Adaptive features of the Simmental breed cattle in conditions of the Lower Volga region

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Abstract. The article presents the results of identifying parental line of Simmental cattle the most stable to aggressive environmental conditions in the Lower Volga region with high milk productivity. The experimental work was carried out at farm-breeding plant named after Lenin of Surovikinsky District of Volgograd Region. All of cows of the farm was distributed among the bulls of different lines, which were selected individually for each one. In total 79 first-calf heifers and 249 full-aged cows participated in the experiment. The assessment of milk productivity of the cattle population was carried out on the basis of data of SELEX program. Productivity of bulls daughters belonging to different breeding lines was examined. Also, as part of the work, the parameters of natural resistance-innate level were studied. The results obtained during the experiment were processed and analyzed using standard methods. It was concluded the most preferred line of cattle for breeding in farm-breeding plant named after Lenin of Surovikinsky District of Volgograd Region.

1. Introduction
In the Russian Federation in recent years, due to the policy of import substitution, much attention is paid to increasing volume of domestic production of livestock products, including milk, which is an excellent source of vitamins and minerals. Modern economical and energy-intensive milk production technologies are characterized by the use of balanced in all nutrients feed, optimal maintenance parameters and timely veterinary treatment, therefore, it is possible to effectively intensify production only through selection work [1, 2].

Promising and widespread method of increasing genetic potential using existing gene pool of dairy cattle in the Volgograd region is Holsteinization [2].

In view of their genotypic characteristics, highly productive dairy cows of the Holstein breed are experiencing serious negative energy balance, which does not allow to fully realize the complex of indicators of milk productivity [3, 5, 7]. Also, it is known that energy deficit is less in dual-purpose breeds, such as Simmental [4, 9]. Therefore, crossing these breeds in order to take advantage of beneficial characteristics of both breeds and gain hybridization advantage of expected crosses may, among other things, reduce the negative effects of metabolic and physiological problems and thereby increase productivity of dairy herd. So, breeders of Simmental breed in our country use sperm of Red Holstein breed to improve parent breed [3, 8].
However, heterosis effect can only be maximized in first-generation hybrids. Obtaining such livestock in conditions of decrease in general number of cattle in the Volgograd region is becoming more and more difficult, and that is why identification of most productive parental lines with high quality milk indicators in specific arid, sharply continental climate gains special relevance [6].

The aim of this work is to determine the line of Simmental cattle the most stable to aggressive environmental conditions of the Lower Volga region with high levels of milk productivity.

2. Materials and methods
The experimental work was carried out at farm-breeding plant named after Lenin of Surovikinsky District of Volgograd Region.

All of cows of the farm was distributed among the bulls of different lines, which were selected individually for each one. Thus, 4 groups of daughters were formed, belonging to different lines: I experimental group of daughters of line Zabavnyj 1142; II - daughters of line Mergel 2122; III - daughters of line Signal 4863 and IV - a group of daughters belonging to Holstein line. In total 79 first-calf heifers and 249 full-aged cows participated in the experiment.

Assessment of milk productivity of the cattle population was carried out on the basis of data of SELEX program, which is commonly used to assess work of breeding farms. Productivity of bulls daughters belonging to different breeding lines was examined.

Immune status of the cows' organism was studied on the basis of bactericidal activity of blood serum by the method of Smirnova O.V. and Kuzmina T.A. in interpretation of Bukharin O.V., Sozykina A.V. (1979). Level of lysozyme activity in blood serum was studied according to Grant, phagocytic activity and phagocytic index, phagocytic number according to the Kostenko method.

The results obtained during the experiment were processed and analyzed using standard biometric methods on a PC using software Microsoft Office package, the general linear model ANOVA and determination of the Student-Fischer difference probability criterion (Plokhinsky A.P., 1970).

3. Results and discussion
Despite the fact that Simmental breed is a breed of mixed type of productivity belongs, its milk production is quite high, for 305 days of lactation in some animals it reaches 6000 kg with high levels of fat 4.2% and protein 3.8%.

The results of experimental studies of milk production of the cows are shown in table 1.

| Parent line  | n   | Milk yield per 305 days of lactation, kg | Fat, %    | Protein, % |
|-------------|-----|----------------------------------------|-----------|------------|
| Zabavnyj 1142 | 14  | 4044±49.17                             | 3.84±0.02 | 3.22±0.01  |
| Mergel 2122  | 35  | 3759±39.86***                         | 3.85±0.03 | 3.19±0.03  |
| Signal 4863  | 7   | 4163±37.65                             | 3.83±0.01 | 3.19±0.02  |
| Holstein line| 23  | 3873±51.14**                           | 3.87±0.03 | 3.18±0.03  |

**P≥0.99; ***P≥0.999.

Analyzing the data in table 1, it can be declared that the animals of Signal 4863 line had the highest milk yield in 305 days of lactation - 4163.0 kg, which is 119.0 kg or 2.94% higher compared to peers of line Zabavnyj 1142; line Mergel 2122 - by 404.0 kg, or 10.75% (P≥0.999); Holsteinized line - by 290.0 kg, or 7.49% (P≥0.99), respectively. In terms of fat content of milk, the leading were the animals of Holstein line, having an average milk fat content of 3.87%, which is 0.03% higher than peers of line Zabavnyj 1142; line Mergel 2122 - by 0.02%; line Signal 4863 - by 0.04% with an unreliable difference. In terms of protein, the animals of line Zabavnyj 1142, having 3.22% protein, surpassed their peers of line Mergel 2122 by 0.03%; lines Signal 4863 - by 0.03%, Holsteinized line – by 0.04% with an unreliable difference. Table 2 shows indicators of milk productivity of full-aged cows of the studied parent lines.
Table 2. Milk productivity of full-age Simmental cows.

| Parent line  | n   | Milk yield per 305 days of lactation, kg | Fat, %   | Protein, % |
|--------------|-----|----------------------------------------|----------|------------|
| Zabavnyj 1142 | 48  | 4315±53.29***                          | 3.86±0.01| 3.20±0.02  |
| Mergel 2122   | 121 | 4241±54.47***                          | 3.86±0.03| 3.19±0.01  |
| Signal 4863   | 12  | 5005±61.32                             | 3.87±0.01| 3.20±0.03  |
| Holstein line  | 68  | 4220±50.86***                          | 3.87±0.02| 3.17±0.01  |

Table 2 shows that full-aged cows parent line Signal 4863 had the highest milk yield in 305 days of lactation - 5005 kg, which is 690.0 kg or 15.99% (P≥0.999) higher compared to line Zabavnyj 1142; line Mergel 2122 - by 764.0 kg, or 18.01% (P≥0.999); by Holsteinized line - by 785.0 kg, or 18.60% (P≥0.999), respectively, and in fat and protein, the difference between the lines was insignificant and insignificant. The question of the correlation of different genealogical groups of Simmental cattle with milk production was highlighted in the work of L.P. Ignatyeva, A.A. Sermyagin (2019), which presents an analysis of milk productivity of Simmental cows from farms in 5 regions of the Russian Federation. Ultimately, in this work, it was concluded that it is necessary to use highly productive animals of foreign breeding to improve the productivity of livestock, which creates the preconditions for genetic progress of population of Simmental cattle in our country. The most important indicators of milk productivity are milk fat and protein, calculation results of which are presented in table 3.

Table 3. Calculation results of fat and protein content in milk of cows of different ages and lines.

| Parent line  | first-calf heifers | full-age cows |
|--------------|--------------------|---------------|
|              | butterfat, kg      | milk protein, kg | butterfat, kg | milk protein, kg |
| Zabavnyj 1142 | 155.29±0.21***    | 130.22±0.17***  | 166.56±0.18*** | 138.08±0.15*** |
| Mergel 2122   | 144.72±0.18***    | 119.91±0.19***  | 163.70±0.17*** | 135.29±0.13*** |
| Signal 4863   | 159.44±0.22       | 132.80±0.21    | 193.69±0.23    | 160.16±0.17    |
| Holstein line  | 149.89±0.23***    | 123.16±0.22***  | 163.31±0.19*** | 133.77±0.18*** |

As can be seen from table 3, the animals of line Signal 4863 were superior to their analogs in milk fat and protein both among first-calf heifers and among full-age cows. Their milk contained more butterfat compared to line Zabavnyj 1142 by 4.15 kg, or 2.67% (P≥0.999); line Mergel 2122 - by 14.72 kg, or 10.17% (P≥0.999) and Holsteinized line - by 9.56 kg, or 6.38% (P≥0.999); protein in milk of full-grown cows with line Zabavnyj 1142 - by 2.58 kg, or 1.98% (P≥0.999); line Mergel 2122 - by 12.89 kg, or 10.75% (P≥0.999) and Holsteinized line - by 9.64 kg, or 7.83% (P≥0.999), respectively.

At the same time, adaptive capacity has a huge impact on productivity of animals. However, formation of adaptive traits is closely related to presence of natural immunity and protective functions of body as a response to various negative environmental factors. Natural resistance-innate level is interrelated with breed of animals, therefore, identification of characteristics of blood of Simmental cows, which affect humoral and cellular elements, is of interest for zootechnical practice. Natural resistance also can act as one of the factors of animal adaptation, which is confirmed by a number of Russian and foreign researchers. Parameters of natural resistance-innate of Simmental cows breed are presented in table 4.

Table 4. Parameters of natural resistance-innate, %.

| Index               | Parent line | Zabavnyj 1142 | Mergel 2122 | Signal 4863 | Holstein line |
|---------------------|-------------|---------------|-------------|-------------|--------------|
| Bactericidal activity | 74.5±1.6    | 69.8±2.3      | 72.6±2.4    | 70.9±1.5    |
| Lysozyme activity   | 12.9±1.4    | 13.2±1.3      | 14.1±1.2    | 13.6±1.2    |
| Phagocytic activity | 58.7±2.8    | 60.3±3.6      | 61.4±3.1    | 59.6±2.9    |
| Phagocytic index    | 12.0±0.9    | 13.6±1.2      | 14.4±1.3    | 13.8±0.7    |
| Phagocytic number   | 5.7±0.4     | 6.2±0.6       | 6.9±0.7     | 6.6±0.5     |
Higher phagocytic and lysozyme activities were observed in animals of line Signal 4863, and bactericidal activity was higher in animals of line Zabavnyi 1142. Thus, bactericidal activity of blood serum in animals of line Zabavny 1142 was 74.5%, which is higher than that of analogues of lines Mergel 2122; Signal 4863 and Holstein line at 4.7; 1.9 and 3.6%, respectively. In terms of lysozyme activity of blood serum the highest value was noted in animals of line Signal 4863, which is higher than in peers of line Zabavny 1142; Mergel 2122 and Holstein line by 1.2; 0.9 and 0.5%; phagocytic activity of blood serum – by 2.7; 1.1 and 1.8%; phagocytic index – by 2.4; 0.8 and 0.6%; phagocytic number – by 1.2; 0.7 and 0.3%, respectively. Despite the fact that in terms of bactericidal activity animals of line Signal 4863 were inferior to their peers of line Zabavny 1142, they significantly led their peers of all studied lines in lysozyme and phagocytic activities of neutrophils. This indicates a rather high level of defense reactions, and also indirectly confirms of more intense metabolic processes in their bodies.

4. Conclusion

The study of productive and adaptive parameters of the cattle of Simmental breed showed that cows of line Signal 4863 outperform peers from other lines in first-calf heifers and full-age cows in milk yield, milk fat and protein, and also have higher indices of phagocytic activity. All this together allows us to conclude that animals belonging to this parent line, more preferred for breeding in farm-breeding plant named after Lenin of Surovikinsky District of Volgograd Region in comparison with their peers of other lines.

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