Genotypical features of the exterior development of Hereford bull-calves

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Abstract. An analysis of previous years shows that there is a gradual increase in the rate of breeding and pedigree work, its intensification, which is caused primarily by the implementation of new methods of biotechnology and population genetics. In this regard, the improvement and development of new criteria for cow evaluation taking into account created highly productive lines, types, and populations are relevant for science and practice. There was carried out scientific and economic research in order to characterize the main indicators of the breeding value of cows that belong to the created hornless Ural-type Hereford breed of domestic breeding. The influence of these indicators on the formation of the productivity of bull-calf progenies fell under the characterization as well. There were formed five groups of full-aged cows (5-8 years) different in productive qualities to determine the influence of the productive value of mother cows on the pedigree and productive qualities of progenies. Cows of all groups were inseminated by the deep-frozen seed of Hereford bull of the "elite-record" class produced by Golub 4168. Five groups of experimental bull-calves were formed by the method of groups-analogs from the resulting progeny. The analysis of weight and linear growth of the progeny bull-calves showed that all the animals normally developed being characterized with the general patterns of ontogenesis. At the same time, bull-calf progenies of cows different in productive value were inherent in some features - the average live weight of bulls of group III was larger than those of its peers from groups I, II, IV, and V by 27.4 kg (6.3 %, $P>0.95$), 64.1 kg (16.1 %, $P>0.999$), 28.9 kg (6.6 %, $P>0.95$), and 47.4 kg (11.4 %, $P>0.999$), respectively.

1 Introduction

Livestock production today is one of the most profitable industries of the agro-industrial complex not only in Russia but also abroad. One of the main areas of breeding in beef cattle husbandry is to increase the yield of meat from different breeds of cattle.

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Genetic diversity of farm animals is needed for the sustained genetical improvement and the satisfaction of requirements of the country's population in various fields. Key issues of biodiversity management include the distribution of potentially useful qualitative and quantitative signs of productivity among breeds and populations. One of the ways to increase meat production in our country is the accelerated development of meat cattle breeding [1].

The basis for improving the efficiency of meat breeding and productive qualities is the perfection of breeding and pedigree work [2]. One of the main ways to develop Russian cattle breeding now and in the future is to improve the breeding and productive qualities of widely bred cattle of meat breeds and create new types of animals [3-4].

An analysis of previous years shows that there is a gradual increase in the rate of breeding and pedigree work, its intensification, which is caused primarily by the implementation of new methods of biotechnology and population genetics. In this regard, the improvement and development of new criteria for cow evaluation taking into account created highly productive lines, types, and populations are relevant for science and practice [5].

There was carried out scientific and economic research in order to characterize the main indicators of the breeding value of cows that belong to the created hornless Ural-type Hereford breed of domestic breeding. The influence of these indicators on the formation of the productivity of bull-calf progenies fell under the characterization too.

2 Materials and methods

In order to determine the influence of the productive value of mother cows on the pedigree and productive qualities of progenies, we formed five groups of full-aged cows (5-8 years) different in productive qualities: group I consisted of cows of "elite-record" and "live weight elite" classes, group II – cows of the "live weight" first class, group III – cows of "elite-record" and "milk-producing elite" classes, IV – cows of the "milk-producing" first class, V – cows corresponding to the first class on a set of signs (type standard).

Cows of all groups were inseminated by the deep-frozen seed of Hereford bull of the "elite-record" class produced by Golub 4168. Five groups of experimental bull-calves were formed by the method of groups-analogs from the resulting progeny.

Young animals were kept according to the technology of cattle breeding. Until the age of 8 months, they were fed by their mothers, after ab lactation - at the experimental station. The palatability was accounted in groups on two contiguous days once a month. The dynamics of growth and development were studied by weighing animals monthly on the same date before morning feeding [6].

Newborn bull-calves aged 8, 12, and 15 months were by the conventional method examined on the main measurements on the basis of which body-build indices were calculated [7].

To consider the physique features of animals of different directions of productivity, their characteristics on only absolute values of measuring are not enough. In order to better understand the proportionality of the physique, the interdevelopment of different parts of the body relative to each other, the typicality of the animal, there is used the method of analyzing and comparing the physique indices that are expressed in the percentage, the ratio of anatomically related surveys.

The body-build indices depend on two or more surveys, so, the body-build indices should be considered taking into account the absolute values of the respective measurements in the comparative characterization of animals; as a result of the analysis, it should be concluded what the similarity or difference of the physique of the compared animals lies in, what specific indicators it is manifested in, whether the animal corresponds

to the type of breed; if there are deviations from the type, then what signs indicate it. The calculated indices are compared to the standard ones. The indices method allows more accurately and in detail describing the physique of the animal and determining different degrees of underdevelopment of animals, etc.

In addition to calculating body-build indices, the measurements can be used to build exterior profiles. The exterior profile is a graphic image of the degree of difference in the measurements of the animal or group from their standard (from the norm).

3 Results and discussion

Hereford cattle at the Polotsky stud farm were kept according to the conventional technology of cattle breeding. In winter, the animals were kept unattached, on a deep irremovable litter.

In the summer, cows with calves were in natural pastures with regular access to water. After ablactation from mothers at the age of 8 months, bull-calves of all groups were transferred to an open area for young animal raising. Feeding the young animals was carried out three to four times a day, the juicy and concentrated feed was given in two portions in the form of fodder mix.

Diets for all groups of experimental animals were the same. The amount of feed consumed by the bulls of different groups was determined by their different palatability (table 1). The composition of the diet in winter included: hay from smooth brome, lucerne, multigrass, corn silage, haylage, and concentrated food, and in summer: corn, green mass of smooth brome, haylage, and concentrated food.

Table 1. Consumption of feed and nutrients by bull-calves for the period from birth to 15 months (per a head).

Item	Group				
	I	II	III	IV	V
Milk, kg	1028	1032	1061	1030	1028
Cereal and multigrass hay, kg	58	104	70	68	62
Smooth brome hay, kg	597	502	624	590	570
Sainfoin hay, kg	176	176	176	176	176
Haylage, kg	900	880	900	900	900
Corn silage, kg	1382.5	1356.5	1383	1382	1382
Grainmix, kg	1485	1485	1485	1485	1485
Gamma grass, kg	602	584	610	602	600
Green material, kg	1201	1061	1145	1140	1150
Salt, kg	18	18	18	18	18
Feed contains:					
Dry matter, kg	2842.1	2771.2	2865.6	2862.0	2840.2
Feed units (FUs), kg	2851.9	2790.8	2872.2	2845.4	2830.6
Metabolizable energy (ME), MJ	30270.0	29103.9	30409.5	30120.3	30073.7
Digestible protein, kg	300.2	293.9	302.8	298.5	298.2
Concentration of ME in 1 kg of dry matter, MJ	10.61	10.43	10.58	10.58	10.62
Digestible protein per 1 feed unit, g	105.2	105.3	105.4	104.9	105.3

The largest amount of feed was consumed by bulls of group III and the smallest – by animals of group V. In 15 months, bull-calves of the 3rd group ate more feed than their peers from group I by 20.3 feed units (0.7 %), from group II – by 81.4 FUs (2.8 %), from groups IV and V – by 26.8 units (0,9 %) and 41.6 FUs (1,4 %), respectively. Metabolizable energy was consumed by the young animals from group III 139.5 MJ (0.5 %), 1016.4 MJ

(1.1 %), 289.2 MJ (0.95 %), and 335.8 MJ (4.3 %) more than by their peers from groups I, II, IV, and V, respectively.

At the age of 12-15 months, animals of groups I and III were characterized with a great consumption of silage and green material. In all age periods, bulls from group II consumed less feed than their peers from other groups. Being in the same paratypical conditions, the bulls of the groups reacted differently to the environmental factors, as evidenced by their growth and development indicators (table 2).

An analysis of the weight growth dynamics shows that bull-progenies of cows different in productive qualities varied in the size of live body weight throughout the experiment in the same conditions of feeding and housing. So, newborn bulls of group I excelled their peers from groups II, III, IV, and V in this indicator by 1.8 kg (6.4 %, $P>0.95$), 1.3 kg (4.6 %, $P<0.95$), 2.1 kg (7.6 %, $p>0.95$), and 2.0 kg (7.2 %, $P>0.95$), respectively.

Table 2. Dynamics of the live mass of experimental bulls, kg.

Age, months	Group									
	I		II		III		IV		V	
	$X\pm S_x$	C_v	$X\pm S_x$	C_v	$X\pm S_x$	C_v	$X\pm S_x$	C_v	$X\pm S_x$	C_v
0	29.6 ± 0.49	5.00	27.8 ± 0.63	6.80	28.3 ± 0.52	5.48	27.5 ± 0.69	7.49	27.6 ± 0.58	6.30
7	201.8 ± 5.82	8.64	186.4 ± 4.41	7.09	228.4 ± 5.66	7.42	204.1 ± 4.64	6.81	190.3 ± 4.66	7.35
8	220.9 ± 3.84	5.22	205.6 ± 6.17	9.00	247.6 ± 4.78	5.80	224.6 ± 3.25	4.35	216.3 ± 4.49	6.23
15	434.5 ± 8.13	5.61	397.8 ± 8.77	6.62	461.9 ± 10.2	6.60	433.0 ± 9.23	6.39	414.5 ± 9.75	7.06

The findings reveal a correlation between the live mass of a newborn calf and its mother's live mass – cows with a larger live mass give larger offspring.

However, by the age of ablation from mothers (205 days) bull-progenies of mothers from the “elite” and “elite-record” classes in milk-producing (group III) surpassed the size of the living mass of peers from groups I, II, IV, and V by 26.6 kg (13.2 %, $P>0.99$), 42 kg (22.4 %, $P>0.999$), 24.3 kg (11 %, $P>0.99$), and 38.1 kg (20 %, $P>0.999$), respectively.

On this basis, it can be concluded that the living mass of a mother does not have such an effect on the mass of calves during the milk feeding period as at birth. During the period of milk feeding, the greatest effect on the live mass of bulls was caused by the milk-producing ability of their mothers because not only bulls of group III had an advantage in live mass over their peers from other groups, but also bulls of group IV excelled the peers but to a lesser extent.

By the end of the technological (test up to 15-month age) period, the differences between animals of different groups became more significant.

The average live weight of bulls from group III was larger than those of groups I, II, IV, and V by 27.4 kg (6.3 %, $P>0.95$), 64.1 kg (16.1 %, $P>0.999$), 28.9 kg (6.6 %, $P>0.95$), and 47.4 kg (11.4 %, $P>0.999$), respectively. It should be noted that the minimum live mass was observed in bull-progenies of group II cows in almost all accounting periods.

For a more complete idea of the development of bull-progenies of cows different in production value, the average daily increase in live mass was calculated. Studying the dynamics of the average daily increase found an unequal weight rate of calf-progenies of cows of different productive value (table 3).

Table 3. Change in the average daily increase in live weight of bulls by age period, g ($X\pm S_x$).

Age, months	Group				
	I	II	III	IV	V
0-7	839 $\pm$ 28.7	808 $\pm$ 23.5	976 $\pm$ 27.5	861 $\pm$ 23.8	793 $\pm$ 21.5
0-8	787 $\pm$ 16.6	735 $\pm$ 25.2	902 $\pm$ 19.4	810 $\pm$ 13.7	776 $\pm$ 17.4
7-15	927 $\pm$ 10.7	842 $\pm$ 20.1	930 $\pm$ 18.4	930 $\pm$ 20.9	893 $\pm$ 21.1
8-15	1002 $\pm$ 22.1	902 $\pm$ 21.2	1005 $\pm$ 22.9	978 $\pm$ 29.5	930 $\pm$ 25.9
0-15	887 $\pm$ 18.1	813 $\pm$ 19.1	950 $\pm$ 20.7	889 $\pm$ 20.6	848 $\pm$ 27.5

The different ability to realize the productive potential of mother cows was already revealed in the first stage of raising - from birth to ab lactation from mothers. At the same time, the higher intensity of growth during this period was characterized by progenies of cows from group III.

In this case, the productive potential of cow mothers of the “elite” and “elite-record” classes for milk producing more pronouncedly manifested in the average daily growth of their progenies. The advantage of calves from group III over group V was 183 grams (18.7 %, $P>0.999$), bulls of the other groups occupied an intermediate position.

Data on the average daily increase in live weight of bulls show that the results are heterogeneous for different age periods and experimental groups.

At an early age, our study revealed peculiar features of the exterior of bulls descended from cows of different productive value.

Newborn young animals of group I were characterized with large body sizes - especially the height at the shoulder, the height at hips, and the oblique body length compared to bulls of other groups. They had the greatest superiority over the calves of group II – by 2.2-3.8 cm (3.6-5.1 %, $P>0.95$).

It should also be noted that most of the surveys showed insignificant intergroup differences in groups III, IV, and V. The minimum size of the main body parameters was recorded in bulls of group II. At the same time, the picture became somewhat different by the age of ab lactation. A noticeable advantage of group III bulls was revealed compared to other groups. Bulls of group II had the minimum value of the measurement. Differences in measurements between bulls of different groups persisted at 12 months of age as well.

During this period, the body of the group III bulls significantly distinguished. At the age of 15 months, animals of group III surpassed the counterparts from other groups in all the measurements. At the same time, the greatest advantage was revealed for the oblique body length, the chest girth, the height at the shoulder and hips, the semi-girth of rump, and slight advantages in the width of the chest behind the shoulder blades, the depth of the chest, the width of hips, the girth of a pastern.

Meanwhile, the advantage of bulls from group III over group II only increased, the bulls of other groups occupied an intermediate position. The nature of changes in the size of the parameters in the bulls of different groups in all age periods basically corresponded to the

dynamics of the live mass of experimental animals. Bulls with higher live weight growth had also higher values in body parameters.

4 Conclusion

The analysis of weight and linear growth of the progeny bull-calves of created hornless Ural-type Hereford breed showed that all the animals normally developed being characterized with the general patterns of ontogenesis. At the same time, bull-calf progenies of cows different in the production value were inherent in some features - the average live weight of bulls of group III was larger than those from groups I, II, IV, and V by 27.4 kg (6.3 %, $P>0.95$), 64.1 kg (16.1 %, $P>0.999$), 28.9 kg (6.6 %, $P>0.95$), and 47.4 kg (11.4 %, $P>0.999$), respectively.

In particular, bulls of group III can be defined as the most fully characterizing the best meat productivity and desirable type of physique in pedigree cattle husbandry by a number of exterior features. It also leads to the conclusion about the positive effect of the high milk-producing ability of cows on their offspring and their advantage over their peers.

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