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GENETIC CHARACTERISTICS OF HOLSTEIN CATTLE

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Abstract

There are presented the results of the evaluation of animals of Holsteins of Dutch selection in herd SLL „DokSanCom" for the 2 study periods: Ist (2012, n = 202) and the IInd (2016, n = 144). During the analyzed periods of research in the population of the assessed animals is observed a high frequency of occurrence of antigens B_2, G_2, I_2, O_2, Y_2, E'_2, G", which is typical for the Holstein breed and other breeds of black motley roots, and also to the Moldovan type of black - motley cattle. In the AEC-system is observed an increase in the frequency of occurrence of antigens R_1 (0.0247-0.0833), E (0.5742-0.5903), X_2 (0.5891-0.6806), L' (0.0742-0.2083). During the analyzed period of studies were found 21 identical alleles of AEB-locus. The main relative densities in the structure of the allelophond of herd alleles occupy B_2O_1, $B_2O_1Y_2D'$, $G_2Y_2E'_1Q'$, I_2, D'G'O', O', Q' and G". Low homozygosity ratio (Cα – 5.0-5.2%) shows the high genetic diversity of the population of studied cattle. In the antigenic spectrum and in the allelophond of AEB locus at cattle of SLL „DokSanCom" predominate marker antigens and alleles characteristic to Holstein cattle, to other breeds of black motley roots, and also to Moldovan type of black motley cattle. Further selection and selection of animals in the herd SLL „DokSanCom" expedient to maintain in view of the genetic blood group systems.

Key words*: antigen, allele, frequency of occurrence, homozygosity ratio, Holstein breed.*

INTRODUCTION

The study of genetic polymorphism of blood groups of farm animals allows us to analyze the genetically structure of populations, to identify the individual, group and population features, follow the changes in the genetic structure of herds at the selection (Alimjanov, 1992; Boev, 1990).

Blood groups are constant in the ontogeny of animals, do not depend on changes of external conditions and the state of the organism, it is easily identified on the early stages of animal development and have a co-dominant pattern of inheritance. In dairy farming polymorphic proteins and blood groups are widely used in the study of the genetic structure of populations and the development of ways to manage selection and genetic processes (Marzanov et al.; Mashurov, 1980; Podoba et al., 2007). Comparative study of inbreeding populations by immunogenetic methods is important for the understanding of mechanisms to ensure the relative constancy of the breed and its development.

Of particular significance is the holding of Holstein cattle research on the different types of genetic markers as well as the use of molecular - genetic methods contributes to a more reliable assessment of the genotype of the animals, use it effectively, while maintaining the biodiversity of the population. The greatest number of antigenic factors has EAB-locus, which is mainly used in detecting the correlation of genes of blood groups and economic-useful signs, (Duniec et al., 2002; Morita and al., 1987).

Numerous studies performed on different breeds of animals, proved the existence as statistically significant differences on the frequency of occurrence of certain blood groups as and similarities between species that have a genetic relationship (Popov et al., 2000; Samorukov, 2001; Sivkin et al., 2011; Turbina, 2006). It is known that the more genetically diverse population is, so it is more viable and better adapted to the conditions of keeping.

In recent years, to the Republic of Moldova is imported the livestock of Holsteins from

Holland, Germany, Austria. A Holstein cattle has a high milk yield and plasticity adaptations to different climatic conditions of maintenance and for improvement of other breeds, (Gravert. 1974; Dairy Facts, 1986; Alimjanov, 1992; Buyarov et al., 2011; Galazova, 2004; Izhboldina et al., 1996; Klunduk and al., 1992; Krasnov, 1998; Nikolaev, 2007; Prokhorenko, 2013; Saks et al., 2013).

The purpose of research - to study the genetic polymorphism of erythrocyte antigens at animals of Holstein breed and to assess its genetic structure.

MATERIAL AND METHODS

As the material for the research served the blood taken from animals of Holsteins breed of Dutch selection in a herd of cattle SLL "DokSanCom" cattle for Ist (2012, n=202) and the IInd (2016, n=144) of the study period. Taking blood from animals, staging the reactions of haemolysis of red blood cells, as well as the study of blood groups was performed by the standard procedure (Guidelines, 1983). Blood groups were determined with hemolytic tests with the use of 49 reagents of cattle, unified in international comparative tests, which detected antigens controlled by allelic genes of 9 genetic systems. The frequencies of occurrence of antigens and alleles (q) were determined by a conventional method. The level of homozygosity in locus (Ca) was calculated with the use of Robertson formula (Robertson, 1956). The number of effective alleles (Na) was determined by dividing the unit at the rate of homozygosity. Through the use of homozygosity coefficient was determined also the degree of genetic variation (V). Indicators of immunogenetic similarity (r) and the distance (d) between the two periods of research were determined by the (Serebrovsky, 1970).

The obtained materials were treated on a personal computer.

RESULTS AND DISCUSSIONS

The most common genetic characteristics of the population serve the data on the number of genetic systems, antigens and alleles in each system. In the study of the population of Holstein cattle, imported from the Netherlands to the Republic of Moldova, are found 49 antigenic factors controlled by allelic genes of 9 chromosome locus. In the antigenic spectrum of blood groups of the evaluated animals is revealed a fairly large range of variation of the frequency of their occurrence and the changes that have occurred in the population in the comparable period of the study. So in the AEA locus antigen Z′ at the animals of the second period of the studies was not revealed. It should be noted that this antigen is extremely rare in most cattle breeds, including Holstein, with the exception of Pinzgau and Sharole. Frequency of occurrence of antigen A_2 has increased and amounted to 0.4861.

In the AEB locus for the comparable periods of the research from 25 studied antigens are detected by 22 antigens. Antigens Q and B″ are not identified in both periods of studies, the antigen T_1 - in the first period of research and antigen Q′ - in the second study period, although the frequency of its occurrence in the first period was at the level of 0.5297.

It should be noted that in the analyzed periods of studies at animals of the given population of cattle is observed a high frequency of occurrence of antigens B_2, G_2, I_2, O_2, Y_2, E'_2 and G″ (Figure 1).

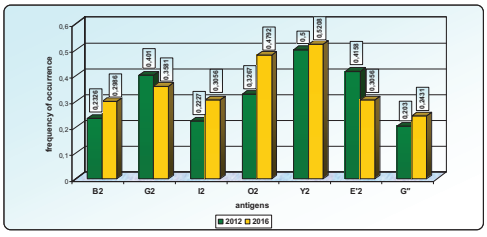

Figure 1. Antigens of AEB locus with a high frequency of occurrence in the dynamics

This is typical for Holstein, as well as to other breeds of black motley root (Popov and al., 2000), the Moldovan type of black motley cattle (Foksha et al., 2001).

During the analyzed period of time has happened an increase in the frequency of occurrence of such antigens as G_1 (0.0445-0.6597), B′ (0.1188-0.2500), D′ (0.1732-0.3611), K′ (0.0742-0.2639) and P′ (0.0396-0.4722). It is observed a decrease of the frequency of occurrence of the antigens I_1

(0.0841-0.0069), P_1 (0.0148-0.0069), G′ (0.2723-0.0556), I′ (0.01287-0.0694), O′ (0.3317-0.0556).

In the AEC- system from 10 studied antigens were identified all antigens, frequencies of occurrence antigens R_2, W decreased (0.3564-0.3403) and (0.4703-0.2986) (Figure 2).

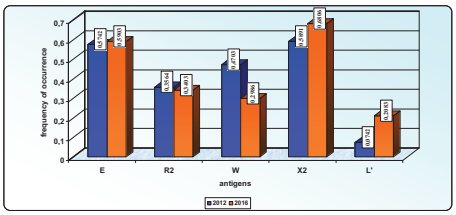

Figure 2. Dynamics of frequency of occurrence of certain antigens of AEC locus

It is observed an increase of the frequency of occurrence of antigens R_1 (0.0247-0.0833), E (0.5742-0.5903), X_2 (0.5891-0.6806), L′ (0.0742-0.2083). Our data confirm research (Podoba, 1997; Popov et al., 2003). The authors found similar antigens of AEC locus with a high frequency of occurrence inherent to Holstein, Canadian, Dutch and Ukrainian breeding respectively.

In the AEF system the frequency of occurrence of F antigen changed slightly towards increasing – 0.9356-0.9931. The same is observed in AEM- and AAZ- loci, the frequencies of occurrence of antigens M and Z have increased 0.0099-0.0208 and 0.5396-0.5417 (Figure 3).

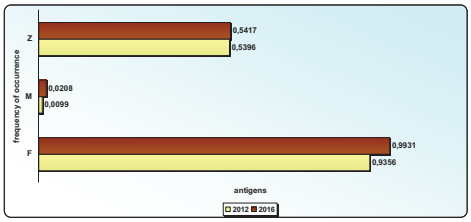

Figure 3. Dynamics of the frequency of occurrence antigens in one-factor loci

According to AES-locus from 6 studied the antigen U″ in the first period of research was not identified, in the second period the bearer of the given antigen was one animal (0.0069).

Most widespread antigen proved to be H′, the frequency of occurrence of antigens S_1, U′ increased, and antigens U, H″ - decreased, Figure 4. The saturation with antigenic factors during this period also increased, as the average frequency of antigens in 2016 is 25.0 against 23.7%.

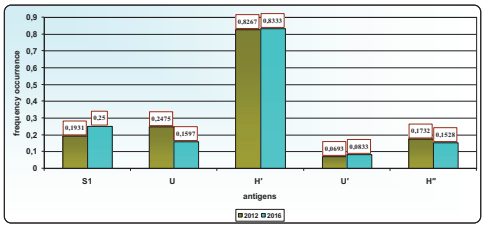

Figure 4. Dynamics of the frequency of occurrence of antigens of AES-locus

Currently the allelic diversity of AEB locus of the blood groups is the most informative and objective criteria for assessing the level of genetic variability. The number of alleles reflects the magnitude of genetic variability. The more alleles are found in a population, the greater is its genetic variability. In the the first period of investigations were identified 79 alleles in the second - 64 allele of AEB-locus.

During the period of studies were found 21 identical alleles, among which the main share in the structure of the allelophond occupy alleles B_2O_1 (0.0322-0.0729), $B_2O_1Y_2D'$ (0.0148-0.0243), $G_2Y_2E'_1Q'$ (0.1510-0.1215), I_2 (0.1163-0.1458), D′G′O′ (0.0569-0.0208), O′ (0.0223-0.0139), Q′ (0.0544-0.0451) and G″ (0.0421-0.0451) (Figure 5).

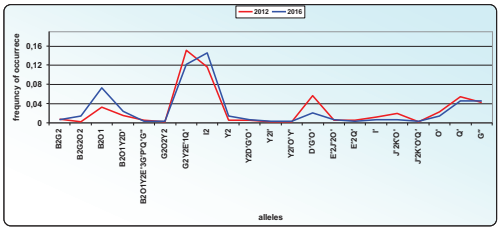

Figure 5. The dynamics of the frequency of occurrence of identical alleles of AEB-locus

Intensive use of the genophond of the black – motley, Dutch and Holstein breeds in a quality of improving in many countries, leads to a common genetic convergence. Thus, the majority alleles found among animals of the herd SLL "DokSanCom" are present in the studies (Litvinenko et al., 2014) in the allelophond of Dutch, Holstein, the German black –motley breeds.

Objective genetic characterization of the analyzed animal populations reflect and such factors as the coefficient of homozygosity (Ca), effective number of alleles of (Na), the degree of genetic variation (V coefficient) (Table 1).

Table 1. Genetic variation of Holstein population of cattle in dynamics (2012-2016)

No	Indicators	2012	2016
1.	In all investigated, heads	202	144
2.	The number of installed alleles: - basic - rare	 255 86	 154 53
3.	The total frequency of alleles: - basic - rare	 0.6312 0.2129	 0.5347 0.1840
4.	homozygosity coefficient, Cα	0.0501	0.0518
5.	The number of effective alleles, Na	20	19.3
6.	The degree of genetic variability, V	95.9	95.5

As it can be seen, the frequency of occurrence both basic and rare alleles in the first period of studies was higher than in the second and amounted to 0.6312-0.2129 and 0.5347-0.1840 accordingly. In the second period of investigations there was a slight increase of the level of homozygosity (Cα) – 5.0-5.2%, which is reflected in the number of effective alleles - 20 and 19.3 respectively. Low homozygosity coefficient (Cα) shows the high genetic diversity of the population of the studied Holstein cattle. The degree of implementation of the possible genetic variability (V) is fairly high, the differences are minor.

CONCLUSIONS

1. In the antigenic spectrum and in the allelophond of EAB-locus at cattle of the herd SRL "DokSanCom" prevail marker antigens and alleles typical to Holstein cattle, other breeds of black –motley roots, as well as Moldovan type of black-motley cattle.
2. The allelophond of Holstein breed of the herd SRL "DokSanCom" is quite diverse for conducting selection with the use of blood groups and the homozygosity level (5.0-5.2%) will allow to maintain breeding of 19-20 genetically different from each other structural units and ensure the current genetic variability of the given population of cattle.

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