

# Exterior Features and Productive Qualities of Young Beef Cattle of Various Genotypes



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**Abstract:** *The article describes the issues of comparative assessment of economic and biological features and productive qualities of beef cattle bred in Western Kazakhstan. The authors present norms and rations for feeding young animals of different genotypes. The results of studying the exterior features, body weight and average daily gain of Kazakh Whiteheaded breed and foreign Hereford and Aberdeen Angus breeds are presented. The authors conduct a comparative analysis of body weight and average daily gain of young animals of different breeds grown in the semi-desert zone of Western Kazakhstan. It has been found that during the growing period from 8 to 15 months, the average daily gain of body weight of the Hereford breed was 658.1 g for bull calves and 587.1 g for heifers, of the Aberdeen Angus breed – 603.8 g and 500.9 g respectively and of the Kazakh Whiteheaded breed – 758.8 g and 561.1 g respectively.*

**Keywords :** *genotype, Hereford breed, Aberdeen Angus breed, Kazakh Whiteheaded breed, selection, acclimatization, exterior, average daily gain, body weight.*

## I. INTRODUCTION

The problem of increasing meat, especially beef, production is one of the most important in animal breeding.

The main reserve for beef production is the intensification of animal breeding and an increase in the genetic potential of animal meat productivity.

Currently, a number of farms in the Western region are engaged in growing the Hereford and Aberdeen Angus breeds and scientific support of the breeding process with animals of this breed.

The relevance of the study is due to the need to choose the cattle breeds, which are characterized by high adaptability to dramatically changing climatic conditions.

In recent years and at present, there have been persistent anomalous climate manifestations, the result of which is pasture wilting of grasslands, sharp decrease in hayfields yield and temperature differences. In these conditions, an urgent issue is the scientifically-based selection of the breed

and breeding of new breeds adapted to local conditions and the requirements of the genotype market.

In most developed countries, a special branch of beef cattle breeding has been created. Its role and importance as a source of high-quality meat production are steadily increasing.

According to T.S. Sidikhov, Kh.A. Amerkhanov, F.G. Kayumov and N.P. Gerasimov [1], beef cattle breeding as a specialized industry is developing dynamically in many countries of the world. The number of beef cattle makes up 39% of the total livestock in the world.

It should be noted that the further development of specialized beef cattle breeding in Kazakhstan can be successful if there is a good breeding base, which includes valuable breeding cattle with a high genetic potential of productivity. Unfortunately, the Kazakh breeding base cannot satisfy the needs of farms for breeding young animals to achieve the rates planned by the cattle breeding development program. To develop the breeding base of beef cattle breeding in Kazakhstan, it is necessary to expand and strengthen the existing and create new reproductions of breeding animals by importing a limited number of the most valuable and promising breeds, focusing on traditional beef breeds from the CIS countries, in particular the Hereford and Aberdeen Angus breeds. However, Kazakh breeding resources should be preferred.

The social aspect of the need to breed and study animals of the Hereford and Aberdeen Angus breeds and also to compare them with the Kazakh Whiteheaded cattle is associated with the necessity to take into account the specific climatic zones of the Western region of Kazakhstan.

The intensification of technology requires the creation of highly productive genotypes. Among a large number of breeds in the world, not all meet the promising requirements to their qualities. Medium-sized animals of the classic British breeds (Hereford and Aberdeen Angus) and other breeds of beef cattle developed on their basis are characterized by a relatively early maturation and adipopexis. This does not satisfy producers since the early adipopexis in animals causes a decrease in muscle tissue growth and excessive consumption of feed. Farmers are interested in animals with the long, large and muscular body, from which heavy carcasses without excess fat can be obtained [2]-[4].

The study of exterior and constitutional features, as well as breeding, productive and adaptive qualities of the Hereford and Aberdeen Angus breeds (cows and calves) in the conditions of Western Kazakhstan in comparison with the Kazakh Whiteheaded breed is of great scientific interest.

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One of the ways to solve the problem is early productivity prediction based on the constitutional characteristics of animals. The relationship between exterior and constitutional type and productivity has been known for a long time in animal science.

The body type is determined by the heredity of the animal and the conditions, in which it develops.

Among environmental conditions, the level and type of animal feeding, as well as the housing conditions, affect the body type significantly.

## II. MATERIAL AND METHODS

The object of the study was young animals (bull calves, heifers) of the Hereford, Aberdeen Angus and Kazakh Whiteheaded breeds.

The rations of the experimental animals were composed of feed available on the farm.

Feed costs were determined by the limit of the given feed. The milk yield of cows was determined by body weight of calves at the age of six months.

The body weight, average daily and relative gain of young animals of different genotypes were studied by weighing at birth and monthly in the morning before feeding and drinking.

The exterior change of the experimental young animals with aging was studied by taking the main measurements (height at the withers, height at the hips, oblique length of the

body, chest depth, chest width, hip width, hip joint width, circumference of the chest behind the shoulder blades, circumference of the metacarpus) at the age of 8, 12, 15 and, for heifers, 18 months.

According to the measurements, the following indexes of body type were determined: legginess, lengthiness, hip and chest, chest, overgrowth and boniness.

## III. RESULT

The organization of complete feeding of animals is based on knowledge of their needs for various nutrients.

It is well known that the higher the level and completeness of feeding, the higher the productivity of animals and the lower the cost of feed per unit of output. Highly nutritious feeds should be included in animal rations to obtain high productivity and ensure good health and high reproductive functions.

The completeness of feeding is determined by a certain amount of energy and nutrients in the rations in accordance with the needs of animals. In complete rations, there should be an optimal balance of coarse, fleshy (if any) and concentrated feeds. A necessary condition for the completeness of rations is high-quality feed and their good eatability by animals.

The optimal level of digestible protein in rations should be in the range of 90-120 g/feed unit. However, according to our results, it amounted to 71.0-76.5 g/feed unit (Table 1).

**Table 1: Feeding norms for young animals of the beef cattle breeds (average daily gain 900 – 1,000 g).**

Index	Age, month			
	9-10	11-12	13-14	15-16
Body weight at the end of the period, kg	267	324	381	444
Energetic feed unit, feed unit	6.9	7.3	7.9	8.6
Metabolic energy, MJ	69	73	79	86
Dry matter, kg	7.2	7.6	8.3	9.0
Crude protein, g	958	1,010	1,108	1,210
Digestible protein, g	623	663	720	774
Crude fiber, g	1,656	1,753	2,050	2,223
Starch, g	864	912	996	1,062
Sugar, g	500	528	581	630
Crude fat, g	207	225	247	275
Calcium, g	43	46	50	55
Phosphorus, g	30	32	37	40
Sulfur, g	24	25	29	32
Ferrum, mg	504	532	581	630
Copper, mg	72	76	83	90
Zinc, mg	324	342	374	405
Manganese, mg	360	380	415	450
Cobalt, mg	5.8	6.0	6.6	7.2
Iodine, mg	3.6	3.8	4.2	4.5
Carotene, mg	166	175	183	198

The main sources of feed were natural pastures and field foraging. Coarse feeds prevailed in the ration of young animals; the rest were concentrates. For growing bull calves,

it is necessary to ensure that the energy concentration is quite high in the rations (Table 2).

**Table 2: Feeding ration for breeding young animals.**

Index	Age, month			
	9-10	11-12	13-14	15-16
Hay	6.0	7.0	9.0	11.0
Concentrate	3.0	3.0	3.0	3.0
Ration contains:				
Energetic feed unit, feed unit	6.3	6.8	7.8	8.8

Metabolic energy, MJ	61.8	66.5	75.9	85.3
Dry matter, kg	7.1	7.8	9.3	10.8
Crude protein, g	778.0	833.5	944.5	1,055.5
Digestible protein, g	482.5	511.0	568.0	625.0
Crude fiber, g	1,820.1	2,107.2	2,681.4	3,255.7
Crude fat, g	171.3	193.3	237.4	281.5
Sugar, g	135.1	150.5	181.3	212.1
Starch, g	1615.0	1,621.3	1,633.9	1,646.5
Calcium, g	21.4	24.5	30.8	37.1
Phosphorus, g	19.1	20.8	24.2	27.6
Magnesium, g	14.2	15.5	18.2	20.8
Potassium, g	77.5	88.0	109.1	130.2
Ferrum, mg	1,039.5	1,212.6	1,558.8	1,905.0
Zinc, mg	92.7	95.4	100.6	105.9
Copper, mg	44.5	48.3	56.0	63.7
Cobalt, mg	4.1	4.7	6.0	7.2
Manganese, mg	244.6	267.0	311.9	356.9
Iodine, mg	2.0	2.0	2.0	2.0
Carotene, mg	78.6	91.7	117.9	144.1

Table 2 shows that the energy concentration was 1.12 feed units/kg of dry matter. The bull calves' ration contained 6.3-8.8 feed units, 61.8-85.3 MJ of metabolic energy, 482.5-625.0 g of digestible protein, 171.3-281.5 g of crude fat and 78.6-144.1 mg of carotene, which corresponds to the norms of feeding young animals. A competent approach to feeding young animals of beef breeds has a decisive influence on the growth rate, body type and early maturity of animals. It is known that the development of young animals during growth periods is changeable; as a result, the consumption of some feeds changes significantly with age. Therefore, the

main condition for the normal development of calves is the satisfaction of their needs for nutrients based on the established norms of feeding.

In beef cattle breeding, the study of the exterior features of animals is important to assess breeding qualities and features of productivity. The determination of the growth of young animals of different genotypes was conducted by taking measurements of the body at different age periods (Tables 3 and 4).

**Table 3: Main measurements of bull calves of different genotypes, cm.**

Measurements of bull calves	Breed								
	Hereford			Aberdeen Angus			Kazakh Whiteheaded		
	8 months	12 months	15 months	8 months	12 months	15 months	8 months	12 months	15 months
Height at the withers	98.7±0.10	109.7±0.12	115.2±0.11	96.7±0.12	107.7±0.14	113.2±0.11	96.7±0.12	107.7±0.14	113.2±0.12
Height at the hips	103.8±0.21	112.5±0.11	118.1±0.23	101.8±0.23	110.5±0.12	116.1±0.21	101.8±0.20	110.5±0.13	116.1±0.24
Chest depth	48.2±0.11	56.6±0.14	63.6±0.51	46.2±0.12	54.6±0.11	61.6±0.51	46.2±0.13	54.6±0.12	61.6±0.54
Chest width	33.6±0.12	36.5±0.13	40.2±1.71	31.6±0.11	34.5±0.12	38.2±1.73	31.6±0.12	34.5±0.11	38.2±1.72
Hip width	34.5±0.21	38.4±0.12	43.8±0.42	32.5±0.22	36.4±0.11	41.8±0.43	32.5±0.22	36.4±0.11	41.8±0.412
Oblique length of the body	104.4±0.11	123.3±0.11	133.3±0.22	102.4±0.13	121.3±0.10	131.3±0.23	102.4±0.13	121.3±0.12	131.3±0.21
Oblique back length	43.6±0.22	59.9±0.12	69.8±0.23	41.6±0.21	57.9±0.10	67.8±0.22	41.6±0.21	57.9±0.12	67.8±0.22
Chest circumference	144.9±0.51	156.6±0.32	175.3±0.42	142.9±0.51	154.6±0.33	173.3±0.42	142.9±0.51	154.6±0.31	173.3±0.42
Metacarpus circumference	16.9±0.043	18.5±0.051	19.1±0.13	16.5±0.41	18.3±0.041	18.9±0.12	16.5±0.44	18.3±0.04	18.9±0.12

It was ascertained that even at the beginning of the postnatal development period, the animals had characteristic exterior features. Bull calves of the Hereford breed differed in main measurements during all age periods in comparison with the herdmates of the Aberdeen Angus and Kazakh Whiteheaded breeds. The Hereford bull calves were characterized by the best development of height measurements.

They exceeded the herdmates of the Aberdeen Angus and Kazakh Whiteheaded breeds by 2 cm (2.02%) in height at the withers. In all age periods, the Hereford bull calves had superiority in terms of width measurements over analogues of the Aberdeen Angus and Kazakh Whiteheaded breeds.

**Table 4: Main measurements of heifers of different genotypes, cm.**

Measurements of heifers	Line variety								
	Hereford			Aberdeen Angus			Kazakh Whiteheaded		
	8 months	12 months	15 months	8 months	12 months	15 months	8 months	12 months	15 months

## Exterior Features and Productive Qualities of Young Beef Cattle of Various Genotypes

Height at the withers	93.8±0.21	104.5±0.11	109.7±0.21	93.8±1.21	105.5±0.12	110.7±0.21	91.8±0.21	102.5±0.11	107.7±0.21
Height at hips	97.6±0.12	106.1±0.12	112.6±0.10	97.6±0.92	107.1±0.11	113.6±0.12	95.6±0.12	104.1±0.11	110.6±0.12
Chest depth	41.8±0.11	48.7±0.11	54.1±0.11	41.8±0.73	49.7±0.12	55.1±0.12	39.8±0.11	46.7±0.12	52.1±0.11
Chest width	31.3±0.09	33.3±0.13	34.6±0.22	31.3±0.51	34.3±0.13	35.6±0.23	29.3±0.09	31.3±0.12	32.6±0.21
Hips width	29.7±0.10	32.2±0.14	35.4±0.11	29.7±0.81	34.2±0.14	36.4±0.12	27.7±0.12	31.2±0.12	33.4±0.12
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Oblique length of the body	106.3±0.41	117.0±0.14	121.8±0.21	106.3±2.20	118.6±0.13	122.8±0.21	104.3±0.42	115.0±0.12	119.8±0.22
Oblique back length	40.4±0.21	50.1±0.23	54.3±0.12	40.4±5.01	51.1±0.23	55.3±0.13	38.4±0.22	48.1±0.21	52.3±0.12
Chest circumference	127.6±0.32	140.4±0.32	158.4±0.91	127.6±19.93	141.4±0.32	159.4±0.91	125.6±0.32	138.4±0.31	156.4±0.91
Metacarpus circumference	16.4±0.02	17.4±3.12	17.8±0.08	16.7±2.41	17.5±0.031	17.8±0.08	16.2±0.022	17.2±0.032	17.6±0.081

Periodic exterior changes during the study indicate different age-related changes in particular measurements of the experimental heifers. At the age of eight months, the heifers of the Hereford and Aberdeen Angus breeds were distinguished by the best development of most linear measurements. The largest and significant difference was recorded for all of the above measurements by 2 cm ( $P \leq 0.05-0.01$ ).

At the age of 12 and 15 months, the Aberdeen Angus heifers were distinguished by insignificant advantage in the development of measurements in comparison with the Hereford breed ( $P \geq 0.95$ ); in comparison with the Kazakh Whiteheaded breed, they exceeded by 3 cm (2.84%)

( $P \geq 0.95-0.99$ ) in all measurements.

Body type indexes characterize exterior features of animals more fully (Tables 5 and 6).

**Table 5: Body indexes of bull calves of different genotypes, cm.s**

Indexes	Breed								
	Hereford			Aberdeen Angus			Kazakh Whiteheaded		
	8 months	12 months	15 months	8 months	12 months	15 months	8 months	12 months	15 months
Legginess	55.4±0.11	53.4±0.11	50.6±6.51	55.4±0.10	52.9±0.42	50.2±0.21	56.6±0.12	54.4±0.10	51.6±0.22
Lengthiness	113.3±0.52	112.0±0.12	111.0±0.32	113.3±0.52	111.9±0.12	110.9±0.31	113.6±0.52	112.2±0.11	111.2±0.31
Hip and chest	105.5±0.71	100.2±0.52	97.6±0.71	105.5±0.72	100.2±0.51	97.6±0.71	106.0±0.72	102.2±0.66	97.4±0.82
Chest	75.0±0.30	68.5±0.21	63.9±0.33	75.0±0.31	69.1±0.22	64.6±0.31	73.8±0.32	67.0±0.21	62.6±0.41
Blockiness	120.0±0.41	119.9±0.02	130.0±0.72	120.0±0.42	119.7±0.21	129.8±0.72	120.4±0.43	120.2±0.22	130.5±0.75
Overgrowth	104.1±0.31	101.5±0.10	102.6±0.23	104.1±0.32	101.5±0.13	102.6±0.20	104.1±0.30	101.6±0.10	102.7±0.23
Boniness	17.5±0.042	16.6±0.030	16.2±0.082	17.8±0.041	16.6±0.032	16.1±0.08	17.7±0.050	16.8±0.041	16.4±0.08

One can see the uneven development of different parts of the skeleton at different stages of ontogenesis, as well as muscle growth in the changes in body type indexes. With aging, there was a slight increase in indexes of lengthiness and by the age of 15 months, it decreased. The blockiness index decreased in 12 months and increased in 15 months. A

decrease in the legginess index was found. In general, according to the exterior and constitutional indexes, bull calves of the Hereford, Aberdeen Angus and Kazakh Whiteheaded breeds were characterized as a beef type of animals.

**Table 6: Body type indexes of heifers of different genotypes, cm.**

sIndexes	Breed								
	Hereford			Aberdeen Angus			Kazakh Whiteheaded		
	8 months	12 months	15 months	8 months	12 months	15 months	8 months	12 months	15 months
Legginess	51.1±0.11	48.4±0.12	44.7±0.41	50.6±0.13	47.9±0.11	44.4±0.41	52.2±0.12	49.3±0.13	45.5±0.42
Lengthiness	105.7±0.21	112.4±0.12	115.6±0.22	105.6±0.21	112.3±0.12	115.5±0.21	105.8±0.22	112.6±0.11	115.9±0.23
Hip and chest	97.3±0.81	94.9±0.52	97.4±1.31	97.3±0.83	95.0±0.053	92.6±4.02	97.1±0.82	94.6±0.53	92.2±4.21
Chest	69.7±0.41	64.4±0.32	67.0±0.83	70.3±0.42	65.0±0.310	63.9±2.72	68.4±0.42	63.1±0.33	62.2±2.82
Blockiness	138.8±0.53	126.9±1.93	131.5±0.30	138.4±0.53	126.7±0.31	131.2±0.30	139.5±0.54	127.4±0.33	131.9±0.31
Overgrowth	105.1±0.21	102.5±0.11	102.4±0.20	105.1±0.21	102.5±0.13	102.4±0.21	101.5±0.22	101.5±0.11	102.6±0.21

Boniness	17.1±0.044	16.9±0.051	16.6±0.091	17.1±0.04	16.8±0.051	18.8±0.09	17.1±0.040	17.0±0.052	16.7±0.091
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All heifers of different genotypes had an increase in the lengthiness index. However, legginess, blockiness, hip and chest, as well as chest, parameters showed a reducing trend.

The indexes of age-related dynamics of body weight of young animals of different genotypes are of particular

**Table 7: Indexes of body weight of young animals of different genotypes, kg.**

No.	Animal sex	n	Hereford		Aberdeen Angus		Kazakh Whiteheaded	
			$\bar{x} \pm Sx$	$C_v, \%$	$\bar{x} \pm Sx$	$C_v, \%$	$\bar{x} \pm Sx$	$C_v, \%$
6 months								
1	Bull calves	15	233.86±1.89	4.28	236.13±4.04	1.73	182.7±2.85	4.17
2	Heifers	15	191.81±0.75	7.21	195.66±2.73	5.28	171.5±1.91	3.28
8 months								
1	Bull calves	15	267.2±2.74	3.32	262.3±3.47	4.74	216.34±1.41	3.37
2	Heifers	15	228.4±1.85	4.12	225.0 ±1.74	5.21	197.37±2.74	4.41
12 months								
1	Bull calves	15	343.3±3.28	2.35	331.3±3.15	3.25	314.74±2.85	2.65
2	Heifers	15	305.7±2.73	4.21	299.5±1.96	4.85	272.24±1.87	3.79
15 months								
1	Bull calves	15	405.4±0.78	2.85	389.1±0.41	4.25	375.7±0.31	3.74
2	Heifers	15	351.7±0.63	3.11	330.2±0.23	3.68	315.2±0.17	2.62

According to Table 7, the body weight of young animals of all genotypes corresponded and exceeded the requirements of the breed standard in all age periods. The young animals of the Hereford breed in terms of the body weight exceeded the herdmates of the Aberdeen Angus breed from the age of eight months and the herdmates of the Kazakh Whiteheaded breed in all age periods.

Significant differences in body weight of the young animals

were observed in animals of different genotypes at the age of 15 months in favor of Hereford breed. The difference was in the range of 16.3-29.7 ( $P \geq 0.999$ ) kg for bull calves and 21.5-36.5 kg ( $P \geq 0.999$ ) for heifers.

In the selection and breeding of beef cattle, the main feature is the growth rate of young animals at different age periods (Table 8).

**Table 8: Indexes of average daily gain in body weight of young animals of different genotypes, g.**

Breed	Sex	N	Age period, month			
			6-8	8-12	6-12	8-15
			$\bar{x} \pm Sx$	$\bar{x} \pm Sx$	$\bar{x} \pm Sx$	$\bar{x} \pm Sx$
Hereford	Bull calves	15	555.7±1.12	634.2±1.02	690.1±0.23	658.1±0.23
	Heifers	15	609.8±2.54	644.2±1.63	511.1±0.17	587.1±0.17
Aberdeen Angus	Bull calves	15	436.2±.68	575.0±3.89	642.2±0.75	603.8±0.75
	Heifers	15	489.0±0.32	620.8±0.17	341.1±0.32	500.9±0.32
Kazakh Whiteheaded	Bull calves	15	560.6±1.78	820.0±2.15	677.7±0.14	758.8±0.14
	Heifers	15	431.2±2.12	623.9±0.85	477.7±0.98	561.1±0.98

The analysis of the obtained data shows that the bull calves of the Kazakh Whiteheaded breed in the period of 8-12 months had a noticeable advantage in average daily gain in body weight in comparison with the Hereford breed, which amounted to 185.8 g ( $P > 0.95$ ), and with the Aberdeen Angus breed – to 245.0 g ( $P > 0.95$ ). Obviously, after weaning, the adaptation of young animals of the Kazakh Whiteheaded breed was more successful, with less stress compared to the herdmates of imported breeds.

#### IV. CONCLUSION

According to the exterior and constitutional indexes, the young animals of the Hereford, Aberdeen Angus and Kazakh

Whiteheaded breeds were characterized by a wide body, long legs, strong bones, well-filled ham and rather round body shape. The Hereford and Aberdeen Angus breeds excelled in body weight while superiority in the average daily gain belongs to bull calves of the Kazakh Whiteheaded breed.

In general, the acclimatization of the Hereford and Aberdeen Angus cattle in the semi-desert zone of Western Kazakhstan is successful. The young animals of these breeds are characterized by typical beef exterior and high live rates of meat productivity.



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