Cow’s milk productivity: effects of bull’s genotype and line

S A Surkova¹, I F Gorlov, M I Slozhenkina, T N Barmina, A A Kaidulina and N I Mosolova
Volga Region Research Institute of Manufacture and Processing of Meat-And-Milk Production, Volgograd, Russia

¹E-mail: api.niimmp@mail.ru

Abstract. The article presents sire proving results of 11 Holstein stud bulls of three lines of breeding, i.e. Vis Back Ideal 1013415, Reflection Sovering 198998, and Montvik Chieftain 95679. Experimental studies were conducted in the conditions of a dairy complex of OOO agricultural enterprise “Donskoe” in the Volgograd region. Comparative analysis of bulls’ daughters in the first complete lactation with their mothers and herdmates showed that the average milk yield of daughters of bulls under study varied within 8256-9895 kg, the fat content values of milk were 3.80-4.30%, and the protein content values ranged from 3.10 to 3.40%. Seven of the sire proved bulls were recognized as improving bulls with varying degrees of genetic potential realized. The Vis Back Ideal 1013415 bulls’ daughters were found to have superior milk yield in comparison with the Reflection Sovering 198998 and Montvik Chieftain 95679 bulls’ daughters. Moreover, the Reflection Sovering bulls’ daughters outnumbered the Vis Back Ideal bulls’ daughters in terms of the fat content in milk by an average of 0.1%. The milk yields of all evaluated bulls’ daughters exceeded their mothers with respect to the milk yield, which indicated genetic progress over a generation. Thus, the stud bulls that turned out to be improving in terms of the milk yield and fat content will further improve the productive traits of cows.

1. Introduction
Today sanctions against Russia continue to be applied and affect many sectors of the national economy. One of the main tasks facing the country’s agroindustry is to provide the population with necessary and vital food products in order to ensure the food security of the Russian Federation. In this regard, animals of high productivity can help solve the problem of increasing the production of livestock products, including milk [1-3].

The productivity of farm animals is a determining criterion in predicting the effectiveness of breeding and assessing their genetic potential and largely depends on the selection and breeding work performed. It is possible to genetically improve the livestock due to bulls of a high breeding value [4, 5].

To increase the efficiency of the breeding work, it was very important to evaluate the bulls’ sire proving capability. This is the most reliable method for assessing genetic merits inherited from outstanding animals. The father’s genotype is known to have the strongest effect on the offspring productivity. In breeding dairy cattle, the issues of improving productive traits remain relevant. At present, the Holstein breed is used to improve domestic dairy cattle breeds and is widespread throughout the world due to its high productive traits [6-10]. In this regard, we evaluated the stud bulls of the
Holstein breed in terms of their sire proving capability in order to accelerate the breeding progress by identifying the most outstanding breeding individuals and creating animals of the desired type.

2. Materials and methods

The research was performed in OOO agricultural enterprise “Donskoe,” Volgograd region. Eleven stud bulls with 10 or more daughters that completed lactation were assessed.

The breeding stock on the farm was represented by breeding animals of the “elite-record” and “elite” classes of three lines of bulls, namely, Vis Back Ideal 1013415, Reflection Sovering 198998, and Montvik Chieftain 95679. The milk productivity of 141 daughters for 305 days of first lactation was analyzed in comparison with the productivity of their mothers and herdmates. The keeping and feeding conditions for the bulls’ daughters and cows of the same age in the herd were the same.

All livestock on the farm was loosely stabled.

The dairy complex was equipped with a herringbone milking parlour (Win Pulsa, Germany) and electronic milk meters. There was a housing for 600 cows with a Carousel milking parlor (Westfalia Surge, Germany). The farm had all the necessary conditions for keeping livestock in compliance with all veterinary conditions, used robotic milking technology, and performed control by the Dayri Plan computer system that provided a clear picture of livestock productivity and important production processes and a SELEX automated system. The results obtained in the research study were processed using economic and mathematical methods.

3. Results and discussion

Like many economically useful traits of cows, the genetic factor and, above all, the genotype have a decisive influence on the productivity. In the “Donskoye” farm, sufficient attention was paid to a uniform genealogical structure of a herd obtained by the method of intraline selection. Milk productivity indicators, interior and productive indicators of genotypes of 100% Holstein livestock, their exteriors, and constitutions were studied.

In 2020, the total number of cattle in OOO “Donskoye” was 5006 head, 2195 of them were cows. The work with purebred Holstein cattle has been carried out here since 2006, when 386 head of Holstein heifers were imported from Germany. In the following years, heifers were brought from Australia, Denmark, America, Holland, and Denmark.

The breeding stock contained 66.4% of the Vis Back Ideal line, 31.7% of the Reflection Sovering line, and 1.7% of the Montvik Chieftain line. According to the valuation data of 2020, the average milk yield per cow amounted to 9104 kg, the milk fat content made 3.96% and protein content was 3.26%. Table 1 shows the results of the analysis of the milk productivity of 141 daughters for 305 days of first lactation in comparison with their herdmates and mothers. The average milk yield of the studied bulls’ daughters in the first lactation was found to be within the range from 8256 to 9895 kg, the fat content in milk from 3.80 to 4.30%, the protein from 3.10 to 3.40%. The average milk yield of first lactation per herd for 305 days was 8125 kg, fat content in milk 3.93%, and protein content 3.25%. The breeding line and father’s genetic potential were established to be influencing on the milk productivity. In terms of the average milk yield, the Vis Back Ideal bulls’ daughters were noted to slightly (+ 22.6 kg) surpass the Reflection Sovering bulls’ daughters and to a significant extent (+ 804.4 kg) surpass the Montvik Chieftain bulls’ daughters. The Reflection Sovering bulls’ daughters also exceeded the Montvik Chieftain bulls’ daughters by 781.8 kg in terms of the milk yield. The Reflection Sovering bulls’ daughters exceeded their herdmates of the Vis Back Ideal line by 0.1% with respect to the average milk fat; no significant difference was revealed in terms of their protein contents. Of the 11 sire proved bulls, 7 bulls were considered as improving bulls that are capable to increase the milk yield of their daughters to varying degrees, i.e. the Barhat 5524 bull’s daughters exceeded their herdmates in terms of the milk yield per lactation by 1001.5 kg. Michelle 801 bull’s daughters by 467.9 kg. Orlan 3376 bull’s daughters by 380.0 kg. Parade 3778 bull’s daughters by 155.6 kg, and Alta Tyson 66133528 bull’s daughters by 87.4 kg. The AltaR2 62916235, Napoleon 9840, Strelec 5427, and No. 34760 bulls’
daughters had lower values of the milk yield than their herdmates by 800.0, 502.2, 98.5, and 753.0 kg, respectively.

### Table 1. Assessment of the stud bulls by the quality of progeny.

| Line | Name and number of the stud bull | Daughters | ± in comparison with mothers |
|------|---------------------------------|-----------|-----------------------------|
|      |                                 | milk yield for 305 days, kg | fat, % | protein, % | milk yield, kg | fat, % | protein, % |
|      |                                 | Daughters | herdmates | mothers |
| Opekun 564 | 10 | 9017 | 3.90 | 3.27 | +35.7 | -0.08 | +0.01 | +1747 | -- | -0.03 |
| Michelle 801 | 15 | 9410 | 3.90 | 3.40 | +467.9 | -0.08 | +0.14 | +2397 | +0.10 | +0.20 |
| Orlan 3376 | 15 | 9330 | 4.00 | 3.30 | +380.0 | +0.03 | +0.03 | +1556 | +0.20 | +0.30 |
| Alta Tyson 66133528 | 13 | 9064 | 4.00 | 3.10 | +87.4 | +0.03 | -0.19 | +2742 | -0.10 | -0.10 |
| B. Oneshot 62207139 | 12 | 9009 | 3.80 | 3.40 | +27.0 | -0.19 | +0.14 | +2225 | -- | +0.10 |
| AltaR2 62916235 | 17 | 8256 | 4.10 | 3.30 | -800.0 | +0.14 | +0.03 | +2099 | +0.09 | -0.30 |
| Barhat 5524 | 16 | 8985 | 3.80 | 3.40 | +1001.5 | +0.19 | +0.14 | +262 | -- | -- |
| Parade 3778 | 11 | 8925 | 3.90 | 3.20 | +155.6 | -0.08 | -0.08 | +2368 | -0.10 | -- |
| Strelac 5427 | 10 | 8895 | 4.00 | 3.20 | -98.5 | +0.03 | -0.08 | +403 | +0.07 | +0.02 |
| Napoleon 9840 | 12 | 8528 | 4.30 | 3.30 | -502.2 | +0.36 | +0.03 | +2186 | -- | -- |

In terms of the milk fat content, the Barhat 5524 bull’s daughters also surpassed their herdmates by 0.19% and Napoleon 9840 and AltaR2 62916235 bull’s daughters by 0.36 and 0.14%, respectively. The superiority of the Orlan 3376, Alta Tyson 66133528, Strelac 5427, and No. 34760 stud bulls’ daughters was insignificant and made 0.03% each. In terms of the milk fat content, the B. Oneshot 62207139 bull’s offspring were inferior to their herdmates by 0.19%, and the Opekun 564, Michelle 801, and Parade 3778 bulls’ daughters were slightly inferior (0.08% each). In terms of the protein content in milk, the daughters of the bulls (Michelle 801, B. Oneshot 62207139, and Barhat 5524) surpassed their herdmates by 0.14%. A slight predominance (from 0.01 to 0.03%) was observed in the Opekun 564, Orlan 3376, AltaR2 62916235, and Napoleon 9840 bulls’ daughters. A decrease in protein occurred in the Alta Tyson 66133528 bull’s daughters by 0.19% and the Parade 3778, Strelac 5427, and No. 34760 bulls’ daughters by 0.08%. Significant progress was observed when comparing sire proved bull daughters with their mothers with respect to the milk yield. The daughters’ milk yields were higher than those of their mothers, which indicated genetic progress over a generation. Moreover, three milking a day instead of two milking a day also played an important role. The Alta Tyson 66133528, Michelle 801, Parade 3778, B. Oneshot 62207139, Napoleon 9840, and AltaR2 62916235 bulls’ daughters had the greatest predominance in the milk yield in comparison with their mothers. The differences made 2742, 2397, 2368, 2225, 2186, and 2099 kg, respectively. The Opekun 564, Orlan 3376, No. 34760, Strelac 54274, and Barhat 5524 bulls’ daughters outnumbered their mothers in terms of the milk yield by 1747, 1556, 1379, 403, and 262 kg, respectively. The milk yield of the Alta Tyson 66133528, Michelle 801, Parade 3778, and Orlan 3376 bulls’ daughters significantly increased in comparison with their mothers; so did
the fat content that increased by 0.1%. The fat content in milk from the AltaR2 62916235 and Strelec 54274 bulls’ daughters increased by 0.09 and 0.07%, respectively. The fat content remained unchanged in milk from the Opekun 564, B. Oneshot 62207139, Barhat 5524, and Napoleon 9840 bulls’ daughters. The fat content in milk from No. 34760 bull’s daughters decreased by 0.10%.

The protein content in milk from the Michel 801, Orlan 3376, and B. Oneshot 62207139 bulls’ daughters increased from 0.10 to 0.30% in comparison with their mothers. The protein content in milk from the Strelec 5427, Barhat 5524, Parade 3778, Napoleon 9840, and No. 34760 bulls’ daughters slightly increased. The protein content in milk from the AltaR2 62916235 and Alta Tyson 66133528 bulls’ daughters decreased by 0.10 and 0.30%, respectively.

4. Conclusion
By all indicators of productivity—milk yield, fat and protein contents in milk, — the superiority of the daughters of stud bulls Barhat 5524 of the Reflection Sovering line and Michel 801, Opekun 564, and Orlan 3376 of the Vis Back Ideal line was established.

Thus, in the future the identified best breeding bull genotypes will increase the milk yield, as well as the contents of fat and protein in the cow’s milk.

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