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MEAT PRODUCTIVITY OF FRENCH-BRED BULLS DUE TO ADAPTIVE TECHNOLOGY IN WESTERN SIBERIA

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The study of meat productivity of introduced cattle breeds in Western Siberia using adaptive technologies is of scientific and practical interest. We carried out the experiment on five cattle groups of Hereford, Limousin, Charolais, Aubrac and Salers bull calves. Furthermore, we determined the indicators of weight growth from birth to 18 months and meat productivity at the age of 18 months. At birth, live weight control was carried out at 3, 6, 9, 12, 15 and 18 months when weighing animals in the morning before feeding and watering. We studied meat productivity during the control slaughter of animals at the Yalutorovsky meat processing plant. Three heads from each group were slaughtered. The slaughter was carried out according to the Lenin All-Union Academy of Agricultural Sciences [VASKhNIL] method. The experimental material was processed by the method of variation statistics using the Microsoft Excel software application. Steers of French meat breeds surpass Hereford cattle breeds in terms of live weight and average daily growth. The carcass weight of Charolais animals is 329.5 kg, which is 75.3 kg more than in Hereford bulls, P≥0.999. The results of the chemical analysis indicate that the highest fat content is contained in the minced meat of Hereford bulls – 10.6%. Introduced cattle breeds, when bred under new conditions, showed a fairly high level of meat productivity, carcasses were obtained during slaughter, with an optimal ratio of tissues and chemical composition of carcasses, in terms of the yield of edible parts in the carcass and the meat content coefficient, they surpass the Hereford cattle breed. Thus, French meat breeds are promising for beef production in Western Siberia.

Keywords: *breed; limousin, aubrac; charolais; salers; carcass weight; slaughter output; live weight; gain; meat; bones*

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МЯСНАЯ ПРОДУКТИВНОСТЬ БЫЧКОВ ФРАНЦУЗСКИХ ПОРОД ПРИ ИСПОЛЬЗОВАНИИ АДАПТИВНОЙ ТЕХНОЛОГИИ В УСЛОВИЯХ ЗАПАДНОЙ СИБИРИ

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Изучение мясной продуктивности интродуцированных пород скота в Западную Сибирь при использовании адаптивных технологий представляет научный и практический интерес. Эксперимент проведен на 5 группах бычков пород герефордская, лимузинская, шароле, обрак и салерс. Определены показатели весового роста в период от рождения до 18 месяцев и мясная продуктивность в возрасте 18 месяцев. Контроль за живой массы осуществлялся при рождении в 3, 6, 9, 12, 15 и 18 месяцев при взвешивании животных утром до кормления и поения. Мясная продуктивность была изучена при проведении контрольного убоя животных на Ялуторовском мясокомбинате. Убой произведен по три головы из каждой группы. Убой проведен по методике ВАСХНИЛ (1997). Экспериментальный материал обработан методом вариационной статистики с использованием программного приложения Microsoft Excel. Бычки французских мясных пород по величине живой массы и среднесуточного прироста превосходят герефордскую породы скота. Масса туши от животных породы шароле – 329,5кг, что больше по сравнению с этим показателем у герефордских бычков на 75,3кг P≥0,999. Результаты химического анализа свидетельствуют, что наиболее высокое содержание жира содержится в мясе-фарше бычков герефордской породы - 10,6%. Интродуцированные породы скота, при разведении в новых условиях показали достаточно высокий уровень мясной продуктивности, от них при убое получены туши, с оптимальным соотношением тканей и химическим составом туш, по выходу съедобных частей в туше и коэффициенту мясности они превосходят герефордскую породу скота. Таким образом, французские мясные породы являются перспективными для производства говядины в условиях Западной Сибири.

Ключевые слова: *порода; лимузинская; обрак; шароле; салерс; масса туши; убойный выход; живая масса; прирост; мякоть; кости*

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Introduction

Increasing the meat productivity of cattle using adaptive technologies is one of the tasks of the beef cattle industry [6]. Cattle breeds, according to several researchers [1], are the strategic basis of the state's breeding and food security, and their diversity reflects the qualitative level of breeding work. In Russia, in recent years, we identified a variety of breeds of beef cattle. Since 2002, French beef cattle breeds have become widespread in Western Siberia. The meat productivity of individual breeds has been studied in several experiments [7; 8], but comparative studies of fattening and meat quality using adaptive technologies have not been studied. Therefore, the study of the productivity of beef cattle breeds in the region with adaptive technologies is relevant. This study allows us to obtain data on the productive qualities of cattle of different breeds and their effective use in the future, involving a system of differentiated animal rearing depending on breed affiliation. The paper aims to study the fattening and meat qualities of specialized cattle breeds in Western Siberia using the adaptive technology of rearing bulls.

The research aims to conduct a comparative study of the indicators of weight growth and meat productivity of bulls of French meat breeds with adaptive maintenance technology.

Based on the set goal, the following tasks were formulated:

1. To conduct a comparative assessment of the weight growth indicators of bulls of different breeds;

2. To conduct a comparative assessment of the meat productivity of bulls of different breeds of cattle.

Materials and methods

The research and production experience was conducted in LLC Tyumen Meat Company. Therefore, we have formed five groups of Hereford, Limousin, Charolais, Aubrac and Salers animal breeds. Furthermore, we used the animals of the Hereford breed as a control group since the breed has been bred in the Tyumen region since the 1970s of the 20th century. Up to the age of six months, the bulls were raised due to adaptive technology. The animals were kept without premises, with maximum use of pasture. After being beaten off from their mothers and the quarantine period, they were placed on the feedlot, where they were reared and fattened. The number of bulls of each breed was 25 heads.

During the experiment, the live weight was monitored at birth at 3, 6, 9, 12, 15 and 18 months. The live weight was determined by weighing the animals in the morning before feeding and drinking. Thus, we determined the live weight

at the age of 205 days by calculation [4]. Moreover, we studied meat productivity during the control slaughter of animals at the Yalutorovsky meat processing plant. The slaughter was carried out on three heads from each group of experimental animals. The slaughter was carried out according to the VASKhNIL method [3]. In addition, we processed the experimental data by the method of variational statistics [5] using the Microsoft Excel software application.

Results

From birth to 8 months, bulls were raised using the technology of beef cattle breeding using full suckling method. Additionally, the bulls received concentrated feed as supplementary feeding; during the summer period, they were on the pasture. After weaning at the age of 8 months, the bulls were placed on the feeding platform. The composition of the diet of the main feeds included: (1) grain-legume hay, (2) haylage from perennial grasses, (3) corn silage, (4) a mixture of concentrated feeds. The composition of the concentrated feed mixture included crushed grains of wheat, barley, oats, and peas. The bulls received mineral supplements, rapeseed cake, and beet molasses to balance the diet during certain periods. Feed consumption is presented in Table 1.

Table 1.

Feed consumption per animal

Feed	Breed				
	Hereford	Limousin	Charolais	Aubrac	Salers
Grain-legume hay	1,306.0	1,396.2	1,426.4	1,371.6	1,382.6
Haylage from perennial grasses	2,056.0	2,215.0	2,411.2	2,210	2,300.0
Corn silage	820.0	829.0	891	828	8,30.2
Mixture of grains	1,263.0	1,320.0	1,390	1,316.8	1,320.2
Beet molasses	45.1	45.1	45.1	45.1	45.1
Feed phosphates	9.46	9.45	9.45	9.45	9.45
Salt	10.8	10.8	10.8	10.8	10.8
Total energetic feed unit [EFU]	3,080.3	3,329.0	3,434.5	3,236.3	3,342.0
Dry matter	3,323.7	3,602.3	3,709.3	3,495.3	3,521.0
Digestible protein	320.3	344.2	357.2	336.5	3,37.8

Animals of different breeds consumed different amounts of feed. The largest amount of feed was consumed by animals of the Charolais breed (3,434.5 EFU); they also consumed a large amount of dry matter and the largest amount of digestible protein. This is due to the large consumption of certain types of feed by animals of the Charolais breed. Differences in feed consumption

provided intra-group differences in live weight and the value of average daily gains.

During the scientific and economic experiments, we established differences in the size of the live weight of bulls, depending on their belonging to certain cattle breeds. In terms of the amount of live weight at birth, one can observe a significant difference with the Hereford breed only in animals of the Charolais breed, with a live weight of 9.9 kg more.

Throughout the entire period of scientific and economic experience, bulls of the Hereford breed had a live weight less than peers of French meat breeds. Therefore, at the age of 3 months, in terms of live weight, the bulls of the Limousine breed significantly exceeded their Hereford peers by 32.7kg (P≥0.95), at 6 months by 54.6 kg (P≥0.95), at 9 months by 45.1 kg (P≥0.99), at 12 by 55.4 (P≥0.99), at 15 months by 62.1 kg (P≥0.99) and 18 months by 66.6 kg (P≥0.99). Moreover, one can observe the same pattern with bulls of other breeds. They also exceed the size of the live weight of the peers of the Hereford breed. The dynamics of live weight is presented in Table 2.

Table 2.

Dynamics of live weight of bulls, kg ($\overline{X} \pm S\overline{x}$)

Age, months	Hereford	Limousin	Charolais	Aubrac	Salers
At birth	28.5±0.8	30.1±0.9	38.4±0.8[3]	30.4±0.7	29.4±0.7
3	95.5±1.8	128.2±2.5[2]	12.5±1.9[3]	118.5±2.9[3]	126.2±3.6[3]
6	170±2.4	224.8±4.5[2]	216.1±2.4[3]	216.6±3.5[3]	220.0±2.8[3]
9	260.1±7.2	289,8.2±9.4[3]	278.6±3.1[3]	300.5±9.3[3]	299.5±9.3[3]
12	332.4±9.3	387.8±910.5[3]	379.6±6.8[2]	388.2±6.1[3]	400±8.5[3]
15	427.8±6.3	489.9±6.2[3]	498.5±6.8[2]	489.5±5.8[3]	475.1±6.1[3]
18	476.2±6.1	542.8±19.8[2]	586.4±6.0[3]	552.2±6.0[3]	542.2±6.0[3]

*Note**: – [1]P>0,95; [2]P>0,99; [3]P>0,999 compared to the Hereford breed, here and further. * Here and further in Tables 2-4, all data were obtained with the participation of the authors (Sheveleva O.M., Bakharev A.A.).

Thus, the steers of French meat breeds can quickly increase the live weight and by the final fattening period, they are significantly superior to the steers of the Hereford breed. At the same time, one should note that the live weight of Hereford bulls in various age periods corresponds to the elite class. This aspect indicates that the bulls are developing intensively, and in terms of live weight, they correspond to breed characteristics. The live weight of bulls of the Aubrac, Charolais and Salers breeds meet the minimum requirements for classifying

them as elite-record and Limousin breed as elite. Thus, we can conclude that bulls develop in accordance with breed standards.

Steers of French meat breeds have shown the ability to produce high average daily gains during the growing period. The number of daily gains by growing periods is shown in Table 3.

Table 3.

Average daily growth of bulls, g ($\overline{X} \pm S\overline{x}$)

Growing periods, months	Hereford	Limousin	Charolais	Aubrac	Salers
0–3	744±34.1	1090±23.0[3]	968±22.0[1]	978±33.0[2]	1075±38.5[3]
3–6	830±41.2	1073±36.6[3]	1012±38.2[3]	1011±57.5[3]	1042±42.1[3]
6–9	825±31.9	720±44.2	688,9±79.2	953.7±86.2	883,3±89.2
9–12	976±26.8	1091±18.9[3]	1122±59.8	974±22.5	1116±89.2
12–15	1060±32.9	1134±20.5	1125±60.2	1321±40.2[3]	834±46.8[3]
15–18	537±35.1	588±32.6	688,9±79.2[2]	697±32.2[3]	749±36.8[2]
0–18	829±36.2	949±34.2[1]	1015±76.2[2]	966±29.2[2]	950±65.2

A common pattern in all breeds was a decrease in the average daily increase from 15 to 18 months of age. The bulls of the French breed surpassed the Hereford bulls in terms of growth. In the first period of life, from birth to three months of age, the highest increase was in the bulls of the Limousin breed – 1090 g, which is significantly more than in Hereford peers during this period by 346 g (P≥0.999). Slightly less than those of the Limousin breed, but a fairly high increase was in the Salers bulls – 1075 g, which is more than the animals of the Hereford breed by 331 g (P≥0.999). The increase in the subsequent period from three to six months is quite high in bulls of all French breeds and significantly higher than Hereford peers.

The period from six to nine months coincides with the adaptation of the bulls to the new growing conditions, as they were separated from mothers and moved to the feedlot. The difference in the number of gains during this period compared to Hereford bulls is not reliable.

In the period from 15 to 12 months of age, Hereford bulls exceed the Salers breed by 226 g (P≥0.999) in terms of average daily growth, while the advantage in terms of growth in the Aubrac bulls over the Hereford breed is 261 g (P≥0.999). Over the entire growing period, the highest average daily increase was in Charolais bulls – 1015g (P≥0.99), Aubrac bulls exceeded their Hereford peers by 137 g (P≥0.99), Salers by 121g (P≥0.99), and Limousin bulls – by 120 g.

Thus, when grown under the same feeding and maintenance conditions, French breeds can grow intensively, getting high average daily gains and exceeding the value of this indicator in Hereford bulls. In addition, we carried out a control slaughter of animals to study the indicators of meat productivity. The data is presented in Table 4.

Table 4.

Results of control slaughter ($\overline{X} \pm S\overline{x}$)

Indicators	Hereford	Limousin	Charolais	Aubrac	Salers
Pre-slaughter weight, kg	462±10.9	527±12.5[3]	569±9.8[3]	536±12.5[3]	526±8.9[3]
Hot carcass weight	254.2±4.5	300.5±4.5	329.5±4.8[3]	300.4±5.1[2]	294.1±6.2[2]
Carcass output, %	55.0	57.0	56.8	58.0	56.0
Mass of internal raw fat, kg	28.5±0.21	18.9±333	19.1±3.2[2]	15.9±0.18[1]	19.1±5.4[2]
Internal fat output, %	6.1	3.6	3.0	3.3	3.9
Slaughter weight, kg	282.7±14.2	319.4±5.6[3]	348.6±6.5[3]	320.4±4.5[3]	314.9±7.5[3]
Slaughter output, %	61.2	60.6	61.2	59.7	59.8

Animals of all breeds have reached a sufficiently high live weight by the time of slaughter. In terms of the size of the pre-slaughter mass, the advantage was on the side of the French bulls. According to the size of the carcass mass, all French breeds except for the Salers breed have reached this value. The heaviest carcasses were obtained from animals of the Charolais breed – 329.5 kg, which is 75.3 kg more than Hereford bulls ($P \geq 0.999$). The largest amount of raw fat was obtained during the slaughter of Hereford bulls.

In Hereford and Charolais bulls, the value of the slaughter yield was the same – 61.2%, while the Limousine bulls were in second place in this indicator. In the Aubrac and Salers breeds animals, the value of the slaughter yield practically did not differ. Thus, we obtained heavy carcasses with a high slaughter yield during slaughter. In terms of carcass weight and slaughter weight, the advantage was for the Charolais and Aubrac breeds.

The morphological composition of carcasses is of great importance for the processing industry. The ratio of tissues in the carcass, which is determined during deboning, characterizes the qualitative and quantitative side of the meat productivity of livestock. Data on the morphological composition of carcasses are presented in Table 4. The pulp part has the greatest value in the carcass. When slaughtering animals of the Obrak breed, we obtained the pulp of 134.8 kg from the Limousine breed – 121.2 kg, this is more than 32.2 kg and 23.8 kg,

respectively, compared to the Hereford animals. The largest number of bones in the carcasses of Charolais bulls amounted to 28.2 kg, which exceeded the amount of bone tissue in the carcasses of Hereford bulls by 7.5 kg. In relative terms, the largest number of bones was also in the carcasses of Salers bulls. Carcasses obtained from the Obrak and Hereford breed bulls contain fewer bones – 15.8 % and 16.3%, respectively.

Table 5.

Morphological and chemical composition of the half carcass of bulls ($\overline{X} \pm S\overline{x}$)

Indicators		Hereford	Limousin	Charolais	Aubrac	Salers
Half-carcass weight, kg		126.8±2.5	150.6±2.2[3]	151.7±1.56[3]	163.4±1.48[3]	146.2±1.56[3]
Pulp	kg	102.6±1.2	121.2±0.92[3]	119.7±0.82[3]	134.8±0.79[3]	113,9±0.9[3]
	%	80.9	80.4	78.9	82.5	78.0
Bones	kg	20.7±0.2	26.4±0.17[3]	28.2±0.16[3]	25.8±0.1[3]	27.7±0.18[3]
	%	16.3	17.5	18.6	15.8	18.9
Cartilage and tendons	kg	3.5±0.05	3.0±0.05	3.8±0.03[2]	3.5±0.04	4.4±0.02[3]
	%	2.7	1.9	2.56	2.1	3.0
Half-carcass, %		100	100	100	100	100
Including	edible	80.9	80.5	78.9	82.5	78.0
	inedible	19.0	19.5	21.1	17.9	22.0
Edibility index		4.23	4.12	3.74	4.60	3.54
Meat ratio		4.95	4.59	4.24	5.22	4.11
Solid matter, %		31.8±0.25	28.9±0.25[3]	39.1±0.12[2]	37.6±0.5[3]	28.7±0.2[1]
Fat, %		10.6±0.13	3.4±0.03[3]	4.3±0.13[3]	3.6±0.5[3]	4.6±0.11[3]
Protein, %, 5		20.7±0.7	23.6±0.62[2]	23.7±0.3[2]	23.1±0.4	23.1±1.5[2]
Ash		1.1±0.03	0.9±0.02	1.1±0.04[3]	0.9±0.03	1.0±0.05

The amount of cartilage and tendons in absolute terms differs from various breeds. We determined the largest number in the carcasses of animals of the Salers and Charolais breeds. Our research has established that the largest number of edible parts contained in the carcasses of the Obrak breed – 82.5%, the smallest in the Salers breed was 78%.

The different nature of the distribution of the main tissues in animal carcasses influenced the indicators characterizing the quality of carcasses (index of edibility and the index of meat). We determined the highest index of edibility and meat content in carcasses of the Obrak and Hereford breeds. In carcasses obtained from the slaughter of Obrak bulls, the edibility index was 4.60, and the

index of meat content was 5.22, respectively, in the Hereford breed – 4.23 and 4.95. In animals of other breeds, the value of these indices was less.

We also analyzed the average sample of minced meat obtained from bulls of different breeds of cattle. The results of the chemical analysis indicate that the highest fat content is contained in the minced meat of Hereford bulls - 10.6%, in animals of other breeds, this indicator was significantly less. Moreover, we found the highest protein content in the carcasses of French bulls. In addition, the difference between French breeds in protein content was insignificant. The protein content ranges from 23.1% in the carcasses of the Salers breed to 23.7% in the carcasses of the Limousin breed. The chemical composition of minced meat indicates that the optimal carcass composition that meets modern requirements is characteristic of French meat breeds when breeding in Western Siberia. The carcasses of Hereford bulls contain significantly more fat.

Thus, the analysis of the chemical composition of minced meat of bulls at slaughter at the age of 18 months indicates high quality and optimal ratio of fat and protein in the carcasses of bulls of French meat breeds.

Introduced cattle breeds, when bred under new conditions, showed a fairly high level of meat productivity. Carcasses were obtained during slaughter, with an optimal ratio of tissues and the chemical composition of minced meat.

Discussion

Taking into account the fact that in Western Siberia, the cattle of French meat breeds have not been widely distributed, the data obtained by us on the results of the fattening and meat qualities of the cattle of French breeds with the use of adaptive technologies allowed us to obtain results of scientific and practical importance. The study of the meat productivity of cattle of French meat breeds showed that they significantly exceed the Hereford cattle breed in terms of live weight and average daily gains. At the age of 3 months, in terms of live weight, the bulls of the Limousin breed significantly exceeded their Hereford peers by 32.7 kg ($P \geq 0.95$), at 6 months by 54.6 kg ($P \geq 0.95$), at 9 months by 45.1 kg ($P \geq 0.99$), at 12 months by 55.4 kg ($P \geq 0.99$), at 15 months by 62.1 kg ($P \geq 0.99$) and 18 months by 66.6 kg ($P \geq 0.99$). All tested breeds of French animals demonstrated superiority in live weight. The obtained research results are confirmed by previously conducted studies on the weight growth of French and English cattle breeds [10], to which the Hereford breed belongs [2].

Over the entire growing period, we obtained the highest average daily increase in Charolais bulls – 1015 g ($P \geq 0.99$), Aubrac bulls exceeded their peers of the Hereford breed by 137 g ($P \geq 0.99$), Salers by 121 g ($P \geq 0.99$, and Limou-

sin bulls – by 120 g. These indicators showed that in the conditions of Western Siberia, Charolais cattle retained the ability to increase live weight intensively. Post-slaughter indicators of meat productivity confirmed this aspect. One of the main tasks for beef cattle breeding is to achieve a carcass mass of at least 300 kg [3; 11]. Thus, the carcass mass at the slaughter of animals of the Charolais breed was 329.5 kg, which was more than the indicator in Hereford bulls by 75.3 kg ($P \geq 0.999$). In addition, we obtained the largest amount of raw fat during the slaughter of Hereford bulls. In Hereford and Charolais bulls, the value of the slaughter yield was the same-61.2%. In second place in this indicator were the Limousine bulls. In the Aubrac and Salers breeds animals, the value of the slaughter yield practically did not differ.

Our research has established that the largest number of edible parts contained in the carcasses of the Obrak breed was 82.5%, the smallest in the Salers breed was 78%. The obtained data was confirmed by previously conducted studies [9].

The results of the chemical analysis indicated that one could observe a more optimal ratio of protein and fat in meat of French meat breeds. In the minced meat of Hereford bulls, the fat content was 10.6%. In animals of other breeds, this indicator was significantly less. We found the highest protein content in the carcasses of French bulls. Moreover, the difference between French breeds in protein content was insignificant. The protein content ranged from 23.1% in the carcasses of the Salers breed to 23.7% in the carcasses of the Limousin breed. Introduced cattle breeds, when bred under new conditions, showed a fairly high level of meat productivity, with an optimal ratio of tissues and chemical composition of beef.

Conclusion

To sum up, we emphasized that bulls of specialized cattle breeds (using adaptive technology) are characterized by high fattening and meat quality. French meat breeds surpass Hereford in terms of live weight and average daily growth. Over the entire growing period, the average daily increase in bulls ranged from 949 g in Limousin bulls to 1015 g in Charolais bulls. When slaughtering animals raised using adaptive technology, we got heavy carcasses, weighing from 254.2 kg in Hereford bulls to 294.1–329.5 kg in French beef bulls. Consequently, we noted that it is necessary to conduct further research on the effectiveness of using livestock breeds for beef production.

We concluded that one could use the obtained research results at the enterprises of Western Siberia engaged in beef cattle breeding when choosing a breed of cattle for beef production.

References

1. Dunin I.M., Tyapugin S.Ye., Kalashnikova L.A., Meshcherov R.K., Knyazeva T.A., Khodykov V.P., Meshcherov Sh.R. Genofond molochnogo skota v Rossii: sostoyaniye i perspektivy sokhraneniya i ispol'zovaniya [The gene pool of dairy cattle in Russia: status and prospects of preservation and use]. *Zootechniya*, 2019, vol. 5, pp. 2-6. https://doi.org/10.25708/ZT.2019.18.21.001
2. Dubovskova M.P. Osobennosti selektsii skota gerefordskoy porody vnutriporodnogo tipa Dmitriyevskiy Severo-Kavkazskoy populyatsii s uchetom polimorfizma GH (L127V) i LEP/A80V [Breeding peculiarities of Hereford cattle of the intra-breed type Dmitrievsky, North Caucasian population, taking into account polymorphism GH (L127V) и LEP/A80V]. *Zhivotnovodstvo i Kormoproizvodstvo* [Animal Husbandry and Fodder Production], 2020, vol. 103, no. 4, pp. 85-95. https://doi.org/10.33284/2658-3135-103-4-85
3. Levatin D.L., Epifanov G.V., Smirnov D.A. *Metodicheskiye Rekomendatsii po Izucheniyu Myasnoy Produktivnosti i Kachestva Myasa Krupnogo Rogatogo Skota* [Methodological Recommendations for the Study of Meat Productivity and Quality of Cattle Meat]. Dubrovitsy, Federal Research Center for Animal Husbandry named after Academy Member L.K. Ernst, 1977, 53 p.
4. *Ministerstvo sel'skogo khozyaystva Rossiyskoy federatsii, Poryadok i usloviya provedeniya bonitirovki plemennogo krupnogo rogatogo skota myasnogo napravleniya produktivnosti, utverzhdennyye prikazom Minsel'khoza Rossii # 270, ot 2 avgusta 2010 g* [Ministry of Agriculture of the Russian Federation, Order "On the procedure and conditions for carrying out bonitization of breeding cattle of the meat productivity direction" No. 270 from August 2 2010, 2010]. URL: https://mcx.gov.ru/ministry/departments/departament-zhivotnovodstva-i-plemennogo-dela/industry-information/
5. Plokhinsky N.A. *Biometriya* [Biometrics]. Moscow, Moscow University Press, 1970, 367 p.
6. Amerkhanov H.A., Miroshnikov S.A., Kotyuk R.V., Dunin N.M., Legoshin G.P. Proyekt kontseptsii ustoychivogo razvitiya myasnogo skotovodstva v Rossiyskoy Federatsii na period do 2030 goda [Draft concept of sustainable development of beef cattle breeding in the Russian Federation for the period up to 2030]. *Vestnik Myasnogo Skotovodstva* [Herald of Beef Cattle Breeding], 2017, vol. 1, no. 97, pp. 7-12.
7. Sheveleva O.M. Rezul'taty ispol'zovaniya porodnykh resursov krupnogo rogatogo skota pri proizvodstve govyadiny v Tyumenskoy oblasti [Results of the use of breed resources of cattle in beef production in the Tyumen region]. *Vestnik APK Stavropolya* [Agricultural Bulletin of Stavropol Region], 2018, vol. 2, no. 30, pp. 97-101. https://doi.org/10.31279/2222-9345-2018-7-30-97-101

8. Sheveleva O.M., Bakharev A.A. Adaptatsiya i khozyaystvenno-biologicheskiye osobennosti myasnogo skota v Tyumenskoy oblasti [Adaptation and economic and biological features of beef cattle in the Tyumen region]. *Sibirskiy Vestnik Sel'skokhozyaystvennyy Nauki* [Siberian Herald of Agricultural Science], 2009, vol. 2, no. 194, pp. 63-70.
9. Sheveleva O.M., Loginov S.V. Sravnitel'naya otsenka myasnoy produktivnosti bychkov raznykh porod v usloviyakh Severnogo Zaural'ya [Comparative assessment of meat productivity of bulls of different breeds in the conditions of the Northern Trans-Urals]. *Izvestiya Orenburgskogo Gosudarstvennogo Universiteta*, 2017, vol. 5, no. 67, pp. 158-160.
10. Bakharev A.A., Sheveleva O.M., Fomintsev K.A., Grigoryev K.N., Koshchaev A.G., Amerkhanov K.A., Dunin I.M. Biotechnological Characteristics of Meat Cattle Breeds in the Tyumen Region. *J. Pharm. Sci. & Res.*, 2018, vol. 10, no. 9, pp. 2383-2390.
11. Lusk J.L. Association of single nucleotide polymorphism in the leptin gene with body weight and backfat growth curve parameters for beef cattle. *Journal of Animal Science*, 2007, vol. 85, no. 8, pp. 1865-1872. https://doi.org/10.2527/jas.2006-665

Список литературы

1. Генофонд молочного скота в России: состояние и перспективы сохранения и использования / Дунин И.М., Тяпугин С.Е., Калашникова Л.А., Мещеров Р.К., Князева Т.А., Ходыков В.П., Мещеров Ш.Р. // Зоотехния. 2019. № 5. С. 2-6. https://doi.org/10.25708/ZT.2019.18.21.001
2. Дубовскова М.П. Особенности селекции скота герефордской породы внутрипородного типа Дмитриевский Северо-Кавказской популяции с учетом полиморфизма GH (L127V) и LEP/A80V // Животноводство и кормопроизводство. 2020. Т. 103. № 4. С. 85-95. https://doi.org/10.33284/2658-3135-103-4-85
3. Левантин Д.Л., Епифанов Г.В., Смирнов Д.А. Методические рекомендации по изучению мясной продуктивности и качества мяса крупного рогатого скота. Д.: ВИЖ, 1977. 53с.
4. Министерство сельского хозяйства Российской федерации, Порядок и условия проведения бонитировки племенного крупного рогатого скота мясного направления продуктивности, утвержденные приказом Минсельхоза России от 2 августа 2010 г. № 270, 2010 г. URL: https://mcx.gov.ru/ministry/departments/departament-zhivotnovodstva-i-plemennogo-dela/industry-information/

5. Плохинский Н.А. Биометрия. М.: Из-во Московского университета, 1970. 367 с.
6. Проект концепции устойчивого развития мясного скотоводства в Российской Федерации на период до 2030 года / Амерханов Х.А., Мирошников С.А., Костюк Р.В., Дунин Н.М., Легошин Г.П. // Вестник мясного скотоводства. 2017. Т. 1. № 97. С. 7-12.
7. Шевелёва О.М. Результаты использования породных ресурсов крупного рогатого скота при производстве говядины в Тюменской области // Вестник АПК Ставрополья. 2018. Т. 2. № 30. С. 97-101. https://doi.org/10.31279/2222-9345-2018-7-30-97-101
8. Шевелёва О.М., Бахарев А.А. Адаптация и хозяйственно-биологические особенности мясного скота в Тюменской области // Сибирский вестник сельскохозяйственный науки. 2009. Т. 2. № 194. С. 63-70.
9. Шевелёва О.М., Логинов С.В. Сравнительная оценка мясной продуктивности бычков разных пород в условиях Северного Зауралья // Известия Оренбургского государственного университета. 2017. Т. 5. № 67. С. 158-160.
10. Bakharev A.A., Sheveleva O.M., Fomintsev K.A., Grigoryev K.N., Koshchaev A.G., Amerkhanov K.A., Dunin I.M. Biotechnological Characteristics of Meat Cattle Breeds in the Tyumen Region // J. Pharm. Sci. & Res., 2018, vol. 10, no. 9, pp. 2383-2390.
11. Lusk J.L. Association of single nucleotide polymorphism in the leptin gene with body weight and backfat growth curve parameters for beef cattle // Journal of Animal Science, 2007, vol. 85, no. 8, pp. 1865-1872. https://doi.org/10.2527/jas.2006-665

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