±0,82	18,6±0,89	19,5±1,04	20,4±0,84
The scapular part	25,9±0,80	28,4±0,74	28,1±0,81	18,1±0,93	19,2±1,12	19,5±0,93
Under the shoulder blade	18,8±0,74	19,6±0,38	21,1±0,86	13,0±0,90	13,9±0,84	14,4±0,84
Brisket	19,7±0,92	21,6±1,03	21,9±0,75	14,0±0,94	14,7±0,73	15,1±0,73
Longest backs	25,1±0,85	27,4±1,01	27,9±0,97	16,3±0,91	19,1±1,91	19,2±0,75
Fillet (tenderloin)	9,5±0,63	11,1±0,57	12,1±0,52	6,0±0,50	7,4±0,35	7,4±0,34
Hip: side piece	75,4 20,5±1,11	85,2 22,8±1,07	85,9 23,1±0,91	53,2 14,3±0,94	57,1 14,9±1,12	57,9 15,7±0,72

top piece	14,2±0,92	16,5±0,385	16,8±0,66	10,5±0,90	11,1±0,44	11,1±0,73
outer piece	21,6±1,03	23,8±1,02	23,9±0,87	15,2±0,92	16,4±1,14	16,5±1,01
inner piece	19,1±1,02	22,1±1,05	22,1±0,70	13,2±0,84	14,7±1,13	14,6±1,05
total	201,2	222,4	226,2	139,3	150,9	153,9
Cutlet meat	58,3±2,11	62,3±2,40	62,3±2,02	42,3±2,11	42,5±1,83	43,5±2,01
Mass of muscle and adipose tissue	259,5	284,7	288,5	181,6	193,4	197,4
Meat ratio	4,18	4,49	4,35	4,05	4,43	4,29
Pulp yield per 100 kg of live weight	43,25	45,41	45,22	42,33	43,89	43,69

4 Discussion of the results

In terms of muscle mass, they outperformed peers of other breeds in the first series of experiments by 5-16, and in the second series – by 6-29 kg with confidence at P> 0.95 and P> 0.999. However, the highest yield of large-batch semi-finished products with industrial and stable-pasture technologies was noted in Kalmyk bulls, which was at the level of 63.89 and 63.67%. Among the peers of the Hereford breed, it was at the level of 63.75 and 63.23%, and among the black–and-white bulls, these indicators were at the level of 62.56 and 61.53, respectively. At the same time, for the share of the most valuable semi–finished products (the longest back muscle, loin and hip parts of the carcass), Hereford bulls are in the first place in absolute terms with both technologies, and in relative values - Kalmyk bulls with indicators with industrial technology of 7.87; 3.19 and 24.47%, against 7.86; 3.14 and 24.21% for Hereford peers. With the stable-pasture technology, these signs had relative values of 8.06; 3.12 and 24.09, as well as – 7.89; 3.04 and 23.79%, respectively. In addition, Kalmyk bulls were 0.3-9.4% superior to peers of other groups in terms of meat content and carcass pulp yield per 100 kg of live weight. At the same time, there were no significant differences in these indicators in bulls between the first and second series of experiments, which confirms the proportional development of bulls in both series of experiments.

Different conditions of maintenance and the level of feeding caused unequal costs and production costs, which is confirmed by the results of two series of our scientific and economic experiments.

The analysis of the results showed that the most effective economic indicators for stable-pasture and industrial technologies were manifested in black-and-white bulls. Since in dairy cattle breeding, when calculating the cost of 1 kg of live weight of offspring, unlike meat breeds, the costs of their mothers are not taken into account, the payback of which is covered by dairy products. Therefore, despite the higher indicators of growth energy and absolute growth, the cost of 1 kg of live weight when raising Kalmyk and Hereford bulls is slightly higher, and the profit margin and profitability level are significantly lower than those of black-and-white peers (Table 8). At the same time, it should be noted that in the conditions of stable-pasture, unlike industrial technology, the bulls mostly fed themselves with grass pastures. They almost did not need the cost of funds for the delivery, storage and preparation of feed for feeding, which significantly increased the payback of their and maternal costs in the process of growing and producing beef.

Table 10. Economic indicators (on average per bull)

Name	Growing technology and group					
	Industrial			Stable-pasture		
	1	2	3	1	2	3
Live weight in 18 months, kg	619,7	646,6	657,7	441,7	454,0	465,6
Cost of 1 kg of live weight, rubles	189,9	190,8	191,0	187,1	187,3	187,6
Total costs, rubles	117681,0	123371,3	125620,7	82642,1	85034,2	87346,6
The selling price of 1 kg of live weight, rubles	211	211	211	211	211	211
Revenue from sales, rubles	130756,7	136432,6	138774,7	93198,7	95794,0	98241,6
Profit, rubles	13075,7	13061,3	13154,0	10556,6	10759,8	10895,0
Profitability , %	11,11	10,58	10,47	12,77	12,65	12,47

Therefore, in the second series of experiments, despite the higher revenue from the sale of bulls and profits, which the black-and–white ones had at the level of 37.5 and 2.5 thousand, and the Hereford one had 40.5 and 2.2 thousand rubles more in comparison with peers of the first series, but the profitability level of the latter was 1-2% higher. This probably explains the viability of the two beef production systems in the country. They are closely interrelated and complement each other. Many performing the function of reproducers of young animals are not able to provide them with intensive rearing to slaughter conditions. It is economically advantageous for them to sell most of the bulls and over-repaired heifers at the age of 8 months to industrial complexes, which contributes to the intensification of the cultivation of the remaining young and increases the yield of beef to the original cow.

5 Conclusions

The use of two beef production systems in the Rostov region makes it possible to increase the growth energy and profitability of growing over-repaired young animals in brood farms with stable-pasture technology and supply for intensive rearing of young dairy and meat breeds in the conditions of the industrial complex. They use free access to self-feeders, in which there are always coarse and a mixture of concentrated feeds, with the calculation of consumption of 8-11 kg of dry matter of feed per head per day, which makes it possible to obtain a heavier carcass with high-quality beef, but the cost recovery and profitability are somewhat lower.

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