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Using A Resistance Index Model For Breeding Work On The Adaptive Ability Of Cows.

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ABSTRACT

The article examines the patterns of productivity of different types of Holstein cows imported from the USA, Denmark, Germany and Australia, establishes the adaptive ability of animals based on indicators of natural resistance, analyzes the correlation between economically useful traits and indicators of natural resistance depending on the genotype. Recommended the use of resistance index for animal breeding on high adaptive capacity. Experimental studies have established that the maximum milk yield per 3 lactations was obtained in group I (USA), which was 25,220 kg of milk, which is more than in group II (Denmark), 1,554 kg more than III (Germany) - 360 kg than in the IV group (Australia) - by 1430 kg with a high level of confidence. The fat content in milk in animals of all groups at a fairly high level. Animals I and III groups by the end 3 lactations reduced the milk production rate by 26%, and their peers - by 17-20%. A similar pattern was observed when analyzing the dynamics of milk fat in cow's milk with a high level of confidence. BASK in animals of group I was 77.1%, which is higher than that of analogs of group II, by 11.8; III - by 7.9 and IV groups - by 12.8%. Chamfer in cows I and III groups is slightly lower than in peers. The highest FASK was observed in cows of group II and amounted to 61.5%, and the phagocytic index was 14.8. Therefore, in order to increase the production of milk and dairy products, it is necessary to study the correlation dependences of such genetic markers as resistance and productivity, which will make it possible to predict the productivity and adaptive qualities of cattle of various selections.
Keywords: genotype, selection, productivity, natural resistance, lactation, adaptation.

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INTRODUCTION

The dairy subcomplex of the agro-industrial complex is one of the main life-supporting sectors of the agrarian economy, which has a decisive influence on the level of food supply of the country and determines the health of the nation.

Dairy cattle breeding is the most efficient animal protein industry. Today, the cheapest food protein of animal origin is milk protein. Therefore, it is the dairy subcomplex of the agro-industrial complex that has a decisive influence on the level of food supply in the country [1].

Russia currently ranks 6th in the world in milk production. Now in Russia, the consumption of milk and dairy products (in terms of milk) per capita is 214 kg with a rational rate of 340 kg. The population's need for milk and dairy products in the country is met by its own production by 80%. Russia is the world's largest importer.

Currently, there are various options for a quick solution to the "dairy" problem. The development of highly productive domestic breeds, types, lines is the most reliable and correct way, but it is a long way, it is designed for results in the long term. In this situation, the import of highly productive animals and their intensive exploitation is one of the real ways to solve the "dairy" problem.

In the past 15 years, about 600 thousand heads of cattle of dairy and meat breeds, including 52.5% of the Holstein black and variegated breed are animals of various genetic selections. When animals are exploited, problems of adaptive nature often arise to different climatic conditions [2,5].

Animals of the Holstein breed in our country need to be further improved in terms of adaptation, taking into account the climatic conditions [7,8].

The study of the results of research published in the available press allows us to conclude that the indices of natural resistance of cattle of various breeds and their relationship with productive qualities in different natural-ecological zones and technologies of use are not well understood. In turn, modern technologies of milk production impose strict requirements on animals on highly mechanized industrial complexes, requiring high milk productivity to be positively combined with a strong constitution, high viability of animals and long-term productive use. Therefore, the study of indicators of the natural resistance of the organism of animals and its relations with productive qualities in the conditions of specific climatic conditions is of great scientific and practical interest.

In studies Kharitonov E.L., Mal G.S., Vorobyeva N.V.et all [9] noted the influence of environmental factors on the formation of the immune system of the organism of animals. One of the most pernicious phenomena in dairy cattle breeding affecting the culling of highly productive dairy cows are various diseases of the hoof horn [10].

Improving the efficiency of dairy cattle breeding in a particular region based on an assessment of the adaptive capacity of Holstein cattle of various genetic selections is an important task. When conducting research the following tasks were solved:

–to study the patterns of productivity of Holstein cows of different selections;
–to establish the adaptive ability of cows on the basis of indicators of natural resistance;
– analyze the correlation between characters depending on the genotype;
–use of resistance index for animal breeding for high adaptive capacity;

Studies were conducted in the period from 2006 to 2015. In the conditions of the breeding plant "Donskoy" Kalachevsky district of the Volgograd region, engaged in the breeding of Holstein cattle.

MATERIAL AND RESEARCH METHODS

The object of research was the Holstein cattle imported into the Donskoye from the USA (245 heads of heifers), Denmark (245 heads of heifers), Germany (386 heads of heifers), Australia (250 heads of heifers).

Experimental groups of animals were formed on the principle of analogs, 4 groups of heifers were formed at the age of 16 months with 20 goals in each:

Group I – heifers of the American selection;
Group II – heifers of Danish breeding;
Group III – heifers of German selection;
Group IV –heifers Australian breeding.

Feeding the animals was carried out in balanced diets in accordance with detailed norms of the VIZH.

The natural resistance and immune status of the organism of animals was assessed by the bactericidal activity of the blood serum (Smirnova O.V. method and Kuzmina T.A. in the modification Bukharina O.V., Sozykina A.V. (1979), lysozyme blood activity (according to Grant), phagocytic activity and phagocytic index, phagocytic number (according to Kost and Stenko) [3,4].

RESEARCH RESULTS

Among the main factors contributing to the level of milk production, the hereditary characteristics of animals formed due to breeding work with each individual breed and herd are of great importance. By studying the milk production of heifers imported from the USA, Denmark, Germany and Australia, it was found that milk yields were higher for peers from the USA and Germany. We studied the milk production of experimental animals for three lactations (Table 1).

Table 1: Dairy productivity of cows

Index	Group			
	I	II	III	IV
1 lactation				
Milk yield for 305 days of lactation, kg	8200±110,5	7600±106,0	8130±113,0	7630±103,5
Fat content in milk, %	3,95±0,02	3,92±0,05	4,00±0,05	3,91±0,02
Amount of milk fat, kg	323,9±0,02	297,3±0,05	325,2±0,05	298,3±0,02
2 lactation				
Milk yield for 305 days of lactation, kg	8420±114,0	7666±111,5	8230±109,3	7910±105,5
Fat content in milk, %	4,10±0,02	4,00±0,04	4,10±0,03	3,95±0,02
Amount of milk fat, kg	345,2±0,02	306,6±0,04	337,4±0,03	312,4±0,02
3 lactation				
Milk yield for 305 days of lactation, kg	8600±110,0	8400±104,0	8500±109,0	8250±108,0
Fat content in milk, %	4,10±0,04	4,00±0,02	4,10±0,02	4,05±0,04
Amount of milk fat, kg	352,6±0,04	336,0±0,02	348,5±0,02	334,1±0,04
Milk yield for 3 lactations, kg	25220±112,0	23666±108,0	24860±110,0	23790±106,0

The maximum yield per 3 lactations was obtained in group I, which amounted to 25,220 kg of milk, which is more than in group II – by 1,554 kg, than III– by 360 kg, and in the IV group – by 1430 kg with a high level of confidence ($P<0,01$). As for the fat content of milk, it can be noted that the fat content in milk in animals of all groups is at a sufficiently high level. The difference in the content of fat in the milk of cows of the American, German, Dutch and Australian selection was unreliable.

By analyzing the milk productivity of cows, the ability of animals to maintain a high level of productivity for a long time is important. We analyzed the dynamics of exceeding the minimum requirements for milk production of cows over 3 lactations (Table 2).

Table 2: Dynamics of exceeding the minimum requirements for milk productivity of Holstein cows of different breeding

Group	Milk yield for 305 days of lactation, kg			Amount of milk fat, kg		
	Minimum requirements kg	actual milk yield, kg	% exceeding	Minimum requirements kg	actual quantit y	%exceeding
1lacrarion						
I	4500	8200	82,2	166	323,9	95,2
II	4500	7600	68,9	166	297,3	79,1
III	4500	8130	80,7	166	325,2	95,9
IV	4500	7630	69,5	166	298,3	79,7
2 lactation						
I	5000	8420	68,4	185	345,2	86,6
II	5000	7666	53,3	185	306,6	65,7
III	5000	8230	64,6	185	337,4	82,4
IV	5000	7910	58,2	185	312,4	68,9
3lactation						
I	5500	8600	56,4	203	352,6	73,7
II	5500	8400	52,7	203	336,0	65,5
III	5500	8500	54,5	203	348,5	71,7
IV	5500	8250	50,0	203	334,1	64,6
Total for 3 lactations						
I	15000	25220	68,1	554	1021,7	84,4
II	15000	23666	57,8	554	939,9	69,6
III	15000	24860	65,7	554	1011,1	82,5
IV	15000	23790	58,6	554	944,8	70,5

Analyzing the dynamics of exceeding the minimum requirements for the milk productivity of Holstein cows of different breeds, it can be seen that the highest level of excess is observed in heifers – by 70-82%, i.e. almost 2 times. Then the rate decreases and, according to the results of 3 lactations, the level of excess is already 50-56%.

Analyzing the dynamics of exceeding the minimum requirements for milk production among groups of animals shows that the highest level of milk production during 3 lactations is observed in cows I and III groups, but they also drastically reduce the rate of milk production to 3 lactation compared with peers. Thus, in animals of groups I and III, by the end of 3 lactations, the rate of milk production decreases by 26%, and in peers – by 17-20%. A similar pattern is observed when analyzing the dynamics of milk fat in cow's milk with a high level of confidence ($P<0,01$).

Probably, the adaptation processes occurring in the organism of animals have an effect. The higher the productivity of animals, the more they are exposed to adverse environmental factors. Adaptation of animals is largely determined by the natural resistance and protective functions of the body to various adverse environmental factors. The level of natural resistance of animals is related to heredity and depends both on the functional state of the nervous system and endocrine regulation, and on the age, breed, type and level of feeding, conditions of detention, season of the year, physiological state of animals.

In the formation of the natural resistance of the organism, blood plays an extremely important role. It communicates the organs and tissues between themselves and the organism as a whole with the external environment. Therefore, to assess the physiological reactivity and potential of the body, humoral and cellular factors of the body are of great interest. Studying the mechanisms of the adaptation process in farm animals is of great biological importance, especially when creating new highly productive breeds that are well adapted to the conditions of intensive technology in modern industrial dairy complexes. Natural resistance is influenced by animal genotype, an indicator of which can be considered interior indicators. The characteristic of hematological parameters allows to judge the resistance of the organism of animals when adapting to new natural and climatic conditions.

The factors of natural resistance of heifers of the Holstein breed of different breeding were studied at different periods of lactation and the physiological state of the cows from the 1st to the 2nd calving. The data obtained in the studies are evidence of the good state of health of animals of all groups and their suitability to the conditions of industrial technology.

The average indices of humoral and cellular factors of nonspecific protection of the first heifers are shown in table 3.

Table 3: Indicators of natural resistance

Indicator	Group			
	I	II	III	IV
Bactericidal activity, %	77,1±1,9	65,3±2,0	69,2±2,2	64,3±2,1
Lysozyme activity, %	13,7±1,5	12,9±1,0	14,8±0,9	12,8±1,2
Phagocytic activity, %	59,9±2,3	61,5±5,0	59,2±2,0	60,0±3,5
Phagocytic index	11,7±1,1	14,8±1,1	12,5±1,0	12,6±0,7
Phagocytic number	5,8±0,6	6,5±0,8	6,4±0,3	6,8±1,0

Higher bactericidal and lysozyme activity was observed in animals of groups I and III. So, BASK in animals of group I was 77,1%, which is higher than that of analogs of group II by 11,8; III – by 7,9 and IV groups –12,8% ($P < 0,01$). Chamfer in cows I and III groups is slightly lower than in peers. The highest FASK was observed in cows of group II and was 61,5%, and the phagocytic index was 14,8.

It was established that animals of groups 1 and III had high levels of natural resistance of the organism (bactericidal activity of blood serum, LASK), and cellular immunity (phagocytic activity of neutrophils). High immunological status indicates the intensity of metabolic processes in the body of animals.

For an objective characterization of the immune status of animals, we have undertaken the possibility of assessing the state of natural resistance using a genetic-statistical indicator - the resistance index (IR). When calculating this index, humoral and cellular factors were used, reflecting the state of the immune status of the organism. An important point when using this index was the determination of the statistical weight of each selection trait [6]. In general, the index represents the following equation:

$$ИР = K_1 * X_1 + K_2 * X_2 + \cdots + K_n * X_n;$$

Where: K is the weight coefficient of the feature,
X –the value of the trait.

The weight of a trait depends on many factors. It is determined by the coefficient of heritability, the degree of variability, the selection differential.

The number of signs included in the index, as a rule, should be no more than 6-7. At the same time, the index should not include signs that have a low breeding value. When calculating the resistance indices of animals, we took into account 5 signs: the bactericidal activity of the blood serum, the lysozyme activity of the blood serum, the phagocytic activity of the blood serum, the phagocytic index and the phagocytic number.

The scheme for calculating the indices of resistance of animals is shown in table 4.

Table 4: Scheme for calculating the index of resistance of animals

Biometric indicators	Factors of natural resistance				
	Serum bactericidal activity	Serum lysozyme activity	Phagocytic activity of serum	Phagocytic index	Phagocytic number
Vi	V_1	V_2	V_3	V_4	V_5
$Vmax$	$Vmax$	$Vmax$	$Vmax$	$Vmax$	$Vmax$
$Vmin$	$Vmin$	$Vmin$	$Vmin$	$Vmin$	$Vmin$
$Vmax - Vmin$	$Vi - Vmin$	$Vi - Vmin$	$Vi - Vmin$	$Vi - Vmin$	$Vi - Vmin$
Cv	Cv	Cv	Cv	Cv	Cv
$\mathrm{k} = \frac{\mathrm{Cv}}{\Sigma Cv} * 100$	k_1	k_2	k_3	k_4	k_5
$Ki = \frac{\mathrm{k}}{\mathrm{Vmax - Vmin}}$	K_1	K_2	K_3	K_4	K_5
$Xi = Vi - Vmin$	X_1	X_2	X_3	X_4	X_5

Resistance Index (P = K * X);
Where: Vi– individual value of the trait;
Vmax – the maximum individual value of the trait;
Vmin– the minimum individual value of the trait;
Vmax-Vmin is the difference between the maximum and minimum individual value of the trait;
Cv– coefficient of variation.

Analysis of the results showed that the cows resistance index is at a high level. An interesting fact is that in animals of the 1st and 3rd groups this indicator (95,1-96,2) is slightly lower than in animals of the other groups (98,1-98,3), although these animals absolute indicators of humoral and cellular defense of the body exceeded their peers. This is probably due to the fact that these animals are worse than the others acclimatized to the local natural conditions, but surpass them in terms of productivity and suitability for the intensive technology of milk production, under which the research was conducted. These animals, as a rule, require closer attention from the veterinary service.

Analysis of indicators of natural resistance of cattle of various breeds and their relationship with productive qualities in different climatic zones and technologies of use once again showed that they are insufficiently studied and show the need to use different integral indicators to assess the immune status and with further breeding of animals.

The calculation of such an integral indicator as the resistance index, the use and regular monitoring as interior tests for selection in breeding farms will allow to obtain more reliable information on the resistance rates of young animals at the early stages of ontogenesis and thereby increase the efficiency of selection for economically useful qualities.

By studying the relationship between the indices of natural resistance and the level of milk productivity, it was established that the degree and direction of correlation is related to the lactation period.

It has been established that in all groups of animals, BASK with milk yield for 305 days of lactation has a weak negative correlation (r = – 0,12-0,19). At the same time, in all groups, at the 1st month of lactation, there was a negative average degree of interrelation of indicators (r = – 0,40-0,49), and at the 3rd month of lactation – a weak negative correlation (r = – 0,16-0,19), at the end of lactation - a weak positive correlation (r = 0,13-0,19).

LASK on the first day after calving and during the 1st month of lactation in all groups of animals had a moderate degree of negative correlation with milk yield (r = – 0,32-0,42). Further, from the 3rd month of lactation, the correlation becomes positive and persists until launch (r = 0,11-0,17). The correlation of the FILLET with the milk yield for 305 days is weakly positive (r = 0,10-0,13).

FA with milk yield for 305 days of lactation has an average degree of negative correlation (r = – 0,33-0,37). After calving, the correlation between the indicators in all groups was moderately negative (r = –0,33–0,35). 1 month after calving, a strong negative relationship between indicators was established (r = – 0,50-0,53). During lactation, the correlation dependence between the signs becomes weakly negative (r = – 0,12-0,03). At the end of lactation, before starting, the correlation between the signs became positive (r = 0,12-0,14).

With MJ milk, cows of all BASK, LASK, and FA groups had a weak negative correlation (r = –0,11–0,18).

Humoral factors that characterize the body’s natural resistance are very labile, they can decrease or increase both in parallel and compensating for each other.

CONCLUSION

Thus, the first-hens of Holstein breed, brought to the Lower Volga region from different countries, have high rates of milk production and high rates of natural resistance. The lecture of the Holstein breed was conducted in completely different climatic and fodder conditions. Therefore, the animal organism is deprived of the instinct of self-preservation and works with full dedication to the production of milk. Therefore, in the operation of imported animals, it is necessary to preserve to the greatest extent the feeding and housing technology used in countries importing livestock.

Modern data characterizing the correlation between the most likely markers of resistance and productivity, indicate the possibility of simultaneous selection of these characteristics. Selection for resistance is becoming a necessary element of modern animal selection programs.

REFERENCES

[1] Gorlov, I.F. Improving the technology of raising young cattle / I.F. Gorlov, O.P. Shakhbazov, P.S. Kobylyatsky, D.V. Nikolaev, A.A. Zakurdaeva // Dairy and beef cattle. – 2014. – № 4.–P. 5-8.

[2] Gorlov, I.F. Prediction of productivity and adaptability of cattle of the Holstein breed of various genetic selection / I.F. Gorlov, V.V. Gubareva, O.P. Shahbazov // Materials of the international scientific-practical conference. –Persianovsky, 2016.– P. 88-92.

[3] Vasilyeva, E.A. Clinical biochemistry of farm animals / Ye.A. Vasiliev.– M.: Rosselkhozizdat, 1982. – 254 p.

[4] Voronin, E.S. Immunology / E.S. Voronin, A.M. Petrov, M.M. Sedykh, D.A. Dervishov. – M.: Kolos-Press, 2002. – 408 p.

[5] Gorlov, I.F. Adaptation of black-and-white cattle of various ecological-genetic types / I.F. Gorlov, Z.B. Komarova, Ya.P. Serdyukov // Bulletin of the Russian Academy of Agricultural Sciences. – 2014. – № 2.– P. 53-54.

[6] Mikhailov, N.V.Methods of constructing selection selection indices in pig breeding / N.V.Mikhailov, A.Ganzha, A.Mikhailova et all. // In Proc. Breeding, feeding and technology of pigs. –Persianovka, 1986. – P. 92-96.

[7] Gorlov, I.F. Productivity and adaptation ability of Holstein cattle of different genetic selections / I.F. Gorlov, S.E. Bozhkova, O.P. Shakhbazova,

V.V. Gubareva, N.I. Mosolova, E.Y. Zlobina, Y.N. Fiodorov, A.S. Mokhov // Turkish Journal of Veterinary and Animal Sciences. – 2016.– №40.– P. 527-533.

[8] Gorlov, I.F. Conomic and biological peculiarities of golshchinsky breed cows of different ecological-genetictypes //I.F.Gorlov, A.S.Mokhov, E.S.Vorontsova, A.R.Karetnikova, N.I.Mosolova, M.I.Slozhenkina, A.S.Ovchinnikov, S.D.Fomin // ARPN Journal of Engineering and Applied Sciences. – 2018. – T. 13.– № 7.–P. 2562-2570.

[9] Kharitonov, E.L.Functional aspects of body resistance / E.L. Kharitonov, G.S. Mal, N.V. Vorobyeva, A.V. Makhova, I.N. Medvedev //Research journal of pharmaceutical, biological and chemical sciences. – 2018. – №6.– P. 60-65.

[10] Marin, E.M.The microbiocenosis analysis of suppurative-necrotic ulcers in the area of hooves in cows by PCRmethod (real-time) /E.M. Marin, V.A.Ermolaev., O.N. Marina,P.M.Lyashenko,A.V.Sapozhnikov// Research journal of pharmaceutical, biological and chemical sciences. – 2018. – №6. – P. 898-903.