

BIOLOGICAL FEATURES AND GENETIC VALUE OF THE LEBEDYN BREED IN THE NEED FOR ITS PRESERVATION ON THE TERRITORY OF UKRAINE

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Abstract

Research was conducted in the aspect of preservation the gene pool of aboriginal Lebedyn cattle in the Sumy region of Ukraine, which belongs to the brown breeds of the world. Cows of the Lebedyn breed are characterized by good indicators of milk productivity. Milk yield for 305 days of the first, third and highest lactation, respectively, amounted to 4,446, 5,281 and 5,292 kg of milk with a fat content of 3.82-3.87% and protein of 3.33-3.35%. The presence of lactose in the milk of Lebedyn cows ranged from 4.68-4.73%, and dry matter - 12.61-12.72%. A negative correlation was established between the amount of milk and the content of fat ($r=-0.014\dots-0.367$) and protein ($r=-0.051\dots-0.212$) depending on the estimated lactation. A fairly close and reliable positive correlation between protein and fat content was established ($r=0.326\dots0.651$), which allows effective indirect selection between these traits.

Key words: Lebedyn breed, milk yield, fat, protein, correlation

INTRODUCTION

It is a fact that few local breeds remain carriers of particularly valuable hereditary traits and allelic complexes, without which further breeding process would be one-sided. However, these breeds cannot compete with commercial specialized breeds in performance traits that determine their economic advantage. That is why there is a sharp decrease in the number of livestock and the network of breeding farms both in Ukraine and in Sumy region. Particularly acute is the problem of the gene pool preservation for small number of local animal species, whose disappearance decreases the biological diversity of the animal genetic resources and, even more lead to the loss of the national cultural heritage [4, 8, 17].

Large-scale breeding of the Holstein breed all over the world, as the best in milk production and conformation type, has led, according to D.T. Vinnichuk [19] to the fact that it actually became a world-class monobreed. Because of one-sided selection and the use of inbreeding, it loses important natural diversity value, especially reproductive ability, thereby

reducing the duration of productive use [15, 18].

From the point of view of economic efficiency, there is no objective justification for the use of highly productive Holstein breed in the conditions of Ukraine. The reduction in cow lifetime leads to the need for intensive herd replacement (at least 30% annually). As a result of this, the enterprise is forced to maintain virtually the entire number of cows born over the last two to three years in order to ensure the preservation of achieved herd size.

From an economic point of view, significant costs for raising replacement heifers, annually introduced into the herd to replace retired cows, are included in the cost of produced milk. Thus, a decrease in the fertility of Holstein cows cannot ensure the expanded formation of a herd, since the goal is to at least preserve the existing number of cows [2]. The excessive physiological load on specialized highly productive breeds, which is the Holstein breed, contributes to a decrease in adaptive qualities and often leads to various diseases. It is also important to take into account that Holstein cattle have a number of

hereditary defects that have a recessive type of inheritance [1, 9, 12, 17].

In terms of preserving the aboriginal breeds as carriers of various rare genetic blocks, which have important selection significance by the ability of these animals to be highly adaptable, resistance to common diseases, long period of productive use and the feature of excellent reproductive qualities. The same cannot be said about the Holstein monobreed, which has lost these properties that are important in breeding and economic values [5, 7, 14, 16].

Now in Ukraine, especially valuable, combined breeds of cattle productivity have almost disappeared, which, in the process of long-term selection, adapted to local feeding and housing conditions. These breeds include: gray Ukrainian, Ukrainian white-headed, brown Carpathian, red Polish, Lebedyn, and Pinzgau [11]. All of these listed breeds are included in the state gene pool conservation program. Among these breeds, especially brown ones, the most numerous is the Lebedyn, widespread in the Sumy region of Ukraine [10].

The process of intensification and specialization of the dairy cattle breeding industry with the widespread use of highly productive imported gene pool has necessitated the creation of new breeds of dairy livestock. They were formed by the method of absorptive crossbreeding of non-competitive aboriginal breeds with specialized dairy ones. With disappearance of aboriginal cattle, problem of preserving the gene pool of local breeds arose in many countries of the world, including Ukraine, which is only getting worse with time [11].

According to the current difficult situation, a set of selection and administrative measures aimed at protecting the Lebedyn breed is being developed. Her disappearance will lead to a depletion of genetic diversity and limited opportunities, including in the selection process to improve the newly created Ukrainian brown dairy breed. In this regard, scientists were tasked with an in-depth study of the genetic resources of brown cattle, monitoring the selection situation and, on their basis, developing methods for preserving

the gene pool of the Lebedyn breed, especially in a closed population [9].

The productivity level of animals in gene pool herds should not be a major feature for breeding, because the vast majority of aboriginal breeds for its productive life give more production and of a higher quality than specialized breeds.

Recently, scientific studies have focused on the economically beneficial features of animal husbandry being a result of crossbreeding Lebedyn breed with the Swiss breed, at intermediate stages, in the process of selection of the Ukrainian brown dairy breed. That is why, not much attention was paid to the study of milk productivity and, in particular, the qualitative composition of milk from this cattle.

9. It caused, the deficiency of information in the scientific literature about the biological value and technological properties of milk at the present stage of breeding of the Lebedyn breed.

The question of the conservation and development of such important hereditary "Lebedyn" traits with increased fat and protein content in milk remains relevant. In connection, the staff of the Sumy NAU conducted a purposeful study of the dairy productivity features of cows in the gene pool herd of the Lebedyn breed.

MATERIALS AND METHODS

Studies have been conducted in the breeding farm ZAO "Sad" situated in Okhtyrsky district Sumy region. The main physicochemical parameters of milk - fat, protein, lactose and dry matter were determined by infrared diagnostics method on the automatic milk quality analyzer "Laktoscope" produced by "Deltainstruments" (Holland). Milk samples from each cow of the herd were taken once a month according to the recommendations of DSTU 4834:2007 of Ukraine [13].

The coefficient of linear correlation was calculated by formula of Pearson:

$$r_{xy} = \frac{\sum(x_i - \bar{x}) \times (y_i - \bar{y})}{\sqrt{\sum(x_i - \bar{x})^2 \times \sum(y_i - \bar{y})^2}}$$

where:

x_i – value for variable X ;

y_i – value for variable Y ;

\bar{x} – average value for X ;

\bar{y} – average value for Y .

RESULTS AND DISCUSSIONS

The research of quantitative and qualitative indicators of milk from cows of the Lebedyn breed showed that the productivity background of dairy cattle in the region considering all forms of ownership, according to the last completed lactation yield was an average of 5,117 kg, according to the 2018 statistical data, and in experimental herd - 5,292 kg, proved the sufficient competitiveness of the animals of this unique breed (Table 1).

The average milk yield of first-lactation cows at the level of 4,446 kg meets the target standard for cows of Ukrainian brown dairy breed according to breeding program and points to the high potential of Lebedyn cattle, which is confirmed by the yield of the third lactation - 5,281 kg, which also meets the requirements of the target standard and proves its potential in the breeding process to further improvement of the Brown cattle population.

Since the quality of milk is an integral part of the milk productivity traits, the breeding value assessment of animals is impossible without determining the mass fraction of fat in the milk. Local combined breeds created as a result of long-term selection are usually characterized by a high fat content. Lebedyn cattle is no exception and also belongs to breeds that traditionally have high milk fat and milk protein content, as evidenced by reports from scientific sources [3].

The selection process of improving the milk productivity of the Lebedyn cows over the past three decades has not affected on significant variability the fat content in milk, as evidenced by our research results. Milk fat content varied from 3.82 % in the first to 3.87 % in the full-age third lactation. Values of these indicators exceed the fat content standard for milk of brown breeds by 0.12-0.17 %. The level of variability coefficients of

fat content in the milk of experimental herd is significant, as for a selected trait (3.93-5.67 %), which creates the opportunity for effective selection of animals based on fat content.

Table 1. Indicators of dairy productivity and quality components content in the milk of Lebedyn breed on the farm ZAO "Sad"

Feature	n	$\bar{x} \pm S.E.$	Cv, %
First lactation:			
milk yield, kg	39	4.446±138.9	19.52
% fat		3.82±0.032	5.21
kgfat		169.7±5.25	19.31
% protein		3.33±0.025	4.61
Kg protein		147.9±4.49	18.95
% lactose		4.73±0.020	2.64
% dry matter		12.61±0.072	3.56
Second lactation:			
milk yield, kg	26	4,605±119.8	13.27
% fat		3.85±0.030	3.93
kgfat		177.1±4.19	12.06
% protein		3.34±0.033	4.97
Kg protein		153.8±3.97	13.15
% lactose		4.72±0.021	2.27
% dry matter		12.72±0.066	2.64
Third lactation:			
milk yield, kg	45	5,281±57.6	7.32
% fat		3.87±0.033	5.67
kgfat		204.8±2.87	9.41
% protein		3.34±0.023	4.57
Kg protein		176.5±2.22	8.43
% lactose		4.68±0.024	3.39
% dry matter		12.72±0.060	3.16
Total heard:			
milk yield, kg	171	5,292±78.2	19.34
% fat		3.83±0.015	5.27
kgfat		202.4±3.01	19.43
% protein		3.35±0.013	4.94
Kg protein		177.1±2.65	19.59
% lactose		4.70±0.010	2.82
% dry matter		12.66±0.029	3.01

Source: Own calculations.

The next, no less important indicator of milk quality is its protein content, which in terms of selection and economic significance is not inferior to fat content. In general, the most essential components of milk, such as protein, sugar and minerals, characterize the healthy properties of this product. The importance of milk protein is due not only to its high nutritional value, but also to its content of essential amino acids. In addition, protein is the main source of calcium and phosphorus,

easily absorbed by the human. The protein level of milk is a useful component for the production of canned milk and cheese.

The content of protein in milk of the Lebedyn cows ranged from 3.33-3.35 %, depending on lactation, exceeding the breed standard for brown cattle by 0.03-0.05 %. Comparing the obtained protein level with indicators given by author of the Lebedyn breed A. E. Yatsenko [6], it decreased significantly (by 0.20% of its minimum value). In the future, it needs selective improvement using the method of rational, informed selection of animals with high values.

Lactose or milk sugar is not a constituent element that is massively assessed for milk selection and processing. However, the taste of milk depends on lactose, which is the main carbohydrate of the disaccharide group of milk. The structural elements of which are glucose and galactose. Lactose in milk is the most stable component. The lactose content remains almost unchanged during lactation. Lactose plays an important role in maintaining constant osmotic pressure in the blood-milk system. It determines the volume of water secreted in milk and is the main factor determining the level of milk yield, therefore its fluctuations in milk are much lower than fat and protein.

The average lactose content in the milk of Lebedyn breed cows was 4.68-4.73 % with the lowest level of variability in coefficients of variation – 2.27-3.39 %, when compared with fat content (3.93-5.67%) and protein (4.57-4.97%). The average level of dry matter in the milk of cows of the Lebedyn breed also does not vary significantly; it depends on the content of the dry matter components of skim milk and milk fat and varies within the calculated lactation from 12.61%, according to the first, to 12.72% of the data for the second and third lactations.

Selection of the cattle for several traits of milk productivity will be more effective if there is a close correlation between selected traits. Therefore, in the process of animal selection, it is important to monitor the level of

correlation variability between the amount of milk yield and milk components, Table 2.

Long-term practice of breeding dairy cattle has proven that, as a rule, there is a negative relationship between the level of milk yield and fat content in milk, which complicates selection and breeding work on these two traits in the direction of their simultaneous growth. The results of our research were no exception to the rule, since the correlation between milk yield and fat content in the milk of the Lebedyn cows also turned out to be negative.

Its negative grade was highly variable and dependent on the estimated lactation. The lowest level of negative correlation was found according to the second lactation data (-0.367) with reliability at $P < 0.05$. The overall trend for negative correlation of milk yield-fat content is characterized by the total amount of cows in the whole herd ($r = -0.114$), although it is not reliable.

A similar situation was observed in the estimation of the correlation coefficients of milk yield – protein content in the milk of Lebedyn breed cows, the degree of which with a negative value varied within $r = -0.076... -0.212$.

The lactose content in milk, according to the unreliable values of the correlation coefficients, is almost independent of the milk yield as well as the dry matter content.

A sufficiently close and reliable positive correlation between protein and fat content ($r = 0.326... 0.651$), especially according to the first lactation and taken in a whole herd, proved the possibility of indirect breeding on any of these important selection traits.

The indicators of the degree of positive correlation coefficients between these traits show to what extent the percentage of dry matter in milk depends on other milk constituents - fat, protein and lactose, strongly show. The highest content of the dry matter content is affected by the fat content of milk, as proved by the highest correlation coefficients ($r = 0.680... 0.791$) and reliability ($P < 0.001$).

Table 2. Correlation between the traits of milk productivity in cows of the Lebedyn breed on the farm ZAO "Sad"

Lactation	feature	% fat	kgfat	% protein	Kg protein	% lactose	% dry matter
First (n=39)	Milk yield, kg	-0.152	0.963	-0.183	0.970	0.256	-0.085
	% fat	-	0.116	0.651	-0.002	0.030	0.791
	kgfat	-	-	-0.014	0.973	0.247	0.113
	% protein	-	-	-	0.057	-0.170	0.563
	Kg protein	-	-	-	-	0.201	0.040
	% lactose	-	-	-	-	-	0.334
Second (n=26)	Milk yield, kg	-0.367	0.950	-0.212	0.934	0.022	-0.253
	% fat	-	-0.062	0.437	-0.206	-0,044	0.717
	kgfat	-	-	-0.092	0.931	-0.004	-0.043
	% protein	-	-	-	0.149	0.119	0.740
	Kg protein	-	-	-	-	0.053	0.011
	% lactose	-	-	-	-	-	0.399
Third (n=45)	Milk yield, kg	-0.004	0.783	-0.051	0.846	0.039	0.034
	% fat	-	0.615	0.326	0.178	-0.118	0.680
	kgfat	-	-	0.162	0.777	-0.057	0.444
	% protein	-	-	-	0.488	0.115	0.666
	Kg protein	-	-	-	-	0.088	0.386
	% lactose	-	-	-	-	-	0.428
Total for the herd (n=171)	Milk yield, kg	-0.114	0.960	-0.076	0.967	-0.049	-0.066
	% fat	-	0.164	0.432	-0.002	0.001	0.730
	kgfat	-	-	0.044	0.959	-0.054	0.129
	% protein	-	-	-	0.178	-0.025	0.630
	Kg protein	-	-	-	-	-0.065	0.089
	% lactose	-	-	-	-	-	0.364

Source: Own calculations.

Almost at the same level, the dry matter content is influenced by the protein content with the corresponding coefficients ($r = 0.563... 0.740$; $P < 0.001$). The relatively lower correlation coefficients of lactose – dry matter, which variability varied somewhat within the accounted lactations ($r = 0.334... 0.428$) and their reliability ($P < 0.05–0.001$), also proved the dependence of milk dry matter on milk sugar content.

CONCLUSIONS

Generalized data of the milk samples analysis from cows of the Lebedyn breed for the content of fat, protein, lactose and dry matter indicate about general biological patterns of

the dynamics of its quality indicators depending on heredity, physiological condition and paratypical factors.

The established tendency to a significant decrease in protein in milk of cows of the Lebedyn breed testifies to the necessity of taking under the careful control the breeding situation for the evaluation of milk constituents and selection of the sires with high breeding value for protein milk.

At the present stage, in the selection herds where in-depth breeding work is carried out, it is necessary to include the abovementioned indicators of milk quality in the complex assessment of breeding traits. It will enable to estimate the brown cattle animals on these very important grounds, to determine

perfectly the influence of genotypic and paratypical factors on their content, to study the genetic parameters of the relationship and to develop specific breeding measures based on the obtained results, which will promote to increase fat and protein content in milk.

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