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VARIABILITY AND INHERITANCE OF FAT MILK IN SIMMENTAL COWS

Abstract. *The aim of the research was to analyze the influence of Simmental breed on the quality of cow's milk in farms of Ukraine, mainly in Kharkiv region. The research was performed on the basis of breeding records in agricultural farms with Simmental cows. According to the results of research, the fat content in the milk was higher in the crossbreed cows in comparison to purebred Simmentals cows $S1/4+H1/4+M1/2$ (4.0%), and $S1/4+H1/4+A1/2$ (4.0%), $S1/4+M3/4$ (4.0%), $S1/4+M1/4+A1/2$ (3.9%), $S1/4+A1/4+H1/2$ (3.9%), $S1/4+A1/4+M1/2$ (3.9%), $S1/4+A3/4$ (3.9%). The highest yield of milk fat was observed in the following genetic groups: $S1/4+H1/4+A1/2$ ($\sigma=58.0$ k), $S1/4+M1/4+A1/2$ ($\sigma=56.0$ kg). The influence of Simmental crossbreeds has a significant effect ($P>0.999$) on the fat content in cow's milk ($\eta^2 = 0.029$) and on the yield of milk fat ($\eta^2 = 0.049$) with a high degree of reliability ($P> 0.999$).*

Keywords: cow, Simmental breed, variability, inheritance, fat content.

The success of breeding is primarily the prediction of the genetic potential of highly productive livestock in order to maximize its use in specific herds of breeding stations and farms. The scientist works for prediction of the genetic potential of highly productive livestock has been carried out mainly on young and adult breeding stock. Bulls, taking into account their genotype, depending on the Simmental breed, separately and comprehensively, have not been studied [1, 2, 3].

To implement programs of positive improvement of the breed, it is important to establish the optimal ratio of heredity of the original breeds in animals of terminal genotypes. It will ensure the best detection and development of basic breeding indicators provided by target standards, as well as methods of obtaining animals of terminal genotypes [3, 5]. The research and study of genetic groups of breeding cows with genetic potential of in general in milk productivity giving to obtain results of metabolic indicators that affect the quality of cow milk [5, 6, 7]. The genetic-mathematical analysis of fat content in cow's milk and milk fat yield are carried out separately for genetic groups based on Simmental breed.

The researches were performed on the basis of breeding records in agricultural farms of Kharkiv region on cows of different genetic groups created on the basis of Simmental breed. The variability, repeatability and heredity of fat milk and milk fat yield were determined on the basis of appropriate coefficients according to the methods and criteria by Plokhinsky and Snedekor using appropriate computer programs.

The degree of influence of genetic groups on the fat content in milk and the yield of milk fat was determined by applying a general linear model and its derivatives (correlation, regression, analysis of variance). Data processing was performed using the procedures of General Linear Model, Correlation, Regression of the standard package of applied statistical programs SPSS – 12.0.

The following standard statistics were determined for each of the gradations of the fixed factor: number of animals (n), arithmetic mean (M), arithmetic mean error (m), standard deviation (σ), and lower and upper limits of 95% confidence interval. The degree of influence η^2 on the fat content in milk or milk fat yield, as well as the veracity of the difference between the averages values of fat content or milk fat yield were determined.

As one of the genetic factors used "genetic group", resulting in genetic and mathematical analysis of fat content in cow's milk and milk fat yield separately depending on genetic groups created on the basis of Simmental breed.

According to the results of research, the highest fat content in cow's milk was observed in crossbreeds $S_{1/4}+H_{1/4}+M_{1/2}$ (4.01%) та $S_{1/4}+H_{1/4}+A_{1/2}$ (3.99). The

crossbreeds S1/4+M3/4 (3.96%), S1/4+M1/4+A1/2 (3.95%), S1/4+A1/4+H1/2 (3.94%), S1/4+A1/4+M1/2 (3.92%), S1/4+A3/4(3.92%) also had a high fat content. The lowest content of milk fat had two-breed crosses of Simmental breed with Holstein S1/4+H3/4 (3.82%) and S1/2+H1/2 (3.86%).

In many farms, the use of Holstein has an effect on reducing fat content. This pattern was established by the first and third lactations. At the same time, fat milk yield decreased compared to the original breed by 0.08% and 0.03%, respectively [5, 6, 8].

The standard deviations characterize the variability of the fat content in the milk of cows depending on blood. The greatest variability in the content of fat in the milk of cows was characterized for crosses S1/2+M1/4+H1/4 ($\sigma = 0.41$).

Table 1

Variability of fat content (%) in milk of cows depending on different genetic groups created on the base of Simmental breed

Degree of breed of animals	M	m	σ	95% confidence interval	
				lower limit	upper limit
S1/2+A1/2	3.91	0.005	0.238	3.91	3.93
S1/2+A1/4+H1/4	3.89	0.035	0.280	3.83	3.97
S1/2+H1/2	3.85	0.003	0.230	3.86	3.87
S1/2+M1/2	3.88	0.008	0.270	3.88	3.90
S1/2+M1/4+H1/4	3.85	0.045	0.414	3.78	3.95
S1/4+A1/4+H1/2	3.94	0.006	0.282	3.98	3.95
S1/4+A1/4+M1/2	3.92	0.007	0.284	3.92	3.94
S1/4+A3/4	3.92	0.006	0.210	3.92	3.94
S1/4+H1/4+A1/2	3.98	0.010	0.291	3.97	4.01
S1/4+H1/4+M1/2	4.01	0.021	0.279	3.97	4.06
S1/4+H3/4	3.82	0.003	0.236	3.82	3.83
S1/4+M1/4+A1/2	3.94	0.007	0.256	3.93	3.96
S1/4+M1/4+H1/2	3.91	0.007	0.280	3.90	3.93
S1/4+M3/4	3.95	0.008	0.259	3.94	3.97
S3/4+A1/4	3.88	0.012	0.242	3.86	3.91
S3/4+H1/4	3.86	0.008	0.223	3.85	3.88
S3/4+M1/4	3.90	0.015	0.248	3.88	3.94
Simmental	3.88	0.004	0.299	3.87	3.89

Abbreviation of breeds: S – Simmental, A – Ayrshire, M – Montbéliard, H – Holstein

According to the results of the study, the highest amount of fat in cow's milk was found in the crosses S1/4+H1/4+M1/2 (4.01%) and S1/4+H1/4+A1/2 (3.99%).

The crosses S1/4+M3/4 (3.96%), S1/4+M1/4+A1/2 (3.95%), S1/4+A1/4+G1/2 (3.94%), S1/4+A1/4+M1/2 (3.92%), S1/4+A3/4(3.92%) also had a high fat content. The two-breed crosses between the Simmental and Holstein – S1/4+H3/4 (3.82%) and S1/2+H1/2 (3.86%) – had a lowest amount of milk fat.

Mean quadratic values characterize the low content of fat in the milk of cows depend on the genetic group. Crosses S1/2+M1/4+H1/4 were characterized by the greatest variability of fat content in milk of cows ($\sigma=0.41379$). The amount of milk fat is not constant and a change depends on a genetic group. Was also analyzed the level of breed degree of animals by genetic groups based on the Simmental breed to determine its influence on yield of milk fat (Table 2).

Table 2

**Variability of milk fat yield (%) of different genetic groups based
on the Simmental breed**

Degree of breed of animals	M	m	σ	95% confidence interval	
				lower limit	upper limit
S1/2+A1/2	148.37	0.882	42.941	146.64	160.00
S1/2+A1/4+H1/4	176.04	6.816	40.258	162.69	189.40
S1/2+H1/2	172.62	0.642	50.621	171.36	173.88
S1/2+M1/2	159.08	1.574	50.606	155.99	162.16
S1/2+M1/4+H1/4	153.18	8.688	50.045	136.16	170.21
S1/4+A1/4+H1/2	177.80	1.197	50.872	175.46	180.15
S1/4+A1/4+M1/2	162.89	1.366	52.362	160.21	165.57
S1/4+A3/4	146.62	1.223	33.172	144.22	149.02
S1/4+H1/4+A1/2	199.64	1.881	57.982	195.95	203.33
S1/4+H1/4+M1/2	186.65	4.040	49.216	178.73	194.57
S1/4+H3/4	167.36	0.642	42.635	166.10	168.62
S1/4+M1/4+A1/2	169.89	1.390	56.083	167.16	172.61
S1/4+M1/4+H1/2	186.42	1.405	53.990	183.67	189.18
S1/4+M3/4	165.84	1.451	52.116	162.99	168.68
S3/4+A1/4	148.52	2.319	46.465	143.97	153.06
S3/4+H1/4	161.19	1.513	45.018	158.23	164.16
S3/4+M1/4	155.86	2.857	51.703	150.26	161.46
Simmental	159.69	0.739	57.089	158.24	161.14

Thinness of different bloodlines is also observed for the average yield of milk fat. The largest milk fat yield was found in crossbreeds S1/4+H1/4+A1/2 (199.640 kg). The yield of milk fat was higher for crosses in contrast with Simmental peers: for the 1st lactation by 1.3 kg (1.1%); for the 2nd – by 4.7 kg (7%); for the 3rd

lactation – by 8.1 kg (6.8%). The greatest variability for yield of milk fat was in the following genetic groups: S1/4+H1/4+A1/2 ($\sigma=58.0$ kg), S1/4+M1/4+A1/2 ($\sigma=56.0$ kg). The most stable indicator of yield of milk fat was found for group S1/4+A3/4 ($\sigma=33.2$ kg). It has been established that the influence of breed degree of animals on the fat content of milk was equal to $\eta^2=0.029$ ($P>0.999$). The degree of influence of the genetic group on the yield of milk fat was $\eta^2 = 0.049$ with a high degree of reliability ($P>0.999$).

It can be stated that the degree of influence of the genetic group on the yield of milk fat was higher than the degree of influence of this factor on the fat content in milk.

The heterosis effect on the fat content in milk during interbreeding of dairy cattle is observed rare; according to the Breeding Programs and Westell R.A. More often it occurs on the total amount of milk fat [9,10].

In pairwise comparison of the arithmetic means of the fat content and milk fat yield, a greater number of significant differences by the yield of milk fat than the fat content were founded. So, 66 and 77 from 116 evaluated pairs had significant reliability by the yield of milk fat and by fat content respectively. The most significant differences in the fat content of milk were crosses S1/4+H1/4+M1/2 and S1/4+H3/4 (0.19%); in the yield of milk fat were the following pairs S1/4+A3/4 and S1/4+H1/4+A1/2, S1/4+H1/4+A1/2 and S1/2+A1/2, S1/4+H1/4+A1/2 and S3/4+A1/4, S1/4+H1/4+A1/2 and S3/4+M1/4 (48,381 – 51,579 kg).

It was found that the crossing of the Simmental breed with other breeds leads to changes in the parameters of variability of crossbreeds as the fat content and the yield of milk fat. Although low degrees (up to $\eta^2 = 0.049$) of influence of genetic groups on the abovementioned traits suggest more complex mechanisms for the implementation of genetic information, based on the interaction "genotype - environment".

The effect of crossbreeding on both indicators was both positive and negative, depending on the variant. The most positive variant of crossing was S1/4+H1/4+A1/2; animals had the highest yield of milk fat (199.6 kg) and fat content (3.99%). In addition, this genetic group was characterized by high variability

in both the fat content and the yield of milk fat. It gives higher opportunities for selection and effective breeding work compared to others.

Conclusions. The factor "genetic group", based on the Simmental breed, has a significant ($P > 0.999$) effect on the fat content in milk of cows ($\eta^2 = 0.03$). The degree of its effect on the yield of milk fat is greater than the content of milk fat ($\eta^2 = 0.05$) with a high degree of reliability ($P > 0.999$). Significant differences in milk fat content and milk fat yield were observed in 60% and 70% pairs of genetic groups, respectively.

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