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Влияние генотипа по каппа-казеину на молочную продуктивность и выбраковку коров

РЕЗЮМЕ

Для производства молока используют породы высокопродуктивных животных молочного направления продуктивности отечественной и зарубежной селекции. К таким породам относится черно-пестрая порода, которая составляет более 51% от общего поголовья крупного рогатого скота в стране, и голштинская, удельный вес которой — более 15% и постоянно увеличивается. Установлено, что коровы с разным генотипом по каппа-казеину различаются по сыропригодности молока. Изучение влияния генотипа по каппа-казеину на продуктивные качества животных и причины выбраковки коров актуально. Больше всего в стаде оказалось коров с генотипом АА, а меньше — 3,8% —с наиболее благоприятным генотипом ВВ. У них был выше удой: достоверной разницы между удоем коров с генотипом ВВ и генотипами АА и АВ не установлено, но явно прослеживается тенденция по превосходствупервых. Больший удой обуславливает больший выход с молоком питательных веществ. Больший удельный вес на выбраковку коров по первой лактации пришелся на группу с генотипом по каппа-казеину АВ. Меньший показатель оказался в группе коров с генотипом ВВ.

Ключевые слова: каппа-казеин, коровы, генотип, молочная продуктивность, выбраковка коров, удой

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Influence of kappa-casein genotype on milk yield of cows and on culling of cows

ABSTRACT

For production of milk the breeds of highly productive dairy cows of domestic and foreign selection are used. These breeds include the Black-and-white mottled breed, which makes up more than 51% of the total cattle herd in Russian Federation, and the Holstein breed, which share is more than 15% and is constantly increasing. It has been established that cows with different kappa-casein genotypes differ in usability of their milk for cheese production. The research of influence of kappa-casein genotype on milk yield capabilities of cows and the reasons for culling of cows is relevant and of interest nowadays. The biggest share of the herd consists of cows with AA genotype, and the least share, 3.8%, consists of the most favorable BB genotype cows. These cows feature higher milk yield. Though there was no significant difference between the milk yield of cows with genotype BB and genotypes AA and AB, but a tendency for BB genotype superiority was clearly observed. The higher milk yield determines a higher yield of nutrients with milk. The group with the AB kappa-casein genotype accounted for a greater share of culled cows in the first lactation period. The lower rejection rate was recorded in the group of BB genotype cows.

Key words: kappa-casein, cows, genotype, milk productivity, culling of cows, milk yield

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Introduction

Food safety of any state is the most important task of workers in the agricultural and industrial sphere. At the same time, great importance is put upon the development of dairy cattle breeding and raising. The cows provide the valuable food products — milk and beef. For milk production, the breeds of highly productive cows of pure dairy type of productivity of domestic and foreign selection are used [1–6].

These breeds include the Black-and-white mottled breed, which accounts for more than 51% of the total cattle herd in the Russian Federation. In second place is occupied by Holstein breed of cattle, which share accounts to more than 15% and is constantly increasing. Since the 80s yearsof the XX century, the improvement of Black-and-white cattle has been constantly carried out using the gene pool of the world's best breed — Holstein breed. A large array of Holsteinized black-and-white mottled cattle was derived in many regions of our country. Those breeds differ among themselves in economically useful traits and exterior features; the differences and features are related to the breeding zone and breed resources used in the crossing [7–12].

Along with the positive traits of Holstein cattle, which are expressed in high milk yield and enhanced suitability for machine milking, some certain problems have been revealed also. One of these problems is a reduction of cows productive longevity [13–17].

Together with an increase of share ofHolstein breed genetics in the crossing of cows, the researchers also observed decrease in the technological properties of milk during its deep processing for cheeses production. It has been established that cows with different genotypes for kappa-casein differ in usability of their milk for cheese production. The study of influence of genotype for kappa-casein on productive qualities of cattle and reasons for culling of cows from the herd make it possible to develop measures for selection and breeding in the herd.

Materials and method

The research was carried out in one of the breeding farms of Sverdlovsk region for breeding of Holsteinized black-and-white cattle. To carry out the research, we used the "Selex" program database, the database of zootechnical and pedigree registration data. Milk yield was assessed by control milking once per month, mass fraction of fat (MFF) and mass fraction of protein (MFP) were determined in a control sample of milk from each cow on a monthly basis using a milk tester.

The amount of milk fat and milk protein was calculated according to generally accepted formulas. The cows that finished lactation were divided into groups depending on their genotype for kappa-casein. Group 1 consisted of AA genotype; group 2 consisted of AB genotype, and group 3 was represented by BB genotype cows.

Reasons for culling of cows were established on the basis of veterinary records, culling reports, and results of autopsy.

Results and discussion

It is known that cows with BB genotype for kappa-casein have the best technological properties of milk, but their quantity in herds of Holsteinized black-and-white mottled cattle is insignificant (Figure 1).

It was found that cows with AA genotype made the biggest share in the herd, and the least share, 3.8%, was represented with the most favorable BB genotype cows.

The important breeding trait, which is used for assessment and selection of dairy cattle, is the milk yield, i.e. milk productivity. The milk yield of cows of different genotypes for kappa-casein differed among them from group to group (Table 1).

The table shows that the cows with BB genotype for kappa-casein showed higher milk yield. Due to the large statistical error caused by diversity of this trait in the group of cows, the significant difference between the milk yield of cows with genotype BB and genotypes AA and AB has not been established, but a tendency for the superiority of BB genotype is clearly distinguished. A higher milk yield determines a higher yield of nutrients with milk. The quality indicators of milk, namely MFF and MFP in milk, were stable, and did not change across groups of cows with different genotypes.

The diversity of the yield values and stability of milk yield, as well as MFF and MFP in the milk of cows of different genotypes can be seen by its fluctuations among the cows (Table 2).

The kappa-casein genotype influences the variability of milk yield in the groups of cows. Thus, the greatest variations of milk yield per lactation and milk quality indicators were found in the group of AA genotype cows. The cows with AB genotype showed lower variability in milk yielding capacities. The least variability was observed in the group of cows with BB genotype, especially in terms of MFP in milk, which confirms an increase in the technological properties of milk in terms of the production of food with high content of protein.

The genotype of the cows provided a certain influence on the rate of culling of the cows from the herd (Figure 2).

As can be seen in the figure above, the group with the AB kappa-casein genotype accounted for a greater rate of culling of cows in the first lactation period. The lower rate was found in the group of cows with BB genotype. It should be noted that only 2 heads from this group wereculled, one cow — due to barrenness, another cow — due to digestive

Table 1. **Milk yield of cows depending on kappa-casein genotype**

Indicator	Genotype		
	AA	AB	BB
Milk yield for lactation, kg	9222.00±74.64	9058,00±110.15	9595,00±300.95
MFF, %	3.950±0.005	3.940±0.004	3.950±0.024
MFP, %	3.230±0.003	3.230±0.003	3.24±0.01
Amount of milk fat, kg	364.00±2.97	357.00±4.40	380.00±12.63
Amount of milk protein, kg	298.00±2.44	292.00±3.57	311.00±10.02
Nutrient yield, kg	662.00±5.03	649.00±7.92	691.00±21.91

Table 2. **Variety of milk yielding capacity in groups of cows different by genotype**

Genotype	Milk yield per lactation, kg			MFF, %			MFP, %		
	max	min	difference	max	min	difference	max	min	difference
AA	5660	11396	5736	7054	12005	4951	7106	11377	4271
AB	3.86	4.34	0.48	3.85	4.22	0.37	3.90	4.22	0.32
BB	3.05	3.41	0.36	3.08	3.36	0.28	3.20	3.35	0.15

Fig. 1. The shares of genotypes in the breeding livestock, %

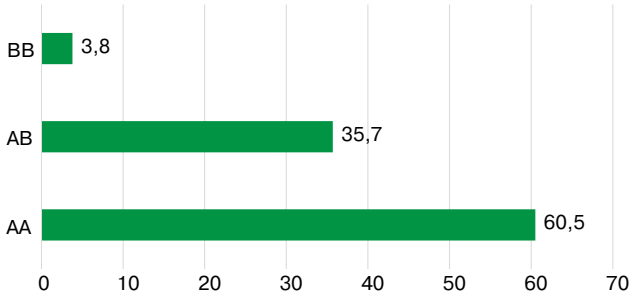

Fig. 2. Culling of cows depending on the genotype, %

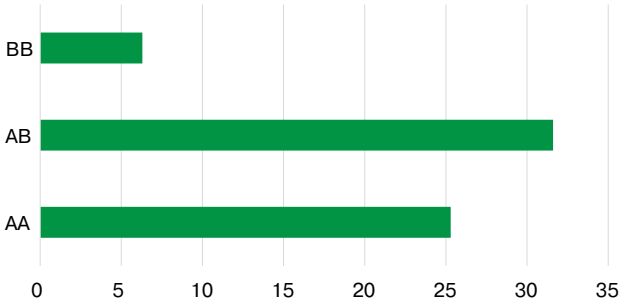

Table 3. **Reasons for rejection of cows by group of disease as a percentage of culled livestock, %**

Reason of culling	Genotype			On average
	AA	AB	BB	
Reproductive system pathology	4.5	9.6	50.0	6.5
Mammary gland pathology	25.0	19.4	-	22.1
Respiratory system pathology	2.3	-	-	1.3
Digestive system pathology, including food poisoning	18.2	25.8	50.0	24.7
Metabolic pathology	2.3	6.4	-	2.6
Injuries and surgical diseases	27.4	30.1	-	27.3
Breeding selection criteria	20.5	9.7	-	15.5

Table 4. **Detailing of reasons for culling of cows, %**

Reason of rejection	Genotype		
	AA	AB	BB
Reproductive system pathologies, including:	4.5	9.6	50.0
gynecological diseases	-	3.2	-
difficult childbirth and complications	-	3.2	-
barrenness	4.5	3.2	50.0
Mammary gland pathologies, including:	25.0	19.4	-
mastitis	25.0	19.4	-
Respiratory system pathologies, including:	2.3	-	-
respiratory system diseases	2.3	-	-
Injuries and surgical diseases, including:	27.4	30.1	-
limb diseases	11.4	12.9	-
tear and stretch	11.4	6.5	-
accidents	4.6	12.9	-
Digestive system pathologies, including poisoning	18.2	25.8	50.0
Digestive system diseases	18.2	25.8	50.0
Metabolic pathology	2.3	3.2	-
Breeding selection criteria, including:	20.5	9.7	-
low milk yield	20.5	9.7	-

system disease. The reasons for the culling of cows are presented in Table 3, arranged by groups of factors.

The table shows that the main reasons for culling of cows are arranged by their specific share as follows: injuries and surgical diseases; pathology of the digestive system and pathology of the mammary gland, namely mastitis. We can say that this is caused by the technology of milking on the dairy farm. The reasons for the culling of cows of different genotypes for kappa-casein differ by disease group. We neglect the culling rate of the BB genotype cows due to insignificant amount of culling. Thus we can say that in the group of cows with AA genotype the largest share is accounted for injuries and surgical diseases; and diseases of the mammary gland. In addition, a significant share was made of low-yielding cows and cows with digestive system pathologies. At the same time, in the group of cows with AB genotype also many animals were culled due to injuries and surgical diseases, pathologies of the digestive system and mammary gland, but this group featured fewer low-yielding first-calf heifers.

Table 4 shows the details of reasons for culling of cows. The table shows that the most common reasons for culling of the breeding livestock were also, as mentioned above, injuries and surgical diseases; digestive system pathologies and mammary gland pathologies, namely mastitis, digestive system diseases, injuries and low milk yield.

The table obviously shows that the main reasons for culling of cows in the group with AA genotype are mastitis, low yield and digestive system diseases — 72.9%. Among the cows of AB genotype, the first place was taken by diseases of the digestive system — 25.8%, followed by mastitis; legs rupture and stretching, accidentsin total amounted to 30.1%. This group showed less number of cows, culled on the basis of the breeding characteristic, i. e. low milk yield.

Conclusion

Thus, it's reasonable to conclude that the kappa-casein genotype of cow influences on the milk yield indicators and on the reasons of cows' rejection (based on research conducted since 2018 and published in scientific reports).

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All authors bear responsibility for the work and presented data.

All authors have made an equal contribution to this scientific work.
The authors were equally involved in writing the manuscript and bear the equal responsibility for plagiarism.
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