

# The Importance of Assessment of the Stress Resistance of Cow-Heifers of the Simmental Breed in the Selection Process

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## Abstract

Simmental breed is one of the most common breeds of cattle in the Central Chernozem Region of Russia. The assessment of its adaptability to conditions of intensive milk production technology is of undoubted scientific and practical importance. At the same time, the identification of animals with an increased stress resistance to unfavorable stress factors of the environment is of great importance in terms of cattle breeding.

The highest milk production indicators were observed in cow-heifers of the 1<sup>st</sup> type of stress resistance. In this group milk yield for 305 days of lactation amounted on average to 4227.3 kg, while the yield of milk fat was equal to 156.9 kg. The lowest milk production indicators were noted in cows of the 4<sup>th</sup> type of stress resistance, which amounted to 2089 kg and 79.4 kg, respectively.

Using the method of single-factor analysis of variance, it was revealed that the influence of fathers on the stress resistance type was negligible as compared to mothers. It can be assumed that the type of stress resistance of cows is a genetically determined trait that is passed on to descendants mainly through mothers.

**Key words:** stress resistance, cow-heifer, milk yield, behavior, service-period, heredity.

## INTRODUCTION

In contemporary conditions of milk production, various stress factors play the negative role. This results in deterioration of animals' health and productivity [1, 2, 3]. In particular, the stresses arise when violating regimes of feeding, milking, and keeping cows. Change of the established daily schedule at a dairy farm (complex) leads to the shift of the internal milieu parameters. To restore the original consistency of the internal milieu, animals trigger various adaptive mechanisms. And the lower the type of animal's stress resistance, the longer period of time is required for a recovery of the initial constancy of the internal milieu [2, 4].

At present the term "stress resistance" is used as a rule to characterize the ability of cows to response to changes in external conditions. Stress resistance (or stress tolerance) is treated as the ability to maintain a stable level of motor and secretory activity of the mammary gland at inhibitory impacts [5].

There are various developed techniques enabling the selection of stress-resistant cows, though they are all based on the assessment of the different responses of animals to one and the same standard stimulus. At that, factors are taken into account, such as the change in daily milk yield and the rate of recovery of the cow, the amount of residual milk in the gland, and the change of the milk yield dynamic curves, hormonal changes in the body, and change of the animal's behavior.

It is known that the cow's nervous system plays major role in the lactation performance and milk ejection. Many researchers note that the secretory activity of the mammary gland throughout lactation period is largely determined by the type of higher nervous activity of the animal. Therefore the answer to the question of what type

of stress-resistant cows represents the greatest economic value in terms of milk production is important both in the scientific and the practical sense.

## MATERIALS AND METHODS

Studies were conducted at the dairy complex of instructional pedigree farm "Komsomolets" of the Tambov Region, using the existing proven methodologies.

## RESULTS AND DISCUSSION

After a stay in the maternity ward, where cow-heifers were milked by one milkmaid, cows were transited to production ward and handed over to a group of other milkmaids. To clarify the nature of the cows' response to the milking in new conditions, milk yield during milking was checked minute by minute. Three milking, the first, second, and fifth were assessed for each animal. Data obtained for each cow-heifer were used to plot lactation dynamic curves. Analyzing plotted curves, and revealing the total inhibitory impacts, we grouped the experimental cow-heifers by types of stress resistance. At that, 32% of the total cow population was attributed to the 1<sup>st</sup> type, 34% - to the 2<sup>nd</sup> type, 28% - to the 3<sup>rd</sup> type, and 6% - to the 4<sup>th</sup> type.

In the course of experiment we have revealed that there were no significant differences between cow-heifers of different stress resistance types in terms of average measurements of main scale points of the animal's exterior, and all animals had a well-expressed milky-meat type of body.

Milk production is an important economic indicator, which largely influences the profitability of dairy cattle breeding [1, 2].

**Table 1 – Milk productivity of cow-heifers with different types of stress resistance**

Type of stress resistance	Number of cow-heifers	Age of the first calving, months	Number of milking days	Milk production			
				Milk yield, kg	Fat%	Amount of milk fat, kg	4% milk yield, kg
1	16	31.8±1.1	337.6± 21.3	4227.3±159.5	3.72±0.03	156.9±5.9	4044.9±152.9
2	17	34.6±1.2	301.2±10.6	3774.8±127.8*	3.72±0.01	140.4±4.8	3616.4±122.6*
3	14	32.4±0.8	263.2±9.9**	3047.2±117.0***	3.72±0.02	113.4±4.3***	2919.2±111.2***
4	3	33.2±1.02	247.0±31.8	2089.0±127.7***	3.81±0.07	79.4±4.1***	1991.6±102.8***

Note: \* -  $P \geq 0.95$ ; \*\* -  $P \geq 0.99$ ; \*\*\* -  $P \geq 0.999$

The data presented in Table 1, clearly indicate the level of milk productivity of cow-heifers of different types of stress resistance. It should be noted that the experiments have shown increasing trend in the age of first calving from the higher stress resistance type to a lower one. Besides, animals with high type of stress resistance manifested clear advantage in the level of milk yield during the first lactation. At that, the difference between the extreme types of stress resistance was quite significant.

The lowest levels of milk production were observed in animals of 4<sup>th</sup> type of stress resistance. So, during the first lactation the amount of milk of natural fat content produced by these cows was on average by 2.2 times less than that of cows from the 1<sup>st</sup> group. The highest milk yields were obtained from cow-heifers of the highest 1<sup>st</sup> type of stress resistance: milk yield for 305 days (or during the shortened lactation) amounted on average to 4227.3 kg, while the yield of milk fat was equal to 156.9 kg.

The difference in the yield of 4% fat milk per 305 days of lactation between the animals of the 1<sup>st</sup> and 2<sup>nd</sup> types of stress resistance amounted to 428.5 kg ( $P > 0.95$ ). The most significant difference in this indicator was noted in cow-heifers of the 1<sup>st</sup> and 3<sup>rd</sup> types of stress resistance – 1125.7 kg ( $P > 0.999$ ), and of the 1<sup>st</sup> and 4<sup>th</sup> types – 2053.3 kg ( $P > 0.999$ ).

The analysis of technological properties of milk, as well as the production and analysis of sweet-cream butter "Vologodskoye" and fatty curd were conducted at the test laboratory of LLC "Lipetsk Food Factory" in accordance with the applicable procedures and processing methods.

The milk used for making dairy products, was subjected to organoleptic assessment as well as chemical analysis. The organoleptic assessment of milk did not reveal significant differences between the milk of Simmental cows of different types of stress resistance in terms of milk taste, smell, color, and consistency.

Despite some differences in data obtained in the production of sweet-cream butter, no significant differences were found between Simmental cows of different types of stress resistance. In consequence of conducted analysis, all samples of the sweet-cream butter were attributed to the higher grade in accordance with the requirements of GOST 37-91 "Unsalted Sweet-cream Butter "Vologodskoye".

In terms of chemical composition, organoleptic and biological properties, as well as the amount of microflora, tested milk of cows belonging to different types of stress resistance, was suitable for cheese production. So, the studied rennin coagulation property of tested milk from cows of the experimental groups ranged from 26 to 29

minutes. Faster coagulation was noted in milk obtained from Simmental cows of the 1<sup>st</sup> type of stress resistance, which accounted for 26 minutes, and somewhat longer in the milk of the cows of the 2<sup>nd</sup> type of stress resistance, which was 29 minutes.

The curd was made from milk by rennet-acid method. Fat curd, obtained from the milk of tested cows of the experimental groups, had almost identical physical and chemical properties with the exception of acidity; the acidity of curd produced from milk of Simmental cows of the 2<sup>nd</sup> type of stress resistance was higher by 2-5°T. In consequence of conducted analysis, all the samples of curd matched to the requirements of the TU 9222-04-49942742-00.

Analysis of the obtained experimental results of studies on the behavior of Simmental cows of different types of stress resistance has shown that there were certain differences in duration of the basic behavioral elements between the animals of extreme types of stress resistance.

The results of observations over animals' behavior of extreme types of stress resistance has shown that energy of Simmental cow-heifers of the 1<sup>st</sup> type of stress resistance was higher than that of the animals of the 4<sup>th</sup> type of stress resistance by 41 minutes. Duration of merycisin refers to the vital manifestations of animals, because animals with different forestomachs, consuming a large amount of bulky feed, produce reflex activity constituting the act of merycisin.

It should be noted that cattle can chew the contents of forestomachs in standing position, though most often when lying.

Studies have revealed that violation of the set daily schedule, milking routine, and animal welfare conditions leads to inhibition of milk secretion reflex and, as a rule, to reduction of milk production. Thus, the experiment of Pogodaev S.F. and Lamonov S.A., conducted in the animal production farm "Shchapovo", revealed that the adaptation of cows to the new milking and welfare conditions after transition from the maternity ward into the production ward was accompanied by a reduction in milk yield in cows depending on animal's stress resistance type [4].

In connection with the above, we studied milk yield dynamics in cow-heifers during the transition period (May). In the instructional pedigree farm "Komsomolets", spring cows were transited from the premises to the summer camp. As a result, the animals' welfare conditions had changed. From the tethered mode of keeping, cows were transited to the loose housing that in the early days led to establishment of hierarchy in the herd. In addition, milking

routine conditions had changed as well, since in premises the cows were milked in the cubicles on a leash, while in the conditions of summer camp milking was conducted using milking machine UDS-3B (that required urging on animals to the milking machine).

We have noted that the cow-heifers of the 1<sup>st</sup> type of stress resistance for the first day after seasonal transition to summer camp had not reduced their productivity. Cows of the 2<sup>nd</sup> type reduced milk yield by 3.8% and restored the initial level of milk production on the second day after seasonal transition to summer camp. Animals of the 3<sup>rd</sup> type reduced milk yield by 8.4% and restored initial milk yield on the fourth day. Cow-heifers of the 4<sup>th</sup> type reduced milk yield by 17.8% and recovered on the sixth day after seasonal transition to summer camp.

The issue of increasing reproductive qualities of animals remains one of the most challenging, especially in

connection with the implementation of industrial milk production technology. Numerous technological stresses arising during the exploitation of cows lead to the depressed conception rate of cows. At the same time duration of service period and calving interval increase, and the output of calves is reduced. This usually results in a premature retirement of cows from a herd.

Analysis of data on reproductive qualities of cow-heifers, presented in Table 2, has shown that the duration of the pregnancy of the animals of different types of stress resistance varied within the normal range (276-279.2 days). More prolonged pregnancy period was observed in animals of the 1<sup>st</sup> and 3<sup>rd</sup> types of stress resistance compared to the cows of the 2<sup>nd</sup> type (1.6-3.1 days) and 4<sup>th</sup> type of stress resistance (1.7-3.2 days). The live weight of newborn calves was practically the same in all the experimental groups (31.7-32.7 kg).

**Table 2 – Reproductive qualities of cow-heifers of different stress resistance types**

Indicators	Type of stress resistance			
	1 (n=16)	2(n=17)	3(n=14)	4(n=3)
Duration of pregnancy, days	277.7±0.2	276.1±0.1 <sup>***</sup>	279.2±0.4 <sup>**</sup>	276.0±1.0
Live weight of newborn calves, kg	32.7±0.1	31.7±0.2 <sup>***</sup>	32.6±0.1	32.0±0.1

Note: data are reliable at \*-P≥0.95; \*\*-P≥0.99; - P≥0.999

**Table 3 – Duration of service period and conception rate of cow-heifers with different types of stress resistance**

Type of stress resistance	Number of cows	Conception rate	Service period, days	Percentage of impregnation capacity from the first insemination
1	16	1.6±0.4	117.9±1.5	50.0
2	17	1.4±0.1	77.2±2.3 <sup>***</sup>	64.7
3	14	1.2±0.1	54.1±2.4 <sup>***</sup>	78.6
4	3	2.0±0.6	89.5±3.7	33.3

More heavy offspring was obtained from cow-heifers of the 1<sup>st</sup> and 3<sup>rd</sup> types of stress resistance compared to animals of the 2<sup>nd</sup> type (0.9-1.90 kg) and 4<sup>th</sup> type of stress resistance (0.6-0.7 kg).

The maximum duration of service period was observed in cows of the 1<sup>st</sup> type of stress resistance, which amounted to 117.9 days (Table 3). Also, they have shown the lowest percentage of impregnation capacity from the first insemination compared to animals of the 2<sup>nd</sup> and 3<sup>rd</sup> types of stress resistance.

This was explained primarily by the fact that in unstable feeding conditions, body reserves in cows of high stress resistance were focused more on the secretion of milk. Consequently, the dominant of secretory activity prevailed among the cows of this type over the sexual activity of the body. The lowest conception rate was observed in the cow-heifers of the 4<sup>th</sup> type of stress resistance.

In our studies it was established that 93.85% of Simmental cows of the 1<sup>st</sup> type of stress resistance had the best udder shape, namely cup-shaped udder. Also cows of the 1<sup>st</sup> type had predominantly cylindrical shape of the teats compared to animals of other types of stress resistance.

Conducted research has revealed that cow-heifers of the 1<sup>st</sup> type of stress resistance were superior over the

animals of other types of stress resistance in terms of the basic sizes of the udder. The length of the udder, which was by 0.5 cm longer, was the only parameter by which they were inferior to animals of the 2<sup>nd</sup> type of stress resistance.

The advantage in terms of milk output intensity, which was by 0.06-0.24 kg/min greater than usual rates, was shown by cow-heifers of the 1<sup>st</sup> type of stress resistance. Due to more intensive milk output, the duration of milking of these cows was less than that of Simmental cow-heifers of the moderate and low stress resistance.

Conducted research has revealed that regardless of lineage, daughters maximally inherited stress resistance trait from their mothers. Using the variance analysis method, it was revealed that the proportion of the influence of bulls on the type of stress resistance of daughters was at the level of 12%. Consequently, the influence of fathers on the type of stress resistance was negligible compared to the influence of mothers.

The net profit from the sale of the milk produced by the cows of the 1<sup>st</sup> type of stress resistance was by 5 711 rubles higher than that from cows of the 2<sup>nd</sup> type, by 9 463.5 rubles higher than that from cows of the 3<sup>rd</sup> type, and by 1 2061.2 rubles higher than that from cows of the 4<sup>th</sup> type of stress resistance.

### CONCLUSION

In consequence of the foregoing, to improve milk productivity and quality, we recommend zootechnicians dealing with breeding to carry out the assessment of Simmental breed cows in terms of the type of stress resistance under industrial technology conditions. We suggest selecting the animals of the 1<sup>st</sup> and 2<sup>nd</sup> type of stress resistance for herd maintenance and as bulls to inseminate cows. We propose to use cows of the 3<sup>rd</sup> and 4<sup>th</sup> types of stress resistance in the peasant farms and private households with small number of livestock, where it is easier to arrange animals' service taking into account their tolerance against stress.

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