Evaluation of the productive qualities of Holstein dairy cattle

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Abstract. Sverdlovsk region is one of the leading regions in milk production. The main livestock of dairy cattle is represented by the Holstein breed, obtained as a result of long-term use of the global gene pool of Holstein servicing bulls. The assessment of the productive qualities of dairy cattle of the Holstein breed, including consideration of linear origin, is relevant and has practical significance. As a result of the conducted research, it was found that the farm is dominated by the number of cows of the Vis Back Ideal line, which account for more than 65.8% of the total number of cows. There is an unreliable insignificant difference in favor of cows of the Reflection Sovering line between groups of animals of different genealogical lines for the first and third lactation. With age, there is a decrease in milk quality indicators, such as FMF and PMF in milk from cows of all genealogical lines, which confirms the natural negative relationship between milk yield and milk quality indicators. The absorption of dairy black-and-white cattle of the domestic breed by the gene pool of the world's most abundantly dairy breed, the Holstein, led to an increase in milk yields and the milk yield coefficient of these cows is much higher than 1000 kg. Despite the fact that the difference in milk yield is unreliable and the variation of the trait within each group along the line is quite significant, this is indicated by indirect traits such as the coefficient of milk production, milk yield for full-age lactation, etc., origin affects the productive qualities of cows.

1 Introduction

An important task that stands and is being solved by the workers of the agro-industrial complex of the country is to ensure the country's food security in the production of high-quality, full-fledged food products. This is possible due to the increased development of agriculture in general and dairy cattle breeding in particular. Milk and the main amount of beef are obtained from dairy cattle. The main livestock of the dairy herd of the Sverdlovsk region is represented by the Holstein breed, obtained as a result of long-term crossing of queens of the black-and-white breed of the Ural offspring with servicing bulls of the Holstein one [1-3]. These are highly productive, large animals with differences in economically useful and biological parameters from the original breeding stock. They are distinguished by high milk yields, strong constitution, good suitability for use in industrial

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milk production, typification by exterior and phenotypic indicators. In the process of their operation, certain problems have been identified, which are related to: a decrease in the duration of productive use, which is associated with a deterioration in reproductive abilities; increased demands on feeding and housing, etc. [5-8]. The productive qualities of cows are influenced by many factors, including genetic ones, such as genotype, selection method, and origin. In this regard, the assessment of the productive qualities of dairy cattle of the Holstein breed, considering the linear origin, is relevant and has practical significance.

The purpose of the work is to evaluate the productive qualities of dairy cattle of the Holstein breed, including consideration of the linear origin.

2 Materials and Methods

The experimental part of the work was carried out in the period from 2022 to 2023 in a typical breeding reproducer for the Sverdlovsk region for Holstein cattle breeding. The material and data for comparison were the IAS "SELEX-Dairy Cattle" database, the results of their own research. The indicators of milk productivity were evaluated according to the last completed lactation. Milk productivity was assessed based on the results of control milking once a month. FMF and PMF in milk were determined monthly in an average milk sample from each cow in the dairy laboratory of the Uralplemcenter and the Department of Biotechnology and Food Products of the Ural State Agrarian University. The yield of nutrients with milk was calculated – the amount of milk fat and milk protein, the coefficients: milk content, BEC and BAF.

3 Results and Discussion

The cattle breeding along genealogical lines is the apogee of breeding work. The breeding reproducer for Holstein cattle has a breeding stock of two genealogical lines - Vis Back Ideal and Reflection Sovering, and 4 first-born heifers who completed the first lactation belong to the Siling Trajun line, which indicates the farm's decision to increase genetic diversity in the herd.

Figure 1 shows the structure of the herd by linear affiliation.

Fig. 1. The structure of the dairy stock along genealogical lines.
The figure clearly shows that the farm is dominated by the number of cows of the Vis Back Ideal line, which account for more than 65.8% of the total number of cows. The animals of the Siling Trijun line are only 0.6%.

The population of Holstein cattle is characterized by a significant level of presence of inbred animals in the dairy herd, obtained as a result of related mating. A variety of cows of different linear origin reduces the risk of inbred depression.

Figure 2 shows data on the inbreeding coefficient of livestock along the lines.

**Fig. 2.** Inbreeding coefficient of cows of genealogical lines.

The inbreeding coefficient of the breeding stock of the main lines of Holstein cattle used in the farm is very high and indicates a decrease in variability within each group and its genetic diversity, which can lead to inbred depression in the herd. In this regard, it is necessary to increase genetic diversity by using bulls of other genealogical lines and cross-lineages to reduce the inbreeding coefficient.

Data on cow productivity for the first and third lactation are presented in table 1.

**Table 1.** Dairy productivity of cows.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Line</th>
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<tbody>
<tr>
<td></td>
<td>Vis Back Idal</td>
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<tr>
<td>Milk yield per 1 lactation, kg</td>
<td>8562.8±1521.6</td>
</tr>
<tr>
<td>MJ, %</td>
<td>4.02±0.036</td>
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<tr>
<td>Amount of milk fat, kg</td>
<td>343.7±63.76</td>
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<tr>
<td>MDB, %</td>
<td>3.24±0.164</td>
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<tr>
<td>Amount of milk protein, kg</td>
<td>277.7±51.40</td>
</tr>
<tr>
<td>BACK</td>
<td>190.75±27.25</td>
</tr>
<tr>
<td>PBC</td>
<td>131.81±18.45</td>
</tr>
<tr>
<td>Milk yield for 3 lactation, kg</td>
<td>8894.8±1807.7</td>
</tr>
<tr>
<td></td>
<td>MJ, %</td>
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<tr>
<td></td>
<td>3,85±0,264</td>
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<tr>
<td></td>
<td>3,88±0,270</td>
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There is an unreliable insignificant difference in favor of cows of the Reflection Sovering line between groups of animals of different genealogical lines after the first lactation. There was no trend of higher milk yields in these cows, as evidenced by the high coefficient of variation of this trait in the first heifers of the Vis Back Ideal and Reflection Sovering lines of 17.77 and 17.27%, respectively, along the lines. A large difference was observed between groups of cows on the third lactation at 677.9 kg in favor of cows belonging to the genealogical line of Reflection Sovering (the difference is unreliable at P≥0.05). The variability coefficient for the main genealogical lines was 20.32 and 22.30%. With age, there is a decrease in milk quality indicators, such as FMF and PMF in milk from cows of all genealogical lines. This confirms the natural negative relationship between milk yield and milk quality indicators, when milk quality indicators decrease with an increase in milk yield.

Indicators of the biological efficiency of the cow and the coefficient of biological usefulness were higher in the first heifers and cows of the Reflection Sovering line.

The productivity of cows, namely milk yield, increases with increasing body weight. The change in the live weight of the breeding stock of bred genealogical lines of Holstein cattle is presented in figure 3.

**Fig. 3. Dynamics of live weight of cows, kg.**

The live weight at the first insemination of cows of different genealogical lines is approximately the same, even despite some difference in favor of cows of common lines relatively new – Siling Trajun, since this difference is associated with the difference in the age of heifers. The live weight of the first heifers and cows at the third calving was the same for cows regardless of belonging to the genealogical line.

The milk content coefficient shows how much milk is received from a cow for every 100 kg of live weight. The absorption of dairy black-and-white cattle of the domestic breed
by the gene pool of the world's most abundantly dairy breed, the Holstein, led to an increase in milk yields and the coefficient of milk production in these cows is much higher than 1000 kg (fig. 4).

Fig. 4. Milk content coefficient.

In the main lines of Holstein cattle in the dairy herd of the organization, the milk production coefficient exceeds 1400 kg of milk for every 100 kg of live weight. Cows of the Reflection Sovering line increase milk production per unit of live weight with age and an increase in live weight after the third lactation, and cows of the Vis Back Ideal line remain at the same level as those of the first heifers, despite an increase in their live weight. This confirms the data on an increase in productivity with age and achievement of physiological maturity, when the animal naturally shows the best results in terms of productive qualities.

4 Conclusion

Thus, a general conclusion can be drawn that the origin has an impact on milk productivity indicators, despite the fact that the difference is unreliable and the variation of the trait within each group along the line is quite significant, this is indicated by indirect traits such as the coefficient of milk production, milk yield for full-age lactation, etc. With age, the milk yield of cows naturally increases with a natural decrease in the indicators of FMF and PMF in milk. Similar data were obtained in the studies of O.G. Loretz, O.V. Gorelik [3]; O.V. Gorelik, S.Yu. Harlap [6] and others.

References