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Improving breeding and productivity qualifications of Holstein cow breeds (b. Taurus) in climate of Uzbekistan

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Abstract. This article accelerates the development of selection methods for selecting the best genotypes that are acceptable from the similarity genotypes of imported Holstein cattle typical of Chinese, German and Slovenian selection. The genetic potential of reproduction and productivity of breeding breeds in genotype-environment interactions has been demonstrated. The results of the same feeding, storage and performance of Holstein cows in summer and winter, the productivity characteristics of the cattle are presented.

1. Introduction

Livestock is one of the leading sectors of agriculture in the world and plays an important role in food production [1]. The development of the industry requires the introduction of scientific advances and modern innovative technologies [1, 2]. The specialization of the cattle breeding sector, breeding of cattle and optimization of technologies are yielding positive results. In the United States, the world's leading livestock producer, the milk yield of Holstein cows increased by 4.6% to 9,500 kilograms. In the Netherlands, Germany and other European countries, the milk yield of Holstein genotype cows increased by 8,000-9,000 kg [2, 10].

Today in our country it is important to strengthen the breeding base of cattle, increase the breeding and productivity of cattle [3, 9]. It is important to improve the selection and technological work, the adaptation of the Chinese, German and Slovenian types of Holstein to the external environment, the improvement of breeding and productivity qualities [4, 11].

One of the main methods is purebred breeding breeds and crossbreeding with regionalized cattle breeds. Fertilization of Holstein breeds in hot climates, the formation of productive genetic potential of cattle of different genotypes, and the interaction of genotype-environment have not been sufficiently studied [4, 5, 12]. In this regard, further improvement of the storage and feeding system is of great scientific and practical importance.

According to the study, milk production of Holstein cows in China, Germany and Slovenia has increased, approaching the breed standard. The economic useful properties of Holstein pedigree cattle have been identified, and their breeding and productivity qualities have been improved [6, 12]. Development of the livestock sector, the introduction of modern and innovative methods, increasing production and expanding the range of products, as well as the uninterrupted supply of the population with quality and affordable livestock products, and the expansion of livestock production were accelerated to some extent [7, 13]. Selection efficiency in the use of breeding breeds in new climatic conditions has always ended with the creation of regional productive types of cattle or new breeds [8].

The main methods of expanding the breeding base of cattle breeding in the country are purebred breeding of milk and dairy-meat breeds and crossbreeding with regionalized cattle breeds. Their breeding and economic useful properties have been studied by a number of scientists and recommended for production [8, 10]. However, there are no data on different regional varieties of Holstein and adaptation of *phlegfix simmental* to hot climates, their genotypes, breeding and productivity characteristics, differences in economic and biological properties in the interaction of genotype-environment, good genotypes on good phenotypes [2, 14]. Methods for selecting acceptable good genotypes from similarity genotypes of Holstein breed cattle have accelerated the development of selection. The genetic potential of breeding and productivity of breeding breeds in genotype-environment interactions has been demonstrated [14].

The focus is primarily on studying the problems of improving the breeding and productivity qualities of breeders, adaptation to different natural and climatic conditions, the relationship of genotype-environment and the manifestation of genetic productivity potential [7, 10].

According to researchers, black-and-white and red-and-white Holstein cattle are the best breeders of black-and-red and red breeds in Uzbekistan [3, 4, 7]. Possibilities of use of Holstein breed in selection work, selection of cattle on breeding and productivity parameters are defined. The aim of this paper is to form the genetic productivity potential of imported Holstein and pedigree cattle on breeding farms to adapt to the climate, improve the quality of breeding and productivity.

2. Materials and Methods

Experimental studies were carried out in the cattle herds of imported Chinese Holsteins breeding farm "Rohatoy", German Holsteins "Milk-Agro" LLC, German and Slovenian Holsteins "Azizjon" breeding farms.

Scientific research was carried out under the same optimized storage, care and feeding technological conditions of breeding herds. The origin and fertility of parents and ancestors were studied according to breeding documents. The milk yield of cows during lactation and the amount of fat it contained were determined by control milking. The lactation coefficient, lactation stagnation, and milk yield decline index were calculated using generally accepted methods [9, 11, 14]. The morphological and functional characteristics of the udder were determined by the proposed methods at 3 months of lactation [10, 12]. In the study of the exterior of cattle, 8 body measurements were taken and their indices were calculated.

Expended feeds were calculated based on the results of controlled feeding. Feed coverage of milk was determined by VE Nedava, heat resistance indices of cattle by YUO Rauschenbach methods [1, 4, 5]. The cost-effectiveness of the research was determined by the method of deducting costs from production revenues [2, 4]. The level of net profit and production profitability was calculated.

Scientific data on the interrelation of genotype-environment in the hot climate and farms of Uzbekistan, the formation of breeding, productivity and biological characteristics of imported Holstein breeds were obtained [6]. Theoretically, the main biological and selection-genetic parameters of imported Holstein cows, the reaction conditions in their adaptation to hot climates and the formation of breeding farms, the genetic potential of productivity and the scientific basis for demonstrating good phenotypes were studied.

3. Results and Discussion

3.1 Climate adaptation, breeding and productivity characteristics of Chinese Holstein cattle in the traditional technological conditions of storage and feeding of the breeding farm "Rohatoy"

The experiment provided zootechnical analysis of the growth, external characteristics, breeding, productivity and biological qualities of Chinese Holstein cattle in hot climates. Genetic productivity potential and adaptive qualities of cattle have been identified.

In the traditional technological conditions, the system of tying in capital buildings and spreading in the open field, in the summer and winter optimized feeding, the imported goods showed their economically useful properties. The nutrient content of feed consumed to cows of different genotypes in adulthood was 6,491-6,492 kg of dry matter, 5,366-5,371 feed units, 671-690 kg of digestible protein. In this optimized technological method, the milk yield of cows increased during I-III lactation. The additional increase in milk yield was 473.4 ± 6.86-500.8 ± 6.59 kg to 559.5 ± 12.15-586.7 ± 4.93 kg, or 18 %. The cows are of medium size, typical of the milk type by body type, the fat height of the cows is 141.5 ± 1.1, the breast width is 49.9 ± 1.11, the depth is 78.01.11 and the slope length is 178.0 ± 4, 79 cm. It should be noted that due to the fact that the breeding documents of imported cattle did not include the productivity of their parents and ancestors, it was not possible to assess by genotype. According to the results of the study of milk yield of cows, Chinese Holsteins have average breeding and productivity qualities (Table 1).

Table 1. Milk yield of Chinese Holstein mature cows of different genotypes (X ± Sx)

Parameters	Cattle group with different genotypes			
	№00171 Bull generations	***№981075 Bull generations***	***№703 Bull generations***	***№2334 Bull generations***
Milk yield, kg	5497.4±285.6	5407.9±190.5	5415.2±205.7	5323.6±166.0
Fat content, %	3.95±0.02	3.94±0.03	3.97±0.07	3.92±0.04
Milk fat, kg	217.0	213.1	214.8	208.0
Milk yield coefficient	964	966	952	946
Correlation of selection traits (r)				
Biomass-milking	+0.48	+0.46	-0.24	-0.03
Biomass-fat	+0.15	+0.19	-0.17	-0.89
Milking-milk fat	+0.47	+0.95	+0.82	+0.42

The milk yield of cows of different genotypes (5,329-5,497 kg) and the fat content of milk (3.92-3.97%) showed the same level. Relative differences were observed between groups on milk fat. Cows are typical of the milk line type in terms of milk yield (946-966).

It should be noted that the milk yield of I-lactation cows of II genetic-ecological generation did not lag behind that of imported (I-genetic-ecological-generation) mothers. In particular, the milk yield of cows of I-genetic-ecological-generation is 4,343-4,562 kg; fat content is 3.90-3.93%, while that of cows of II-genetic-ecological generation is 4,642.9 ± 258.7 kg, 3.90 ± 0 respectively. A positive correlation between selection traits was observed in the first two bulls (No. 00171 and 981075), which showed relative breeding potential. A moderate and high correlation between the milk yield and fat content of cows of all genotypes testifies to an increase in the selection efficiency of cattle in this regard. Although the milk yield of Chinese Holstein, created in the climatic conditions of Asia, was moderate, the adaptive properties to hot climatic conditions were highly demonstrated (Table 2).

The heat resistance index of imported cows is moderate (85.2). In this regard, the cows of the II-genetic-ecological generation dominated, their heat resistance index increased to 88.0 ± 1.87. This indicates an improvement in heat adaptation properties.

The amount of hemoglobin in the blood is high in cows of different genetic-ecological-generations, they are slightly higher in summer than in winter. The increase in the number of erythrocytes and leukocytes during the summer is at a high level of accuracy ($p > 0.99$). Thus, the features of metabolism, oxidation-reduction processes and adaptation to conditions were demonstrated at a high level.

The quality of cattle breeding is also at the level of zootechnical requirements, the service life of cows of I-genetic-ecological generation is 82.7 days, in II-genetic-ecological generation - 74.9 days and the birth interval is 368 and 360 days, respectively. Thus, in hot climates, imported Chinese Holstein cows showed productivity characteristics specific to their genotypes, milk yield was 5,000-6,000 kg; fat content was 3.9-4.0%. They have good adaptability to external environmental conditions.

Table 2. Biological characteristics of Chinese Holstein cows of different genetic-ecological-generation (X ± Sx)

Parameters	**I genetico-ecological-generation**		**II genetico-ecological-generation**	
	During summer	***During winter***	***During summer***	***During winter***
Heat resistance index	85.2±2.40	-	88,0±1,87	-
Amount of hemoglobin, g/%	11.50±0.76	10.90±0.57	12,30±0,34	11,17±0,33
Number of erythrocytes, million/mm^3	7.50±0.02	6.13±0.27	6,73±0,23	5,83±0,12
Number of leukocytes, thousand/mm^3	8.40±0.23	6.13±0.27	8,60±0,12	6,80±0,61
Service period, days	82.7±11.41		74.9±8.37	
Birth interval, days	337.7±12.08		359.9±8.36	

3.2 Climate adaptation, breeding and productivity characteristics of German constitutional Holstein cattle of different constitutional types in the light-type buildings of the breeding farm "Milk-agro" LLC and in the technological conditions of the same type of feeding

In this experiment, it was found that in the breeding of German Holstein cows in hot climates, the main direction of selection and technology is evaluated on the characteristics of breeding, productivity and adaptability to different types of constitution.

In cattle of different constitution types, pedigree and productive ancestors of similarity genotype are characteristic. In particular, the ancestral index of fine-grained cattle is 10,177 kg of milk, 430 kg of milk fat and 9,950 kg and 404 kg, respectively, of those with a strong constitution. That is, the quality of the genotype of cows with fine constitutions prevails. Their predominance in milk fat was 32 kg or 7.9 %. Such superiority is also observed as an assessment of paternal offspring ($P > 0.95$).

Cows of different constitution types with this genotype exhibited different levels of breeding and productivity qualities in hot climates. Although the storage and feeding conditions were the same, the delicate environmental cows were strongly negatively affected by the external environmental conditions. The nutritional value of the nutrients they consumed was 5,795 kg of dry matter, 4,765 nutrient units, and 638 kg of digestible protein. In the effective consumption of nutrients in the diet of cattle with a strong constitution, their nutritional value was 7,633 kg, 6,455 and 849 kg, respectively. In other words, the difference in food consumption increased by 35.4%. These positive factors ensured an increase in the productivity of cows with a strong constitution type. The milk yield of cows in the compared groups was relatively equal in I lactation, while in the last lactations, especially in III lactation, thin constitutional cows did not rise, while those of strong constitutional cows increased significantly, reaching 6,422 kg, or an increase of 25.5%. Their predominance was 1,290 kg (25.1%) in milk yield ($P > 0.99$) and 49 kg (8.5%) in live weight (Table 3).

While cows with thin constitutions were superior to those with strong constitutions (74 kg or 7.7%) in lactation coefficient in lactation I, they lagged far behind in lactation III (137 kg or 15.3%). A positive correlation was found in the correlation of selection traits, which testifies to the effectiveness of selection. The difference in productivity determined depends on the effect of external environmental stress factors on the organism (Table 4).

Table 3. Changes in milk yield of cows of different constitution types with German Holstein (X ± Sx)

Parameters	Delicate constitutional		Strong constitutional	
	Lactation		*Lactation*	
	I	***III and more***	***I***	***III and more***
Milk yield, kg	5132.3±210.0	5132.1±241.6	5117,2±227,4	6422,3±240,6
Fat content, %	3.98±0.08	3.98±0.06	3,91±0,09	3,86±0,09
Milk fat, kg	204.3±0.86	204.2±42.84	200,3±9,62	247,6±0,35
Bio weight, kg	494.8±8.29	572.9±9.39	531,4±9,04	621,8±11,98
Milk yield coefficient	1037±36.75	896.0±42.84	963±47,47	1033±37,74
Character correlation coefficient (r)				
Biomass-milking	+0.300		+0.400	
Biomass-fat	+0.370		+0.403	
Milking-milk fat	+0.917		+0.742	
Demonstration of productivity potential in relation to mothers, %				
Milk yield, %	54.2		66.6	
Milk fat, %	50.4		61.3	

Table 4. Biological parameters of cows of different constitution types with German Holstein (X ± Sx)

Parameters	Types of constitutions	
	Delicate	***Strong***
Body temperature (summer noon), ^{0}C	39.2±0.08	39.1±0.06
Respiratory rate, times/minute	52±1.23	56.0±0.88
Joint intensity, times/minute	83±1.49	76±1.00
Heat resistance index	80.0±0.39	87.0±0.60
Hemoglobin content (in summer), g/%	8.63±0.61	10.40±0.21
Number of erythrocytes (summer), million/mm^3	6.05±0.11	6.50±0.39
Number of leukocytes, thousand/mm^3	10.0±0.09	9.85±0.18
Service period, days	143±16.93	120±21.55
Birth interval, days	428±55.29	405±49.8
Occurrence of foot and hoof diseases, %	38.5	9.1
Mastitis, %	30.8	9.1

The difference in the clinical performance of the cattle is not at the level of accuracy. The intensity of articulation was relatively high in thin constitutions, while the intensity in respiration was observed in cattle with firm constitutions.

These conditions are the body's reaction to the external environment. The advantage in the heat resistance index was observed in cattle with strong constitution. According to hematological indicators, the processes of metabolism and redox in the body of cattle were more rapid than in cows with a strong constitution. An increase in the body's protective response to the external environment has been observed, especially in sensitive constitutions. Summer stress factors had a negative effect on the milking characteristics of cows, with the service period extending to 143 days in cows with thin constitutions and 120 days in heifers. The incidence of foot and udder disease was higher in thin constitutions (30.8–38.5%) (P > 0.99).

Thus, in the care of German Holstein cows of different constitutions in light-type semi-open buildings in boxes and open areas, as well as in the care of the same type of optimized feeding conditions, their economic useful qualities were characterized by their genotypic characteristics. While strong constitutional cows exhibited genetic productivity potential, thin constitutional cows were strongly affected by summer stress factors, leading to decreased productivity and increased morbidity.

3.3 Formation of productivity qualities in the process of acclimatization of German and Slovenian Holstein cows

In experiments, in the study of selection and biological characteristics of German and Slovenian Holstein cattle, it was found that the genetic qualities of cattle with similar genotypes and their manifestation in new climatic conditions. The link nature of the genotype-environment in the manifestation of the genetic potential of fertility was studied. Optimal conditions of storage and feeding were created in the demonstration of these quality indicators. The cattle were kept in modern livestock buildings in boxes and in open areas. The nutrient content of the same type of feed ration was designed to produce 23-25 kg of milk. In the feeding type, succulents accounted for 44 %, concentrates for 40 % and coarse feeds for 16 %.

In this full-value feeding, the phenotype of cows with similar genotypes was manifested in three different ways - high, medium, and low (Table 5). In terms of milk yield, high-phenotype cows differed sharply from low-phenotypes (P > 0.999). In particular, the milk yield of high-phenotype cows typical of Slovenian selection was 2,832 kg (58.6%), milk fat 116 kg (63.1%), live weight 29 kg (5.5%) and milk yield 442 kg (48.7%). %), German selection cows dominated 3,471 kg (89.4%), 142.2 (93.3%), 23 kg (4.9%) and 561 kg (85%), respectively (P > 0.999).

Different levels of phenotypes were observed in cows with similar genotypes. The correlation of the selection traits differed in the correlation coefficients at different levels. While the relationship between milk yield and fat content is in a positive correlation, milk mass with live mass is in a negative correlation.

The incidence of milk yield relative to the ancestral index was 74.5-79.2% in high phenotypes, 60.9-63.9% in average and 39.9-47.4% in low phenotypes. Cattle with similar genotypes showed individual phenotypic characteristics. The external environment affected the biological properties of the cattle to varying degrees. Although cattle were in similar genotypes, their phenotypic performance was high in some of them and moderate to low in others. Therefore, at the suggestion of a number of scientists, it is permissible to look for good genotypes among good phenotypes.

Cattle in different groups consumed different amounts of feed at the same feeding rate and type. High-phenotype cows consumed 9,667-9,733 kg of dry matter, 7,086-7,127 feed units and 1,047-1,056 g of digestible protein, while low-phenotype cows consumed 5,189-6,419 kg, 4,387-5,161 and 593-710 kg, respectively. In the first type of feeding 43.4% juicy, concentrates 44.5-44.8 and coarse 11.1-11.8%, in the second 23.8-34.2%, respectively 61.4-72.2 and 4.0 -4.4%. As a result of low phenotype cows consuming less coarse and succulent feed, the weight of concentrates consumed increased. The different manifestations of phenotypic indicators can be observed in their biological indicators (Table 6).

Some differences in the clinical performance of cattle in different groups were observed. They were maintained at the physiological norm. The heat resistance index of cows was moderate to high, and the predominance of high-phenotype cows was determined.

There are significant differences in the hematological and clinical indications identified during the summer and winter periods. During the summer, hematological parameters, especially the amount of hemoglobin in the blood, increased. These conditions indicate the acceleration of metabolic, redox processes in the body. According to the number of leukocytes, the level of protection of cattle from the summer environment has increased compared to winter.

Thus, a significant difference in the manifestation of the productivity phenotype in cattle with Holstein-like genotype similarity was identified. At the same time, the productivity potential of high-phenotype cows was high (P > 0.99-0.999).

In order to improve the storage and feeding conditions of imported breeders in hot climates, high-phenotype cattle were bred and good genotype cattle were selected from them and herd selection groups were formed.

Table 5. Demonstration of milk productivity of German and Slovenian Holstein cows during the period of adaptation to new climatic conditions

Parameters	**Slovenian selection (I lactation)**			**German selection (II lactation)**		
	Level of phenotype			***Level of phenotype***		
	High	***Medium***	***Low***	***High***	***Medium***	***Low***
Milk yield, kg	7563.4±96.	6092.0±119.5	4832.3±81.0	7334.3±178.2	5587.6±125.8	3823.6±265.2
Fat content, %	3.96±0.09	3.88±0.05	3.81±0.06	4.09±0.06	4.08±0.05	4.07±0.07
Milk fat, kg	300.2±8.02	236.4±5.30	184.1±4.97	300.8±8.80	228.0±6.28	158.6±7.08
Bio weight, kg	561.8	541.2	532.5	602.7	596.8	580.1
Milk yield coefficient	1350	1139	908	1220	936	659
Correlation of selection traits (r)						
Biomass-milking	-0.26	-0.09	-0.05	-0.46	-0.14	+0.32
Biomass-fat	-0.26	-0.42	-0.18	+0.16	+0.32	+0.78
Milking-milk fat	+0.02	+0.79	+0.27	+0.32	+0.40	+0.97
Occurrence of characters in relation to ancestral indices, %						
Milk yield	74.5	63.9	47.4	75.1	63.9	40.3
Milk fat	74.5	62.8	47.3	79.2	60.1	39.9
Phenotype formation rate,%	32	34	34	35	32.5	32.5
Milk nutrient content						
Feed cost per 1 kg of milk	0.94	1.08	1.07	0.98	1.09	1.15
Concentrations, g	486	604	753	500	723	961

Table 6. Biological characteristics of Holstein cows of different phenotypes (X ± Sx)

Parameters	**Slovenian selection (I lactation)**			**German selection (II lactation)**		
	Level of phenotype and seasons			***Level of phenotype and seasons***		
	High	***Medium***	***Low***	***High***	***Medium***	***Low***
Body temperature (summer daytime), ^{0}C	38.84±0.5	38.90±0.6	39.44±0.4	38.90±0.4	39,12±0,9	39,40±0,6

Respiratory rate (summer daytime), times/minute	40±0.81	43±1.3	46±1.1	44±0.51	47±0,51	46±0,81
Heart rate salt (summer daytime), times/minute	82±0.29	76±1.22	78±1.0	75±0.24	76±1,18	83±1,70
Heat resistance index	88.8±0.4	86.2±0.5	79.9±0.9	89.2±0.7	87,0±0,7	78,7±0,7
Seasons of the year	***Summer***		***Winter***	***Summer***		***Winter***
Hemoglobin content (in summer), g/%	12.4±1.39		9.2±0.29	12.3±0.83		9.9±0.42
Number of erythrocytes, million/mm^3	6.32±0.22		5.70±0.26	6.03±0.19		5.0±0.22
Number of leukocytes, thousand/mm^3	7.70±0.31		6.50±0.49	7.67±0.19		6.60±0.34
Body temperature (morning), ^{0}C	38.4±0.10		38.60±0.1	38.5±0.4		38.4±0.15
Respiratory rate (morning), times/minute	38.0±3.49		36.7±3.19	39.0±0.74		40.5±8.3
Heart rate (morning), times/minute	74.0±8.99		78.5±3.39	66.0±0.6		78.5±0.95

4. Conclusions

The main factor in the development of cattle breeding in the country is to increase productivity by making effective use of the genetic potential of pedigree cattle imported from foreign countries.

It is advisable to create breeding farms for the purchase of breeding breeds and their purebred breeding. Chinese Holsteins are well adapted to the natural and climatic conditions of the Republic, the heat resistance index, service life and birth interval are optimally formed. Research has shown that the processes of metabolism, oxidation-recovery and environmental protection in the body are faster in summer than in winter.

German Holstein different constitution-type cattle have demonstrated their physiological condition and milk productivity in light-type buildings, in boxing and open-air distribution systems, and in the same type of optimized feeding conditions. The scorching heat and high solar radiation of the external environment had a negative effect on the milk productivity of cows with thin constitution. The milk yield of cows with a strong constitution has increased. A positive correlation of selection traits was observed in them. The milking type of cows is proportionally formed; the morpho-functional properties of the udder are adapted to machine milking.

In the Slovenian and German Holstein genotype cows of the optimized storage and feeding type, phenotypic indicators were formed differently. The interrelationship of the genotype environment has shown the genetic potential of cows to vary in productivity. Although the ancestral index of the studied genotype cows was higher in all phenotypic cows, it was found that in the new climate, the productivity of their daughters was varyingly lower than that of their mothers.

Stress factors in summer and winter conditions had different effects on the physiological state of cows of different phenotypes. Slovenian and German Holstein phenotypic cows were consumed according to the heat resistance index (P = 0.95). The predominance was specific to high-phenotype cows. In hot summer conditions, the milk yield of cows decreased. Metabolism in cattle increased in summer compared to winter (P = 0.99). Summer and winter stress factors had a stronger effect on low-phenotype cows than on high-phenotypes (P = 0.99). Formation of cattle with good phenotypes, selection of good genotypes from them and formation of breeding herds were achieved. The research was completed with high economic efficiency. The profitability of production of Chinese Holstein cows under traditional technological conditions was 26-30%, German Holstein cows with stable constitution in light type buildings were 35-36% in optimized feeding, Slovenian and German Holsteins were 62%.

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