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SELECTING BEEF COWS ACCORDING TO THE SELECTION INDEX WITH REGARD TO THEIR NATURAL RESISTANCE IN THE CONDITIONS OF THE SANDS OF THE NARYN SEMIDESERT

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ABSTRACT

This article shows the results of selecting beef cows with regard to their natural resistance. The main purpose of the study was to develop and implement the index method for selecting breeding stock for its further reproduction, based on the indicators of natural resistance in animals. The live weight and the milk yielding capacity of the animals were determined by the standard method, and the index of each animal was also determined by these indicators. The phagocytic, lysozymic and bactericidal activity of blood serum in animals was determined by the standard method as modified by A. Z. Zeinullin and A. Alibaeva. The natural resistance of each animal was determined according to the averaged index in phagocytic, lysozymic and bactericidal activity, followed by calculation of the index for each animal. The selection index was calculated by the formula proposed by A. Z. Zinullin. Single-aspect selection of animals only by their main economically useful traits does not ensure full economic effect from beef cattle breeding. The necessity of developing and implementing the methods of selecting animals for breeding with regards to the natural resistance indicators has been urgent for a long time. The studies performed in this area provided very valuable results. Consideration of the natural resistance indicators in selection will create conditions for improving the indicators of natural resistance in animals, providing high enough efficiency of selection by the live weight.

KEY WORDS: **Beef breed, breeding, natural resistance, index assessment.**

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INTRODUCTION

Breeding beef cattle, along with horse and sheep breeding, have always been considered traditional livestock breeding industry in Kazakhstan. In 1913, in Kazakhstan there were only about five million heads of cattle, mainly represented by the beef cattle. In 2013, the cattle population amounted to about six million heads. However, the possibilities of natural pastures and hayfields allow to increase the number of heads in beef herds two or three times. This is also stimulated by the existence of domestic beef breeds like the Kazakh white-headed and the Auliekol breeds, which are well adapted to the climatic conditions of the Republic of Kazakhstan. The main task of animal breeders is to remove the forage deficit by intensification of livestock breeding. Studying the livestock state, which plays a crucial role in providing forage products for the population, acquires special importance. Many studies have shown that the major factor in achieving the genetic potential of productivity, reproductive ability, resistance to diseases, and productive longevity in animals of modern highly productive breeds is the organization of stable biologically complete feeding[1]. However, the currently available resources and opportunities of cattle breeding are not being used to their full capacity. With that, the objective constraints are an insufficient number of the breeding stock and shortage of water for livestock watering. In the conditions of annual reduction of the volume of snowmelt and groundwater, an important reserve for development of meat cattle breeding in Kazakhstan is the use of the vast territory occupied by sands, which is, however, quite rich in pasture land and groundwater. Such sands include sands of the Naryn semidesert, considerable territory of which is located in the administrative territory of the Western Kazakhstan region.This area has historically featured a specific technological approach to cattle breeding, although scientific literature discusses only conventional methods of beef cattle breeding in terms of the steppe zone. The technology of keeping beef cattle satisfies two conditions: the absence of dampness and drafts, i.e., if the animals are well fed, they will not be afraid of any frost. Meat production is closely related to the conditions of keeping cattle[2]. The special characteristic of meat cattle breeding in the conditions of the Naryn sands is the lack of capital buildings for keeping cattle, and therefore, keeping cattle in artificial and natural shelters. Artificial shelters are built of plants that grow here, in the form of a courtyard for 200-250 heads of livestock. The cattle are driven to these shelters in case of bad weather and winter storms, and for veterinary activities in the built-in cleavages. Some farmers add small premises to these shelters of the same plants, covered with hay. These premises are used for keeping weakened animals and young calves. Along with that, numerous natural shelters available here are used for wintering of cattle. They are mainly overgrown natural pits between once established sand dunes. The depth of these natural formations ranges between 4 and 10-15 meters. Therefore, during winter storms, they are very comfortable, since the moving cold air mass passing over these pits creates a dense layer of moving air masses, sort of an "air roof" of the pit, under which the warmth is generated by the animals themselves, and the deep warm microclimate ensures stable temperature and dry air. These are exactly the parameters that cannot be ensured in permanent premises for beef cattle, with the exception of three-walled buildings. Therefore, studying economically useful traits of beef cattle of the Kazakh white-headed breed from the Naryn sands is very important. The above extreme conditions can affect not only animals' productivity, but their resistance as well. Substantiated selection of animals in the conditions of an unfavorable epizootic situation in terms of brucellosis is very important. Moreover, until now, no attempts have been made to consider the level of natural resistance of the animals in selecting them for further reproduction. That is exactly why complete healing from infectious diseases cannot be achieved.The main purpose of the study was development and implementation of the index method for selecting breeding stock for further reproduction, based on the indicators of natural resistance in animals.

MATERIALS AND METHODS

The research was performed on the animals of the Kazakh white-headed breed from the semidesert area of the Naryn sands. The breeding value of cows was assessed, and cows were selected by the live weight, milkiness, and by the indicators of natural resistance.The analysis of the obtained data were calculated the following statistical indicators: arithmetic average (M), average square deviation (SE), coefficient of variation (Cv), the arithmetic mean error (Sx), validation criteria (td), probability level (P), confidence limits, etc. Group of animals and their indicators were identified, the test of significance of differential (difference between them) and determined the level of probability. All averages of the studied groups were highly reliable. Confidence limits of the arithmetic means were within a very high accuracy. Serological studies showed the healthy condition of the animals under observation. Animals were selected according to two economically useful traits such as live weight and milk and indicators of natural resistance. In the breeding nucleus were selected individuals with an index above 100, and the average selection index is selected as the core breeding animals amounted to 108,1±1,1. The live weight of cows was determined by weighing the animals on a weighing machine in the morning before feeding. Based on the indicators of live weight of cows, the index of each animal was calculated from the average value for the herd. The milking capacity of cows was determined in an indirect way, by the live weight of 6-month-old calves. With that, the index was calculated for each animal. For determining the natural resistance, blood serum was obtained in the laboratory by centrifuging. The phagocytic, lysozymic and bactericidal activity of blood serum in animals was determined by the standard method of N. Maksimyuk and V. G. Skopichev[3] modified by A. Z. Zinullin[21]. The natural resistance of each animal was determined according to the averaged index in phagocytic, lysozymic and bactericidal activity, followed by calculation of the index for each animal.The selection index was calculated by

the formula proposed by A. Z. Zinullin[21].The biometric data was processed according to the method of N. P. Plochinsky[4] and E. K. Merkuryeva[5] with the use a personal computer.

RESULTS AND DISCUSSION

(i) Prevalence of natural resistance indicators

One of the indicators that indirectly affect the productivity of animals is natural resistance[6].

According to several scholars and practitioners, genetic improvement of livestock in this century will be focused not only at ensuring high productivity, but at resistance to diseases as well. In performing selection activities in a number of farms that specialize in breeding livestock animals, great attention is paid to increasing productivity of animals, and to studying their immune status. Blood composition significantly affects the state of individual organs and tissues, and natural resistance of the organism. Thus, studying blood composition provides information about the physiological state of an organism, and adaptive and productive qualities of animals[7,8,9]. Animals' ability to manifest increased resistance becomes an important selection indicator. Preventative care and eliminating diseases should be performed not only with vaccines and drugs, but by breeding animals that have high natural resistance as well[10,11]. Numerous studies of the natural resistance of agricultural animals' organisms show that the protective powers are the dynamic indicators. The natural resistance of the organism is determined by its resistance to harmful environmental agents, including pathogenic ones. The natural resistance of an organism is the total result of humoral and cellular factors. Humoral factors of natural resistance include lysozyme, which has antibacterial and stimulating effect. The result of action of blood serum protein components such as immunoglobulins, lysozyme, and compliment is bactericidal activity[12,13]. The dominant factor in the system of natural resistance is phagocytosis, which is the first line of effective mechanisms of immunological homeostasis of animals. In the body, lysozyme performs important biological functions and, in the first place, has a stimulating effect on phagocytosis, and a bactericidal effect on many microorganisms[14]. Studies for determining natural resistance of animals were performed by grouping animals according to their age. Distribution of phagocyte activity in young animals at the age of 6 months shows that there is complete asymmetry, and the variation curve starts from its peak and with an increase in the parameter of each following class, the frequency of the animal units gradually reduces, which in turn indicates distribution of the quantitative traits (Figure 1). At the same time, in heifers and young cows, as well as in mature cows, incomplete asymmetry is observed (Figure 2). The noted peculiarities of the variation distribution curve of the phagocytic activity shows very low resistance in young animals, since the formation of phagocytic protection in the organism is formed gradually with age, which is consistent with the studies of some authors (Emelianenko, 1977; Zhukov, et al., 2005). In addition, it should be noted that the variation curve of the animal units' distribution by phagocytic activity is asymmetrical at a later age as well (Figures 3, 4).

Distribution of young 6-months-old cattle

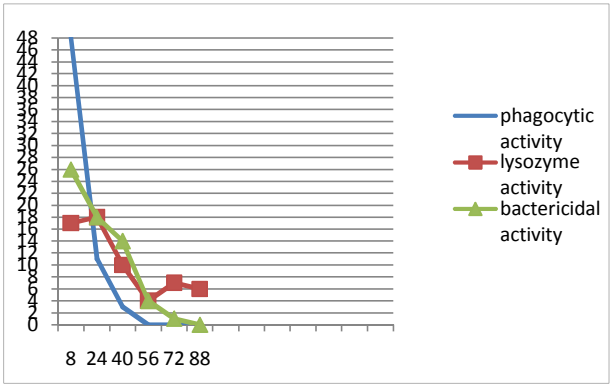

Figure 1
Distribution of young 6-months-old cattle by the indicators of natural resistance

Distribution of heifers and young cows

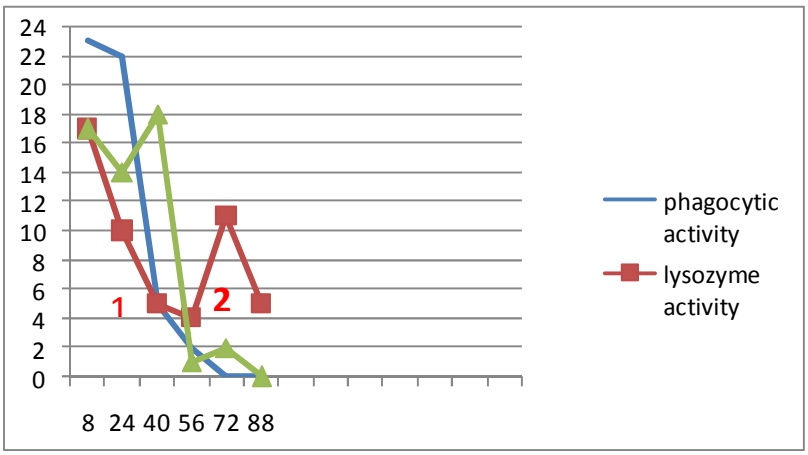

Figure 2
Distribution of heifers and young cows by the indicators of natural resistance

Distribution of young 5-years-old cows

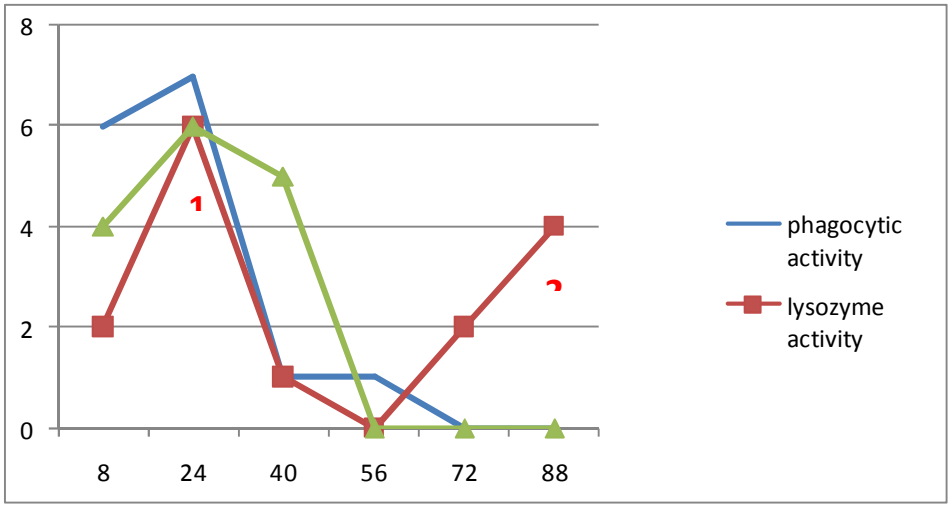

Figure 3
Distribution of young 5-years-old cows by the indicators of natural resistance

Distribution of young 6-years-old cows

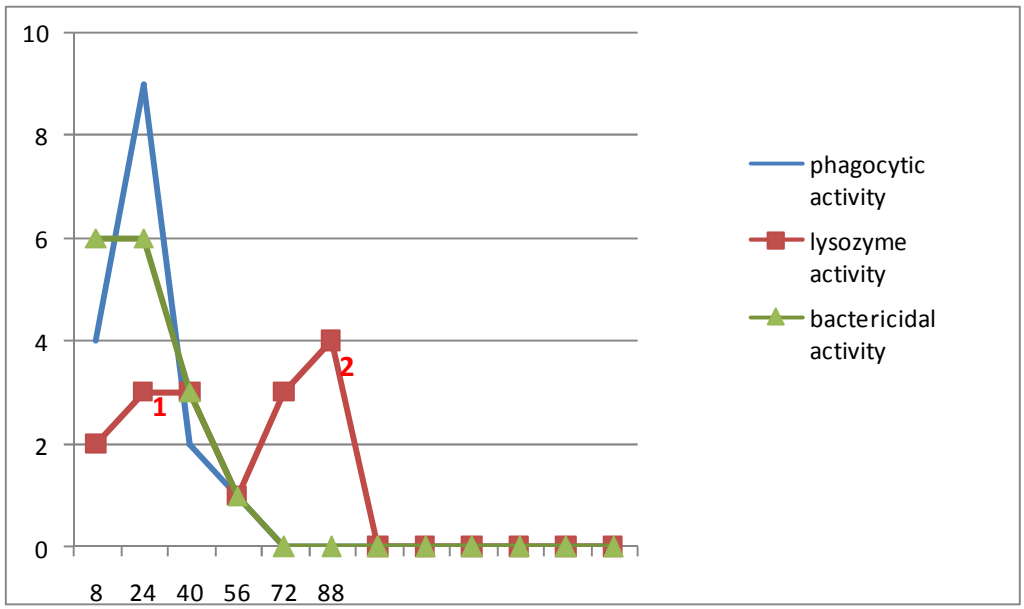

Figure 4
Distribution of young 6-years-old cows by the indicators of natural resistance

The reason for this is perhaps the natural reduction in the number of low-resistant animals, as a result of natural selection. The average phagocytic activity in young 6-months-old animals are equal to only 13.0%, while in two years it increases almost twice and amounts to 25.2%. Reduced natural resistance is characteristic of cows, especially at the age of 4 years. Because at this age there is a delay in the growth of young cows, one should recognize this age as critical in animals of the Kazakh white-headed breed.

(ii) Indicators of natural resistance in animals

The highest level of phagocytic activity, 72%, is observed at the age of 18 months, and this indicator remains the highest in all age groups. This is evidently the genetic potential of the phagocytic activity in animals of the Kazakh white-headed breed (Table 1). In general, it should be believed that phagocytic activity is inherited by the type of additive inheritance of quantitative traits. It seems that the selection according to this indicator will endure noticeable changes in increasing natural resistance in animals. The lysozyme activity of blood serum should also be recognized as a hereditary deterministic trait of natural resistance. Unlike phagocytic activity, lysozyme activity of blood serum in young cattle 6 months of age is not fully asymmetric, and the peak of variational curve is not in the 1st low-resistance class. This is apparently caused by earlier formation of lysozyme activity in blood serum. However, the most characteristic incomplete asymmetry in lysozyme activity is observed in mature cows. The most significant fact is that the variation curves of lysozyme activity in all age groups of the studied herds have 2 peaks. This indicates genetic heterogeneity of the studied herd. With that, the peak of high resistance corresponds to the indicator of lysozyme activity at 72 and 88%. Therefore, there is every reason to believe that selecting animals with lysozyme activity above 56 will allow achieving very good results in natural resistance in the selection process. Moreover, the indicators of lysozyme activity and the live weight of cows at the age of 6 years shows a relatively high correlation r=+0.41±0.1 (P>0.999). The average lysozyme activity and average live weight of cows of this age is relatively higher than those in other age groups. The reason for this phenomenon was apparently the fact that cows with relatively low resistance had lower live weight, and left the herd by this age. Bactericidal activity, same as lysozyme activity, is determined by heredity. However it depends on the environmental factors much more than on the lysozyme activity. Distribution of animals according to the bactericidal activity partly follows distribution of animals according to the lysozyme activity. However, in the group of cows 6 years of age, there has been a clearer separation of the herd into 2 groups. This also increases the possibility of herd breeding according to the bactericidal activity.

Table 1
Indicators of natural resistance in animals of various age (x^{-}±Sx)

Traits	n	Lim.	$\sum_x$	x^{-}±Sx	Σ	Cv
young 6-months-old cattle						
Phagocytic activity	62	0 – 46	774	13.0±1.2	9,232	73,95
Lysozymic activity	62	0 – 96	2193.6	35.0±3.5	27.43	77.54
Bactericidal Activity	62	0 – 78	1411	23.0±2.1	16.35	71.84
2-years-old heifers						
Phagocytic activity	12	0 – 52	302	25.2±5	16.98	67.49
Lysozymic activity	12	0 – 80	469	39.1±9.1	3.,49	80.59
Bactericidal Activity	12	4 – 47	295	24.6±4.1	14.26	58.03
3-years-old cows						
Phagocytic activity	23	2 – 40	464	20.2±2.1	10.08	49.98
Lysozymic activity	23	1 – 96	965	42±6.8	32.50	77.47
Bactericidal Activity	23	0 – 72	609	26.5±4.1	19.45	73.48
4-years-old cows						
Phagocytic activity	17	5 – 36	278.5	16.4±2.5	10.26	62.63
Lysozymic activity	17	0 – 84	562	33.1±6.7	27.63	83.59
Bactericidal Activity	17	0 – 70	397	23.4±4.5	18.57	79.53
5-years-old cows						
Phagocytic activity	15	0 – 52	343	23.0±3.6	13.95	61.04
Lysozymic activity	15	10 – 97	718	48.0±8.5	32.93	68.80
Bactericidal Activity	15	6 – 48	394	26.3±3.7	14.50	55.23
6-years-old cows						
Phagocytic activity	16	4 – 60	370	23.1±3.4	13.41	57.99
Lysozymic activity	16	7 – 88	821	51.3±7.2	28.85	56.22
Bactericidal Activity	16	0 – 58	367	23.0±4.1	16.21	70.68

(iii) 3.3. Selecting mature cows according to the selective breeding index

Modern selective breeding of animals is based on productivity, regular fertility, suitability for complex mechanization, resistance to diseases, etc. However, the more there are signs of selection, the lower the likelihood of progress for each of them is. Therefore, in order to optimize the selection of animals according to the complex of economic and biological signs, it is advisable to use the method of the selection indexes of breeding value, and the indexes of the desired type[17,18,19]. In the recent years, index selection has been widely and effectively used abroad, but in our country, resolution of this issue requires further research and development for particular breeds and populations. Index selective breeding allows to achieve the desired result. Introduction of modern achievements in genetics allows to raise the breeding of farm animals to the high quality level[17]. Studying the relationship between the traits of natural resistance based on defining the coefficient of correlation showed no correlation between the studied parameters of natural resistance. Therefore, it may be concluded that heredity and variability in phagocytic activity, lysozyme activity and bactericidal activity are independent of each other. Therefore, they may be used in selective breeding in parallel for assessing natural resistance of animals. However, in order not to increase the number of selective traits, it is preferable to unite these indicators by defining their sum for assessing the total resistance for each animal separately, followed by determining the average total resistance by dividing it by the number of qualifying indicators of resistance:

$$R_i = \frac{FA+LA+BA}{n},$$

Where R_i is the average index of natural resistance, FA is phagocytic activity, LA is lysozyme activity, BA is bactericidal activity, and n is the number of qualifying indicators.

For practical use of the average indicator of natural resistance in assessing the breeding value of an animal, followed by using it in the selection, we propose to use index score of each animal separately on a 100-points scale. With that, the index of natural resistance of an individual animal is calculated by the following formula:

$$IR_i = \frac{R_i}{R_j} * 100,$$

where IR_i is the average index of natural resistance of individual animal unit, and R_j is the average index of natural resistance for the herd.

$$R_i = \frac{\sum R_j}{N},$$

where N is the total number of all animals.

The obtained index of natural resistance in an individual animal, along with the indexes for other selective breeding traits, show the breeding value of this animal, as compared to other animals in the herd.

Calculation of the indices from live weight and milkiness of cows is performed according to the following 2 formulae:

1. $$IMa_i = \frac{Ma_i}{Ma_j},$$

where Ima_i is the index of live weight of an individual animal, Ma_i is body weight of an individual animal, and MA is the average live weight of the animals in the herd.

2. $$IML_i - \frac{Ml_i}{Ml_j},$$

where IML_i is the milkiness index of an individual animal, Ml_i is milkiness of an individual animal, and Ml_j is the average milkiness of the animals in the herd.

The method of calculating the complex index of beef cows envisages higher importance of body weight, since it significantly correlates with intensity of growth of young cattle and forage payback. Multiple studies have shown that large animals and their offspring typically feature higher growth rate and better forage payback in gained body weight. Therefore, against the background of higher live weight, efficiency of the selecting livestock and the formation of animals of the desired type increases[21,22]. Therefore, in calculating the selective index of a breeding cow, the index of its live weight is multiplied by 2, the index of milkiness - by 1, and the index of natural resistance - by 1.

$$SI_i = \frac{IMa_i \cdot 2 + IMl_i + IR_i}{4},$$

where SI_i is the selective index of an individual animal. The obtained selective index of each animal will allow to perform a comprehensive assessment of the breeding value of a beef cow, based on its live weight, milkiness and natural resistance. The value of the selective index may have a value greater or less than 100. Animals with index 100 are regarded neutral in terms of individual selection, and animals with higher breeding index are regarded improvers of the herd, and will mainly be included into the breeding stock. However, one should note that the value of exterior assessment should not be completely removed from the selection process. However, this is a very subjective assessment of the grader, and it significantly depends on his qualification. Therefore, we believe that it is enough to define the boundaries of the selection by the exterior assessment based on studying the variation series for this trait.

Table 2

Results of selecting mature cows according to the selective breeding index

Groups	n	Average live weight, Ma_j		Average milkiness, Ml_j		Average index of natural resistance, R_j		Selective index, SI_i
		kg	index	kg	index	units	index	
Selective	5	545.8±20.0	112.2±4.5	176.0±6.2	96.2±3.4	50.7±2.8	155.1±8.4	118.8±1.6
Nucleus	36	503.3±8.6	103.7±1.7	182.6±1.9	99.8±1.0	40.3±1.6	123.9±5.0	108.1±1.1
Production	19	475.3±11.2	98.0±2.4	186.0±2.2	101.7±1.2	22.9±2.2	70.1±6.7	92.0±1.1
Rejected	6	411.8±28.9	84.7±5.1	174.5±1.6	95.5±0.7	18.9±2.2	57.6±6.7	77.4±3.9

The consolidated data about the results of the performed selection of a breeding herd of mature cows at the "Akhmetov" farm is shown in Table 2. The results of selection show rather high efficiency of the index selection of an animal into the breeding stock and into the breeding group. The selection indices for these groups were 108.1 and 118.8, respectively. With that, very high selection effect is observed for the indicators of natural resistance. In particular, the average index of natural resistance in the breeding nucleus amounted to 123.9, and in the selection group – to 155.1. The reason of such high index is, in our opinion, the fact that selective breeding has never before been performed according to natural resistance, and therefore, the first attempt resulted in such a sharp increase in the indicators of natural resistance in the group selected for further breeding reproduction of the herd. It is noteworthy that the index of the breeding nucleus and the selection group according to the main breeding trait, live weight, was high enough. Presumably, since the live weight of beef cattle rather strongly correlates with growth intensity, forage payback, growth and meat qualities, the achieved level of index according to the live weight will expand the breeding traits listed above. The neutral position of the breeding nucleus and the relatively low level of selection groups according to the index of milkiness should be recognized as a legitimate concession in the selection process. Moreover, in other studies, we have found that by the age of 15 months the offspring from high-milk cows lose the high rank that they had achieved by the age of 6 months, apparently, because they do not have very high genetic potential in the primary breeding trait of beef cattle, namely, growth intensity. It is no surprise, because the biological inter dependence of the opposites in the milk and meat productivity of animals is unquestionable.

CONCLUSION

The reserve for increasing the beef livestock in Kazakhstan is in development of sands in the semi-desert regions, with enough groundwater and grassland vegetation. In some regions of Kazakhstan, there is a problem with the propagation of infectious diseases, which is assisted by very high variety of the level of natural resistance in animals of the same herds. In herds with animals with very high resistance, there are also animals with extremely low natural resistance, and their share is quite significant. In the conditions of lack of selection of breeding animals, in terms of natural resistance, the specific weight of animals subject to infectious diseases is very high. Therefore, the single-aspect selection of animals only by their main economically useful traits does not ensure the expected economic effect from beef cattle breeding. The necessity of developing and implementing the methods of selecting animals for breeding with regard to the natural resistance indicators has been urgent for a long time. The studies performed in this area provided very valuable results. The index assessment and selection of beef cows based on the indicators of natural resistance is highly effective and relevant. Consideration of the indicators of natural resistance in selection will create conditions for improving the indicators of natural resistance in animals, providing high efficiency of selection by the live weight.

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