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Assessment of the Breeding Qualities of Kazakh White-headed Calves Using the Method of Testing Own Productivity

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Abstract--- The article presents the results of studying the main lifetime meat productivity characteristics of Kazakh white-headed calves during testing their own productivity at the leading farms of the West Kazakhstan region: PF Aisulu, PF Dongelek, PF Khafiz, and Chapaevsky Stud Farm LLC. The dynamics of the live weight of calves over the period between 8 and 15 months of age, the average daily weight gain between 8 and 15 months of age, feed consumption per one kilogram of weight gain, and meat forms were studied. Breeding indices "A" were calculated for each of the above characteristics. It has been found that the highest live weight at the age of 8 and 15 months was noted in the calves from PF Aisulu and PF Dongelek; the maximum live weight at the age of eight months amounted to 239.5 kg and 238.2 kg, and at the age of 15 months — to 408.2 kg and 406.6 kg, respectively. The highest genetic potential in terms of the average daily gain of live weight over the test period was noted in the calves from PF Dongelek, which amounted to 867.3 g. For each characteristic, breeding indices have been determined, along with the comprehensive index as the most unbiased indicators of their breeding value.

Keywords--- Kazakh White-Headed Calves, Own Productivity Test, Live Weight, Average Daily Gain, Feed Consumption, Meat Forms, Breeding Potential, Class assessment, Comprehensive.

I. Relevance

In the economic conditions, especially within the scope of the Eurasian Economic Union of the CIS countries, one of the priorities is the complete supply of meat as a major source of proteins to the population. In these circumstances, the development of specialized beef cattle as the lowest-cost branch of high-quality meat production will be given priority. V. Y. Khainatsky et al. (Makayev, Kayumov and Nazarbaev 2005; Dunin, Sharkaev, V. and Kochetkov, A. 2006; Amerkhanov, H. A., Khainatsky, V. Y. and Kayumov 2010; Khainatsky, Kayumov, Gerasimov and Tretyakova 2019) note that in the developed countries, the development of beef and veal market, as well as the delivery of heavy leather raw materials for the industry became possible only with the development of the beef cattle breeding.

It should be noted that beef cattle breeding in Kazakhstan is mainly based on breeding the animals of the Kazakh white-headed breed. In this regard, forming the full-fledged beef cattle industry is impossible without improving the beef breeds bred in the country in general, and the Kazakh white-headed breed in particular, which cannot be implemented without qualitative assessing their breeding values, screening, and intensive use of the genetic material with high breeding value in the reproduction system. One of the leading trends in the breeding work aimed at creating new genotypes and breeding the livestock with high genetic potential are organization and performing tests of the calves' own productivity.

II. Materials and Methods

The objects of the study were Kazakh white-headed calves at PF Aisulu, PF Dongelek, PF Khafiz, and Chapaevsky Stud Farm LLC in the West Kazakhstan region that had passed own productivity test. Own productivity of the Kazakh white-headed calves was tested in accordance with the Guidelines for Assessing Own Productivity of the Calves of Meat Breeds, and the Quality of their Offspring (Almaty, 2010) No. 1 dated December 26, 2009, decision of the STC of the Ministry of Agriculture of the RK, Inspecting and Assessing Stud Bulls of Beef Breeds by the Quality of their Offspring and Testing Own Productivity of the Bulls (Order of the STC of the Ministry of

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Agriculture of the RK dated 19.07.2010, No. 456, and Regulations for Evaluation of the Cattle of Beef Breeds (Order of the Ministry of Agriculture of the RK dated 16.06.2000 No. 162)).

The technology of feeding and keeping calves during the own productivity test are consistent with the traditional requirements adopted in beef cattle. From 8 to 15 months, the calves were kept loose with free access to the platform. The building was mostly used in the winter and the rainy days in the autumn and spring; it had loafing yards, where the calves remained most of the time. At the loafing and feeding yards, each animal had the available area of 15 m². Such loafing yards contributed to the motor activity of the calves, and provided opportunities for rest in elevated areas (hills).

At PF Aisulu, the bedding was straw, and at other farms, low-value hay was used for bedding.

In the diet, local production fodders were mainly used; their daily amount varied, depending on the age and the live weight of the calves.

For own productivity test, calves of the same season of birth, namely, spring (March 2018), were supplied to PF Aisulu, PF Khafiz, and Chapaevsky Stud Farm LLC, while to PF Dongelek calves of the winter and spring seasons of birth were supplied. After weaning at the age of six months up to eight months, the calves passed the adaptation period and got accustomed to eating the fodder supplied in the following age period.

III. Results

Organization of the calves' own productivity test started with weaning off a herd of 6-month-old calves without body defects, the live weight of which at this age met the requirements of the breed standard. At the age of 15 months, the calves were assessed by four main criteria: live weight, average daily weight gain, meat forms, and feed consumption per one kilogram of weight gain by using indexes calculated from the average values for the evaluated group. The comprehensive index, which is the mean arithmetic of partial indices, reflecting the relative genetic potential of an animal, was used for selecting replacement calves for their own reproduction.

During the own productivity test of the calves, studying the dynamics of the live weight gain in young animals was of the greatest interest (Table 1).

Table 1: Dynamics of the Live Weight of Calves, Kg

Age, months	Names of farms									
	PF Aisulu (n = 18)		Chapaevsky Stud Farm LLC (winter calving) (n = 17)		PF Dongelek (winter calving) (n = 23)		PF Dongelek (spring calving) (n = 7)		PF Khafiz (n = 11)	
	X ± Sx	Cv	X ± Sx	Cv	X ± Sx	Cv	X ± Sx	Cv	X ± Sx	Cv
Newborn	22.4 ± 3.49	0.8	22.1 ± 0.24	6.2	22.3 ± 0.24	5.1	22.3 ± 0.45	4.9	23.2 ± 0.66	9.0
8	241.3 ± 1.74	2.9	222.8 ± 1.29	2.3	237.9 ± 1.27	0.5	233.9 ± 3.07	3.2	221.3 ± 3.05	4.3
9	262.1 ± 2.56	2.4	241.8 ± 1.49	2.5	260.5 ± 1.62	0.6	253.4 ± 2.30	2.2	242.9 ± 3.65	4.7
10	284.8 ± 0.95	1.4	264.0 ± 1.68	2.6	283.3 ± 1.68	0.6	275.1 ± 1.96	1.7	267.6 ± 3.95	4.6
11	308.5 ± 0.86	1.2	287.7 ± 2.11	2.9	306.7 ± 1.50	0.5	299.1 ± 2.42	1.9	291.3 ± 3.69	4.0
12	333.3 ± 1.27	1.6	313.4 ± 2.20	2.8	329.7 ± 1.50	0.5	325.4 ± 4.29	3.2	316.0 ± 4.01	4.0
13	358.3 ± 1.84	2.1	338.4 ± 2.24	2.7	353.6 ± 1.93	2.6	353.0 ± 3.25	2.6	340.6 ± 4.19	3.9
14	383.7 ± 2.46	2.6	362.5 ± 2.70	2.9	379.4 ± 2.37	2.9	378.4 ± 4.00	2.5	363.4 ± 4.37	3.8
15	416.4 ± 4.40	4.4	390.9 ± 3.26	3.3	406.8 ± 3.07	3.5	413.7 ± 4.01	2.3	393.2 ± 4.07	3.3

Table 1 shows that the live weight of the calves at all farms during the test period at all ages exceeded the requirements of the breed standard. In the initial period of testing at the age of eight months, the differences between the live weight of the calves were insignificant and ranged between 15 and 17 kg.

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At the age of 15 months, the calves at PF Aisulu and PF Dongelek exceeded the live weight requirements for the elite class.

The variability in the live weight of the calves from different farms was not uniform and insignificant and did not exceed 4.3 % at the age of eight months, and 4.4 % at the age of 15 months. Although low variability of the live weight characterizes the relative homogeneity of a herd by a characteristic, it does not allow to identify the genetic potential of individual animals with high accuracy, and consequently reduces the efficiency of selection from a population. In the authors' opinion, the low variability of the live weight of young animals is associated with insufficient feeding.

The relative growth rate over the test period from 8 to 15 months of age in the calves at all farms was within 52.25 – 55.95 %, and this insignificant difference was due to the slight differences in the live weight of the calves at the beginning of the test at the age of eight months.

More prominent differences were observed in the coefficient of live weight gain in the context of age (Table 2).

Table 2: Coefficient of the Live Weight Gain in the Calves

Age, months	Names of farms				
	PF Aisulu	Chapaevsky Stud Farm LLC (winter calving)	PF Dongelek (winter calving)	PF Dongelek (spring calving)	PF Khafiz
8	10.8	10.1	10.7	10.5	9.5
12	14.9	14.2	14.8	14.5	13.6
15	18.6	17.7	18.2	18.6	16.9

In all age periods, the coefficients were the highest in the calves from PF Aisulu and PF Dongelek (spring calving), and over the entire period of growth, the coefficient of the live weight gain was 18.6.

In beef cattle breeding, the value of the average daily live weight gain in analyzing the live meat productivity characteristics and the breeding qualities is of paramount importance (Table 3).

Table 3: Dynamics of the Average Daily Gain by Calves, g

No.	Names of farms	Age, months					
		8 – 12		12 – 15		8 – 15	
		X ± Sx	Cv	X ± Sx	Cv	X ± Sx	Cv
1	PF Aisulu	766.2 ± 18.10	9.7	901.9 ± 35.00	16.9	832.3 ± 22.40	11.1
2	Chapaevsky Stud Farm LLC (winter calving)	754.9 ± 25.30	10.6	752.3 ± 42.00	27.4	800.6 ± 14.70	7.4
3	PF Dongelek (winter calving)	765.2 ± 13.60	8.3	856.5 ± 21.60	11.8	804.3 ± 14.30	8.3
4	PF Dongelek (spring calving)	763.1 ± 30.80	12.8	980.9 ± 55.10	13.8	867.3 ± 20.70	5.8
5	PF Khafiz	789.4 ± 20.70	8.3	792.0 ± 51.40	21.5	818.6 ± 16.80	6.5

It should be noted that the calves in all farms during the test period from 8 to 15 months of age had satisfactory indicators of the average daily gain – 800.6 – 867.3 g. The highest average daily gain was observed in the calves from PF Aisulu (832.3 g) and PF Dongelek (867.3 g); with that, the calves showed steadily high indicators of the average daily live weight gain in all age periods, which to some extent characterized greater genetic potential of the animals from these farms.

At the same time, the calves from PF Dongelek (spring calving), although in the period of 8 – 12 months had had lower average daily live weight gain, showed the compensatory nature development, and higher average daily gains at the ages of 12 – 15 and 8 – 15 months, compared to their peers from PF Aisulu. It may be noted that the animals that had previously shown high average daily weight gain (PF Aisulu) slowed their growth rate following the intermittent growth law, and the animals with low average daily weight gain (PF Dongelek), in contrast, showed the compensatory nature of development.

The authors found that the greatest variability was observed in the indicators of the average daily weight gain for the entire test period, compared to the live weight, with that, the coefficient of variability varied at various farms.

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The highest variability of the average daily weight gain was observed in the calves from PF Aisulu (11.2 %) and PF Dongelek (8.3 %), which to some extent brings the hope for more reliable selection by this characteristic.

Studying the correlative relations of the productive characteristics has important practical significance in the breeding work with beef cattle breeds (Table 4).

Table 4: Correlation of the Average Daily Weight Gain and the Live Weight of the Calves

Age, months	Names of farms									
	PF Aisulu		Chapaevsky Stud Farm LLC		PF Dongelek (winter calving)		PF Dongelek (spring calving)		PF Khafiz	
	r	tr	r	tr	r	tr	r	tr	r	tr
0 – 8	+0.99	+++	+0.93	+++	+0.98	+++	+0.99	+++	+0.95	+++
8 – 15	+0.93	+++	+0.91	+++	+0.91	+++	+0.71		+0.68	+
0 – 15	+0.96	+++	+0.99	+++	+0.99	+++	+0.99	+++	+0.98	+++

Table 4 shows that direct correlation is established between the indicators of the average daily weight gain over the entire test period and the final live weight of the calves. At all farms, it was identified to the third degree of certainty. It was the highest during the period from birth to 15 months of age with a high degree of reliability.

In stud herds, the optimum level of selecting calves for breeding (for own reproduction) that have passed the own productivity test may be considered 10 % (Khainatsky, Kayumov, Gerasimov and Tretyakova 2019; Prakhov 1980; Bagriy, and Azarov 1980). The higher the intensity of selection was, the higher was the breeding value of the selected animals(Table 5).

Table 5: Indicators of Productivity and the Selection Differentials of These Characteristics at 10 % Intensity of Selection

Names of farms	Characteristic	Live weight, kg		Average daily gain, g	Feed consumption, feed units	Meat forms, score	Comprehensive breeding index, %
		at 8 months	at 15 months				
PF Aisulu	X	239.5	416.4	832.2	9.05	55.5	100.0
	Sd	11.0	26.1	136.8	1.61	2.5	6.39
Chapaevsky Stud Farm LLC (winter calving)	X	222.8	390.9	800.6	9.86	53.4	100.0
	Sd	9.2	17.6	70.8	1.08	4.5	4.85
PF Dongelek (winter calving)	X	237.9	406.7	804.4	9.42	52.7	100.0
	Sd	10.4	18.3	68.7	1.19	3.3	5.04
PF Dongelek (spring calving)	X	231.6	413.7	867.3	8.91	55.1	100.0
	Sd	6.4	11.29	61.2	0.70	1.9	2.25
PF Khafiz	X	221.3	393.2	818.6	8.02	5.38	100.0
	Sd	13.7	21.8	86.2	0.42	2.2	3.48

For instance, upon selection by the comprehensive breeding index A of 10 % of the best calves at PF Aisulu, their average live weight at the age of 15 months was 385 – 445 kg, the average daily weight gain was 657.14 – 1,004.76 g, fodder consumption was 7.07 – 11,72 fodder units, and meat forms had 53 – 58 scores; at Chapaevsky Stud Farm LLC, the respective values were the following: 365 – 410 kg, 685.71 – 885.71 g, 8.75 – 11.96 fodder units, and 48 – 58 scores; at PF Dongelek (winter calving): 380 – 425 kg, 666.67 – 904.76 g, 8.18 – 12.30 fodder units, and 49 – 56 scores; at PF Dongelek (spring calving): 405 – 425 kg, 785.71 – 928.57 g, 8.08 – 9.67 fodder units, and 52 – 57 scores; and at PF Khafiz: 375 – 415 kg, 752.38 – 904.76 g, 8.74 – 11.03 fodder units, and 48 – 56 scores. The average comprehensive index A by 10% of the best calves at PF Aisulu was within 101.75 – 103.08 %; at Chapaevsky Stud Farm LLC: 105.92 – 107.95 %; at PF Dongelek (winter calving): 101.90 – 103.17 %, at PF Dongelek (spring calving): 100.66 – 101.20 %; and at PF Khafiz: 103.37 – 103.48 %. The values of these breeding indexes reflected the most actual values for a given selection intensity. It should be noted that the efficiency of breeding largely depends on the intensity of selection. As noted by Y. Khainatsky et al. (Khainatsky, Kayumov, Gerasimov and Tretyakova 2019), the fewer animals are selected for reproduction, provided that these animals are the best, the higher is the quality of the subsequent generations obtained from these animals by the characteristics, according to which they had been selected.

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Table 5 shows that by the main breeding characteristics during the selection of 10 % of the best calves by the comprehensive index at PF Aisulu, the breeding differentials were higher, compared to those at other farms, being inferior only to the breeding differential by the meat forms of Chapaevsky Stud Farm LLC.

In beef cattle breeding, the growth rate of young animals is inherited at the level of 50 % (Khainatsky, Kayumov, Gerasimov and Tretyakova 2019; Prakhov 1980; Bagriy, and Azarov 1980), that is, it is possible to efficiently use a selection of parents by this characteristic for improving it.

The genetic progress per generation is calculated by multiplying the coefficient of heritability of a characteristic (the average daily gain) by the breeding potential of the parental generation. With the heritability of 50 % (the coefficient of heritability = 0.5) and the breeding differential of fathers at PF Aisulu, the effect of breeding by the growth intensity per one generation will be (136.8 g + 0)/2 = 68.4 * 0.5 = 34.2 g. That is, with keeping the same conditions for growing the next generation of the animals obtained from selected fathers, the growth rate of their children during the test will be (832.2 g + 34.2 g) = 866.4 g. Thus, the effect of breeding will be slightly higher than eight kilograms per animal (244 days * 34.2 g = 8.3 kg).

It should be noted that if the selection is absent among bulls and cows, the parents will not influence the productivity of their offspring, i.e., one cannot expect any genetic progress, and the observed increase in the productivity is explained by the improvements of the external factors (feeding conditions, etc.).

Thus, the test of own productivity of the calves in beef cattle breeding provides an opportunity to identify the genetic potential of individual populations (herds), to identify the breeding and genetic parameters of the main selection characteristics, and to accelerate the breeding process by choosing the best animals.

IV. Conclusion

The objects of the research were Kazakh white-headed calves with tested own productivity at various farms in the West Kazakhstan region. The calves' own productivity was tested from the age of 8 – 15 months, during which period the live weight was determined at the age of 8 and 15 months along with the average daily weight gain over the period from 8 to 15 months, fodder consumption per one kilogram of the love weight gain, and the meat forms.

The criteria for assessing the breeding value of the calves by the result of the tests were the values of the comprehensive class and the comprehensive index of the above-stated characteristics.

By the results of the test at PF Aisulu, the share of the calves with comprehensive classes elite-record was 50 %, elite — 38.9 %, and the share of calves with the comprehensive breeding index over 100 % was 61 %. At Chapaevsky Stud Farm LLC, the share of the calves with the comprehensive class elite was 52.9 %, and with comprehensive breeding index above 100 % — 52.9 %; at PF Dongelek (winter calving), the share of elite-record was 21.7 %, elite — 34.8 %, the share of the comprehensive breeding index more than 100 % — 65.2 %; at PF Dongelek (spring calving), the share of elite-record was 28.6 %, elite — 71.4 %, the share of the comprehensive breeding index over 100 % was 42.9 %, at PF Khafiz, the share of elite was 45.5 %, the share of the comprehensive breeding index over 100 % was 45.5 %. The highest number of calves with high breeding characteristics was at PF Aisulu and PF Dongelek.

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