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Reproductive Quality Of Cows Of Different Genotypes On Csn3 And Dgat1 Genes Depending On Milk Level.

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ABSTRACT

The purpose of the research was to analyze the impact of the milk level of heifers of different genotypes on the CSN3 and DGAT1 genes on their reproductive qualities. Consequently, the distribution of experimental freshly calved cow of black-motley breeds into 3 groups was carried out, depending on the size of the features. The first group included cows with a yield of milk less than 4500 kg, the II - 4501-5000 kg, the III - over 5001 kg. Based on results of DNA testing, the freshly calved cow were divided into groups according to the CSN3 and DGAT1 genotypes. According to kappa-casein gene on $CSN3^{AA}$, $CSN3^{AB}$, $CSN3^{BB}$ and diacylglycerol gene of O-acyltransferase on $DGAT1^{AA}$, $DGAT1^{AK}$, $DGAT1^{KK}$. It was found, that with the increase in milk yield, the duration of the service- and interstate periods is longer, the advantage of cows with a higher milk yield (group III) in comparison with the smaller milk yield (group I) was in all experimental groups of animals, regardless of CSN3 and DGAT1 genotypes, in the way of a reliable difference between groups (P <0.01-0.001). But with an increase in milk yields, the values of the reproductive capacity and the Doha index of freshly calved cow of different genotypes decrease. In this case, a more pronounced decrease in the reproductive capacity was noted in animals, that have the allele B of the kappa-casein gene and allele K of the diacylglycerol O-acyltransferase gene in their genome. In general, an increase in the level of dairy productivity reduces the reproduction level of cows.

Keywords: Cow, reproductive ability, milk yield, genotype, CSN3, DGAT1, service and interbody period, reproductive capacity, Doha index

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INTRODUCTION

In the development of dairy cattle breeding the success is largely determined by the reproduction intensity of herd, which is directly related to the level of milk production and the fuller realization of the genetic potential of productivity. Reproduction is the main factor in increasing the dairy productivity of the herd and the basic biological condition that limits the growth of livestock.

The problem of increasing reproductive capacity in dairy cattle breeding remains one of the most difficult, especially in connection with the concentration of livestock and the introduction of modern intensive milk production technology.

At low rates of reproductive ability, the herd's reproduction rate is hampered, and the possibility of selecting animals from the main selectable traits is reduced. Therefore, along with the increase in milk productivity, it is necessary to improve the reproductive ability of cows.

Under optimal conditions each cow can produce one calf during the year. This requires, that the cows in the herd become pregnant within 80-85 days after calving, with an average pregnancy duration of 280-285 days (depending on the breed of livestock). The output of calves per 100 cows is the main economic indicator and depends on the duration of the service-period, i.e. interval from calving to profitable insemination. Long service - period is associated with a decrease in the yield of calves by 100 cows, an increase in the lactation duration, which is to a large extent accompanied by a decrease in the average daily milk yield for lactation [21].

According to many authors, with the increase in the milk productivity level, the reproductive qualities of cows are deteriorating [10]. At the same time, the extension of the service-period leads to an increase in milk yield, yield of milk fat and protein [12, 19].

The papers of many researchers are devoted to the study of milk productivity and reproductive qualities of cows with different genotypes of genes-markers of productivity [4, 5, 9, 13, 16, 17, 20, 22, 23]. The obtained results are somewhat contradictory and allow us to state that for each individual livestock it can be different, which is influenced by many factors such as breed, productivity, feeding and maintenance conditions, and the organization of herd reproduction. But the researchers make the main conclusion that there is no negative effect of the genotype of cows on the loci of the genes-markers on their reproductive capacity [1, 2, 3, 6, 7, 8, 11, 14, 18, 24, 25].

The aim of the research is to study the reproductive qualities of the freshly calved cows of different CSN3 and DGAT1 genotypes, depending on the milk yield level.

MATERIALS AND METHODS

Studies were carried out in the breeding reproducer LLC "Dusym" of Atninskiy district of the Republic of Tatarstan. To study the dependence of the reproductive ability of the freshly calved cows of black-mottled breed of different genotypes on the kappa-casein (CSN3) and diacylglycerol O-acyltransferase (DGAT1) from the milk yield, they were divided into 3 groups depending on the size of the features. The first group included cows with a milk yield of less than 4500 kg, the II group - 4501-5000 kg, the III group - over 5001 kg.

Venous blood samples were taken from 142 experienced first heifers for studies. The study of single-nucleotide polymorphism of kappa-casein and diacetylglycerol of O-acetyltransferase was carried out at the Laboratory of Biochemistry and Molecular Genetic Analysis of the Federal Center for Toxicological, Radiological and Biological Safety. DNA was isolated from venous blood by a standard method with the help of the "Magnosorb" (Interlabservis, Moscow). Allelic variants of genes are determined by polymerase chain reaction with subsequent analysis by polymorphism of the length of restriction fragments (PCR-PLRF) of gene amplification products.

Based on the results of DNA-testing, the freshly calved cows were divided into groups according to the CSN3 and DGAT1 genotype. According to kappa-casein gene on $CSN3^{AA}$, $CSN3^{AB}$, $CSN3^{BB}$ and diacylglycerol gene of O-acyltransferase on $DGAT1^{AA}$, $DGAT1^{AK}$, $DGAT1^{KK}$.

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The coefficient of reproductive capacity (CRC) was calculated by the formula of N.M. Kramarenko [15]:

$$CRC = 365 / IBP;$$

where 365 is the calendar year, days;
IBP - interbody period, days.

The Doha index was calculated by the formula of J. Doha:

$$T = 100 - (K + 2 \times i);$$

where T is the Doha index (productivity);

K - the cow's age at the first calving, months;
i – an interval between calving, months.

RESULTS AND DISCUSSION

It was established that as the level of milk yield increases, the duration of the service period and the interbody period increases of freshly calved cows with different kappa-casein genotypes, while in cows with the $CSN3^{AA}$ genotype to 24.2 days ($P < 0.001$) and 30 days ($P < 0.001$), $CSN3^{AB}$ for 22.3 days ($P < 0.001$) and 25 days ($P < 0.001$), for $CSN3^{BB}$ - for 45 days ($P < 0.01$) and 52 days (Table 1).

According to the remaining signs of reproductive ability, the reverse pattern is traced. With the increase in the milk yield, the reproduction factor and the Doha index decrease, while freshly calved cows genes with the $CSN3^{AA}$ genotype are 0.07 ($P < 0.001$) and 2.2 ($P < 0.001$), in $CSN3^{AB}$ - 0.06 ($P < 0.001$) and 2.6 ($P < 0.01$), $CSN3^{BB}$ - by 0.12 and 7.4.

Table 1: Reproductive qualities of freshly calved cows of different CSN3 genotypes, depending on the level of milk yield

CSN3 genotype	Reproductive qualities	Cow groups by milk yield		
		I, less than 4500 kg	II, 4501-5000 kg	III, over 5001 kg
AA	N	51	23	15
	Age of first calving, months	27,5±0,22	27,6±0,26	27,7±0,41
	Service-period, days	95,7±1,59	102,3±2,46	119,9±2,96
	Interbody period, days	382±2,72	392±4,12	412±4,93
	Coefficient of reproductive capacity	0,96±0,007	0,93±0,010	0,89±0,011
	the Doha index	47,4±0,28	46,6±0,42	45,2±0,54
AB	N	24	11	11
	Age of first calving, months	27,7±0,31	28,3±0,52	28,5±0,49
	Service-period, days	98,3±1,65	106,6±2,01	120,6±3,65
	Interbody period, days	383±4,19	395±4,05	408±4,90
	Coefficient of reproductive capacity	0,96±0,010	0,93±0,010	0,90±0,011
	the Doha index	47,2±0,37	45,7±0,63	44,6±0,73
BB	N	2	3	2

	Age of first calving, months	26,5±0,50	27,0±0,03	30,5±0,50
	Service-period, days	83,5±1,50	103,3±10,17	128,5±1,50
	Interbody period, days	369±5,00	392±14,90	421±19,00
	Coefficient of reproductive capacity	0,99±0,010	0,93±0,035	0,87±0,040
	the Doha index	49,2±0,17	47,2±0,98	41,8±1,75

In general, an increase in the level of dairy productivity reduces the reproduction level of cows.

When comparing the reproduction rates between cows of different genotypes, it was established that among milk yield of up to 4500 kg and 4501-5000 kg of milk, the shortest service-period (83.5 days and 103.3 days), the interbody period (369 days and 392 days) and the highest coefficient of reproductive capacity (0.99 and 0.93), the Doha index (49.2 and 47.2) have fresh-cows with the $CSN3^{BB}$ genotype, and at higher milk yields it is observed in animals with the $CSN3^{AA}$ and $CSN3^{AB}$ genotype.

Thus, there is some deterioration in reproductive performance in animals that have the allele B of the kappa-casein gene in the genotype.

Table 2 shows the reproductive qualities of fresh cows of different DGAT1 genotypes, depending on the milk yield. The animals with elevated milk yield showed a significant increase (P <0.001) in the duration of the service and interbody period in the $DGAT1^{AA}$ group for 21.7 days and 22 days, in the $DGAT1^{AK}$ group for 25.1 days and 31 days. A tendency to increase the age of the first calving with an increase in the level of milk also observed in experienced animals.

Table 2: Reproductive qualities of fresh cows of different DGAT1 genotypes, depending on the milk yield

DGAT1 genotype	Reproductive qualities	Cow groups by milk yield		
		I, less than 4500 kg	II, 4501-5000 kg	III, over 5001 kg
АА	N	33	9	8
	Age of first calving, months	27,8±0,27	28,0±0,24	28,7±0,49
	Service-period, days	94,8±1,86	97,9±3,14	116,5±4,03
	Interbody period, days	378±3,66	380±4,75	400±3,85
	Coefficient of reproductive capacity	0,97±0,009	0,96±0,012	0,92±0,009
	the Doha index	47,3±0,31	47,0±0,40	44,9±0,52
АК	N	38	27	20
	Age of first calving, months	27,3±0,23	27,4±0,26	28,2±0,43
	Service-period, days	96,6±1,77	105,6±2,07	121,7±2,69
	Interbody period, days	383±2,96	396±3,32	414±4,30
	Coefficient of reproductive capacity	0,96±0,007	0,92±0,008	0,88±0,009
	the Doha index	47,5±0,32	46,5±0,38	44,5±0,58
КК	N	6	1	-
	Age of first calving, months	27,5±0,76	30	-
	Service-period, days	101,0±2,35	120	-
	Interbody period, days	396±4,99	428	-

	Coefficient of reproductive capacity	0,92±0,011	0,85	-
	the Doha index	46,5±1,06	41,9	-

The advantage of cows with a smaller milk yield (up to 4,500 kg) compared to the large milk yield (over 5001 kg) in the Coefficient of reproductive capacity and the Doha index was in the experimental group with the $DGAT1^{AA}$ genotype 0.05 ($P < 0.001$) and 2.4 ($P < 0.001$) , with $DGAT1^{AK}$ - 0.08 ($P < 0.001$) and 3 ($P < 0.001$).

When comparing the first-calves with different genotype, it was noted that cows with the $DGAT1^{AA}$ genotype are characterized by good reproductive indices among all the experimental genotypes. In this case, there is a significant difference in comparison with the $DGAT1^{KK}$ group in the group with milk yield less than 4500 kg for interbody period for 18 days ($P < 0.01$) and for Coefficient of reproductive capacity - for 0.05 ($P < 0.01$); in comparison with $DGAT1^{AK}$ in the group with milk yield of 4501-5000 kg - for 16 days ($P < 0.01$) and 0.04 ($P < 0.01$), in the group over 5001 kg - for 14 days ($P < 0.05$) and 0.04 ($P < 0.01$), respectively.

CONCLUSION

It can be concluded that with increasing milk yield, the duration of the service and interbody periods increases and the values of the reproduction factor and the Doha index decrease, regardless of the genotype of the cows, with an insignificant decrease in the reproductive ability in animals having the allele B of kappa-casein gene and allele K the diacylglycerol gene of O-acyltransferase.

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