Productive qualities of cows and their relationship depending on the kappa-casein genotype

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Abstract. Due to the rapid development of cheese making, questions arise about obtaining milk with the properties necessary for their production, which are determined, among other things, by heredity. There is a need to evaluate cows of different genotypes by kappa-casein to make a decision on their breeding. The purpose of the work is to study the productive qualities of Holstein cows and their relationship depending on the kappa-casein genotype. As a result of the conducted studies, it was found that cows with the kappa-casein BB genotype exceeded their peers from other groups by 452.35 kg (AA genotype) and 291.33 kg (AB genotype) or by 4.2–2.7% in milk yield for the first lactation. Cows with the kappa-casein genotype AB and BB have stable lactation activity characterized by high milk yields in the second half of lactation, whereas cows with the AA genotype have a decrease in milk yield. Cows with the kappa-casein AA and AB genotype have a negative correlation between milk yield and PMF in milk, while they are positive between milk yield and FMF in milk. The correlation coefficient between milk quality indicators – FMF and PMF in cows with the AA and AB genotypes was positive, while in animals with the BB genotype it was low and negative. Thus, it can be said that cows with different kappa-casein genotypes differ in indicators of the relationship between productive traits.

1 Introduction

In a message to the Federal Assembly, which took place on February 29, 2024, the President of the country set new tasks for the development of agriculture in general and animal husbandry in particular. At the present stage of development of dairy cattle breeding, high results have been achieved in ensuring milk production and the task is not only to preserve the achievements obtained, but also to increase them. For this purpose, highly productive breeds of dairy cattle are used in the country. In the last few years, it has been mainly represented by animals of a new breed formation, the Holstein, obtained as a

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result of long-term absorption crossing of domestic dairy cattle with servicing bulls of the
global gene pool of the Holstein breed [1-3]. As a result, a large array of crossbreeds was
created, having a high blood level for the Holstein breed - over 87.5%. These are highly
productive, large animals with differences in economically useful and biological parameters
from the original breeding stock [3]. Holstein cows differ in economically useful and
biological characteristics depending on the breeding region, since the improvement of
domestic dairy cattle was carried out on the breed resources of the corresponding breeding
zone [4]. Despite this, it is possible to identify certain problems in their breeding, common
to the entire population of Holstein cattle: a decrease in the duration of productive use,
deterioration of reproductive abilities, increased demands on feeding and maintenance [5].
Since the goal of breeding the Holstein breed was to obtain animals with high milk yield
indicators to provide consumers with milk, it was characterized by reduced indicators of
FMF and PMF in milk, which also affected its technological properties when processed into
dairy products. Due to the rapid development of cheese making, questions arise about
obtaining milk with the properties necessary for their production, which are determined,
among other things, by heredity. There is a need to evaluate cows of different genotypes by
kappa-casein to make a decision on their breeding [6]. The study of the kappa-casein
genotype effect on the dairy productivity of cows is relevant and has scientific and practical
significance. In this regard, the characteristics of the growth of repair young animals,
depending on belonging to the servicing bull, are relevant and have practical significance.

The purpose of the work is to study the productive qualities of Holstein cows and their
relationship depending on the kappa-casein genotype.

2 Materials and Methods

The experimental part of the work was carried out in the period from 2022 to 2023 in a
typical Holstein cattle breeding facility for the Moscow region. The studies were conducted
on Holstein cows after the first lactation. There were 3 groups of first-calf heifers,
depending on the kappa-casein genotype: group 1, cows with the AA genotype; group 2 –
AB and group 3 – BB, kappa-casein. Milk productivity was assessed by milk yield for 305
days of lactation, FMF and PMF in milk. Milk yield was determined by control milking
once a month; FMF and PMF in milk monthly in the average milk sample from each cow. Correlation coefficients between milk characteristics were calculated.

3 Results and Discussion

Studies have shown that cows with the kappa-casein BB genotype outperformed their peers
from other groups by 452.35 kg (genotype AA) and 291.33 kg (genotype AB) or by 4.2-
2.7% in milk yield for the first lactation (Table 1).

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Kappa-casein genotype</th>
<th>On average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AA</td>
<td>AB</td>
</tr>
<tr>
<td></td>
<td>X± Sx</td>
<td>Cv</td>
</tr>
<tr>
<td>Milk yield for</td>
<td></td>
<td></td>
</tr>
<tr>
<td>305, kg</td>
<td>10229,92</td>
<td>±169,40</td>
</tr>
<tr>
<td>Fat, %</td>
<td>4,00±0,01</td>
<td>2,00</td>
</tr>
<tr>
<td>Protein, %</td>
<td>3,21±0,01</td>
<td>1,36</td>
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</tbody>
</table>
Stability coefficient, %

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Milk Yield</th>
<th>Fat, %</th>
<th>Protein, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA</td>
<td>11.9</td>
<td>1.36</td>
<td>0.85</td>
</tr>
<tr>
<td>AB</td>
<td>14.13</td>
<td>1.42</td>
<td>0.86</td>
</tr>
<tr>
<td>BB</td>
<td>12.07</td>
<td>1.01</td>
<td>1.66</td>
</tr>
<tr>
<td>On average</td>
<td>13.02</td>
<td>1.11</td>
<td></td>
</tr>
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</table>

In accordance with the general patterns of lactation activity of cows, the relationship between milk yield and milk quality indicators confirms a decrease in the latter with an increase in milk yield. They were lower in the milk of cows with the kappa-casein BB genotype, and higher in the milk of cows with the AA genotype. The milk of cows with the AB genotype occupied an intermediate position. The most common indicators for characterizing the lactation curve are the coefficient of lactation stability (CLS), which is used to assess the level of drop in milk yield over the productive period. In our case, it turned out that cows with the kappa-casein genotype AB and BB have stable lactation activity characterized by high milk yields in the second half of lactation, whereas cows with the AA genotype have a decrease in milk yield.

When conducting breeding work with a dairy herd, an indicator such as the coefficient of variability of a particular trait plays a certain role, the higher it is, the greater its diversity in the herd, which allows for more efficient selection. The data on the variation coefficient is clearly presented in figure 1.

**Fig. 1.** Coefficient of variation of milk characteristics in cows of different genotypes, %.

The highest variability coefficients are established by the milk yield of cows. They ranged from 11.9% (AA genotype) to 14.13% (AB genotype). This allows to say that in all groups of cows it is possible to select according to productive qualities, such as milk yield, since there is a variety of traits. There were smaller differences in the groups for FMF and PMF in milk.

Calculations of the correlation coefficient between dairy characteristics were carried out to establish the possibility of their use in planning further work on improving the herd. The diagram (figure 2) shows the correlation coefficients between milk yield and FMF (PMF) in the milk of cows of different genotypes.
Fig. 2. Correlation coefficients between milk yield and MJ (MDB) in milk of cows of different genotypes.

It was found that cows with the kappa casein AA and AB genotype have a negative correlation between milk yield and PMF in milk, while they are positive between milk yield and FMF in milk. That is, when selecting cows for milk yield, it can be assumed that at the same time there will be an increase in FMF in milk and a decrease in PMF. In the group of cows with the BB genotype, on the contrary, a positive correlation coefficient was obtained between milk yield and PMF, and a negative one between milk yield and fat in milk. Therefore, when working with a group of animals with the BB genotype, it is necessary to consider other traits.

The majority of dairy animals in herds have a positive relationship between milk quality indicators and only a part of them do not confirm this position. We evaluated the conjugacy of FMF and PMF in the milk of cows of different genotypes according to kappa casein (figure 3).
Calculations of the correlation coefficient between milk quality indicators – FMF and PMF showed that in cows with the AA and AB genotypes they are positive, while in animals with the BB genotype they are low negative. Thus, it can be said that cows with different kappa-casein genotypes differ in indicators of the relationship between productive traits. Animals with the BB genotype are just those animals that to some extent do not confirm the general pattern of changes in productive traits in the herd. In this regard, for effective work on improving the breeding stock in breeding enterprises, it is necessary to consider the genotype of animals according to kappa-casein.

4 Conclusion

Based on the above, it follows that cows with different kappa-casein genotypes differ in milk productivity and a tendency to increase milk yield in cows with the BB genotype has been revealed. Higher levels of FMF and PMF in milk were observed in cows with the AA and AB genotypes, which is due to the general pattern of lactation activity – with a decrease in milk yield, milk quality indicators increase. Cows with the BB genotype differ in indicators of conjugation between dairy traits. Similar studies have been conducted by O.V. Gorelik, D.A. Afonina, A.A. Belookov, S.L. Safronov, N.I. Kulmakova, I.V. Bobyleva [4] and others.

References

4. O.V. Gorelik, D.A. Afonina, A.A. Belookov, S.L. Safronov, N.I. Kulmakova, I.V.
Bobyleva, Agrarian Science, 7-8, 110-113 (2022).
