Biological characteristics of Russian black pied cattle

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Abstract. The biological characteristics of farm animals depend on their species and breed differences, but at the same time they are subject to certain variability due to individual heredity. In this regard, from the number of first-calf cows (daughters of different bulls) eight groups of the same age cows were organized and examined. In addition, a group of 65 animals was formed to assess the exterior by the method of random sampling without taking into account their heredity. The current research is aimed to evaluate the first-calf cows in the following options: milk productivity, functional properties of the udder, body type and the main disadvantages of the exterior. As a result of the analysis, Alta Genetics cows showed the best milk productivity among other breeds. The cows of Alta Gost and Alta Samuari breeds turned out to have the best indicators for a number of economically useful traits. The Alta Gost cows were characterized by the best milk yield. When assessing the exterior features and constitution, it was found that the greatest number of conformation defects is associated with the limbs: close hocks (35%); wide interdigital cleft (71%); narrow hoof (22%). Nevertheless, a visual assessment of a complex of features allows to refer all the examined cows to a good body type.

1. Relevance
One of the current trends in the development of cattle breeding is the use of intensive milk production technologies. At the same time, the requirements for the dairy cattle as the main mean of production are increasing. Nowadays the cows used in a high-technological agricultural complex should have high productivity, strong exterior and excellent reproductive qualities. [2, 5-8]

2. Methods and Materials
In regard to the aim of the current research and the formulated tasks in the breeding economy of LLC “Konstantinovo” (Penza region, Russia), 8 groups of cows were formed from the number of first-calf cows (daughters of different proven bulls). The scheme of the experiment is given below (Figure 1).

The selection of data for analysis was taken from zootechnical and breeding records of the SELEX program. The level of milk productivity of cows was assessed by milk yield for 305 days of lactation or the entire shortened lactation. In addition, the quality indicators of milk from the experimental animals were assessed. The milk flow rate and the milk yield index were calculated according to the generally accepted method. Thus, a group of 65 animals was formed to assess the exterior by the method of random sampling without taking into account their heredity. A comprehensive description of the exterior and constitution of cows was organized according to a 100-point system with 5 indexes: general exterior - 20%, milk characteristics - 15%, body size - 10%, legs - 15%, udder - 40%. According to the obtained results for 5 indexes in a complex assessment, a general complex score for
the exterior type was deduced for each animal and a breeding class was also assigned: perfect (90 and more), excellent (85-89), good with a positive tendency (80-84), good (75-79), satisfactory (65-74), poor (50-64).

| Nickname of the bull-father | Aluminium Madison | Alta Gost | Alta Networth | Alta Samuari | Benedict | Karl-A Appleton | Titanium | Eubrox |
|-----------------------------|-------------------|-----------|---------------|--------------|----------|-----------------|----------|--------|
| Number of daughters         | 77                | 21        | 99            | 115          | 59       | 21              | 21       | 29     |

1. Milk productivity
2. Functional properties of the udder
3. Body type
4. The main disadvantages of the exterior

Figure 1. Scheme of the experiment.

When determining the selection and genetic parameters of the studied indexes in all groups, the following options were calculated: the arithmetic mean (M) and its error (m), variability expressed by the standard deviation (σ) and the coefficient of variation (Cv) according to generally accepted methods. The significance of differences between the characteristics was assessed by comparison with the Student's t-test. At the same time, the probability of a prediction error was established according to three reliability thresholds (* – P<0.05; ** – P<0.01; *** – P<0.001). Statistical data processing was carried out on a personal computer using the Excel program. All indicators of milk productivity of the daughters of each bull were compared with the average data of all first-calf heifers of the herd.

3. Results
As a result of assessing the milk productivity of first-calf cows, taking into account their heredity (Table 1, Table 2), it could be seen that in terms of milk yield, a significant superiority of the daughters of Alta Samuari was revealed. The difference was 252 kg (P<0.05). The daughters of Alta Gost showed higher milk yields, but the difference was not significant.

Table 1. Milk productivity of first-calf cows (daughters of various bulls).

| Index | Aluminium Madison | Alta Gost | Alta Networth | Alta Samuari | Benedict | Karl-A Appleton | Titanium | Eubrox | Average by first-calf heifers |
|-------|--------------------|-----------|---------------|--------------|----------|-----------------|----------|--------|-----------------------------|
| Number of daughters | 77 | 21 | 99 | 115 | 59 | 21 | 21 | 29 | 481 |
| Milk, Kg M ± m | 7530 ± 126 | 7833 ± 198 | 7625 ± 99 | 7725 ± 100 | 7078 ± 108 | 7413 ± 234 | 6763 ± 265 | 6957 ± 178 | 7472 ± 48 |
| Cv,% | 14.7 | 11.6 | 13.0 | 14.0 | 11.7 | 14.5 | 18.0 | 13.8 | 14.0 |
It should be noted that all *Alta Genetics* daughters tend to have superiority over the daughters other bulls’ offspring. The daughters of the Benedict, Carl-A Appleton, Titanium and Eubrox daughters differed in milk yield below the average of all first-calf cows in the herd, relatively, by 394 kg (P <0.001); 59 kg; 708 kg (P <0.01), and 515 kg (P <0.01).

**Table 2.** Functional properties of the udder.

| Nickname of the bull-father | Index | Number of daughters |
|-----------------------------|-------|---------------------|
|                             |       | Aldta Madison | Alta Gost | Alta Networth | Alta Samuari | Benedict | Karl-A Appleton | Titanium | Eubrox | Average for first-calf heifers |
| Daily milk yield, kg        | M ± m | 77 | 21 | 99 | 115 | 59 | 21 | 21 | 29 | 481 |
|                            | ± 3.2 | 27.0 | 26.3 | 23.7 | 23.7 | 20.2 | 21.2 | 20.5 | 20.0 | 23.3 |
|                            | Cv,%  | 11.8 | 5.7 | 15.8 | 17.6 | 17.5 | 10.4 | 9.2 | 14.8 | 15.7 |
| Milk flow rate, kg/min      | M ± m | 2.7 | 3.1 | 2.7 | 2.7 | 1.9 | 2.1 | 1.9 | 1.9 | 2.5 ± |
|                            | ± 0.1 | 31.9 | 22.1 | 31.0 | 32.7 | 25.2 | 27.5 | 20.6 | 36.4 | 24.3 |

There were no significant differences in the mass fraction of fat and protein in milk. However, due to the high milk yield of the Alta Gost’s daughters, they surpassed in milk fat yield by 18.6 kg (P <0.05), and the daughters of Alta Samuari - by 9 kg (P <0.05). The latter also differed in protein yield, their superiority was 7 kg (P <0.05). The fat and protein yield was significantly lower than the average for first-calf heifers in the Benedict’s daughters by 15.3 kg and 11.5 kg (P <0.001), and the Eubrox’s daughters - by 17.6 and 14.8 kg (P <0.01). When using cows in modern dairy complexes, much attention is paid to the milking time of the cow. The milk flow rate and the udder capacity are the main features characterizing its functional properties (Table 2).

The daughters of Alta Gost were characterized by the best milk yield at the highest daily milk yield with a difference of 0.6 kg/min by the first index and 3.0 kg by the second one (P <0.001). The daughters of Benedict, Carl-A Appleton, Titanium and Eubrox had significantly lower indicators for both studied characteristics.

Characteristics of cows in terms of weight and milk productivity ratio are given below (Table 3).

There were no differences in weight of first-calf cows. This index is significantly more dependent on the level of feeding the young herd during rearing and is determined by the plan of rearing the young herd, as evidenced by the low variability of the index. At the same time, the daughters of Alta Samuari showed the best milk yield - 16.7 kg, that shows the superiority over the other cows of 0.6 kg (P <0.05). The daughters of Benedict, Titanium and Eubrox, on the other hand, were inferior in terms of milk productivity by 0.8; 1.3 (P <0.001) and 0.8 (P <0.05), relatively.

In improving the productive qualities of animals, breeding of individuals of the desired body type is of great importance. In countries with developed dairy cattle breeding, and more recently in Russia, for the selection of animals of the desired type, a linear assessment of the exterior is used, which makes it possible to evaluate the exterior of the daughters from different bulls to carry out selection in order to correct constitutional deficiencies. [1,3,4,9]

Visual assessment for a complex of indexes showed that animals scored more than 80 points for all its components, which allows us to classify them as “good with a positive tendency” in terms of body type.
Table 3. Live weight and milk productivity coefficient of the first-calf cows.

| Index                        | Nickname of the bull-father | Average by first-calf heifers |
|------------------------------|-----------------------------|------------------------------|
|                              | Aldta Madison               |                             |
|                              | Alta Gost                   |                             |
|                              | Alta Networth               |                             |
|                              | Alta Samuari                |                             |
|                              | Benedict                    |                             |
|                              | Karl-A Appleton             |                             |
|                              | Titanium                    |                             |
|                              | Eubrox                      |                             |
|                              | Number of daughters         |                             |
|                              | 77                          | 21                          |
|                              | 99                          | 115                         |
|                              | 59                          | 21                          |
|                              | 21                          | 21                          |
|                              | 29                          | 481                         |

| Weight, kg                   | M ± m, CV,%                 |
|------------------------------|-----------------------------|
| M                            | 468 ± 2.5, 4.7%             |
| Alta Madison                 |                             |
| Alta Gost                    | 471 ± 4.1, 3.9%             |
| Alta Networth                | 464 ± 2.3, 4.9%             |
| Alta Samuari                 | 462 ± 3.0, 4.8%             |
| Benedict                     | 462 ± 4.9, 5.0%             |
| Karl-A Appleton              | 487 ± 4.5, 4.9%             |
| Titanium                     | 456 ± 4.1, 4.5%             |
| Eubrox                       | 463 ± 1.1, 5.0%             |

| Milk factor                  | M ± m, CV,%                 |
|------------------------------|-----------------------------|
| Alta Madison                 | 16.1 ± 0.2, 13.0%           |
| Alta Gost                    | 16.6 ± 0.4, 11.3%           |
| Alta Networth                | 16.4 ± 0.2, 12.3%           |
| Alta Samuari                 | 16.7 ± 0.2, 12.3%           |
| Benedict                     | 15.3 ± 0.4, 13.4%           |
| Karl-A Appleton              | 16.0 ± 0.4, 13.1%           |
| Titanium                     | 14.8 ± 0.6, 17.7%           |
| Eubrox                       | 15.3 ± 0.4, 13.1%           |

At the same time, first-calf heifers received the lowest score of 77 points for the complex of indexes characterizing the limbs, despite their correct formulation, revealed during the linear assessment (Table 4).

Table 4. Assessment for the body type of cows (n= 65).

| Index               | Score (M ± m), score | CV,% |
|---------------------|----------------------|------|
| Body size           | 82.4 ± 0.52          | 4.1  |
| Milk forms          | 82.7 ± 0.38          | 3.6  |
| Legs                | 77.3 ± 0.51          | 5.2  |
| Udder               | 80.5 ± 0.6           | 5.9  |
| General form        | 82.4 ± 0.36          | 3.4  |
| Overall score       | 80.9 ± 0.38          | 3.7  |
| Body type           | good with a positive tendency |

To detail the reasons for the decrease in the score of the body type index, it is necessary to take into account the shortcomings of the exterior (Figure 2).

Figure 2. The prevalence of major deficiencies in first-calf cows.
Figure 2 shows the disadvantages that frequently occur than 10%. These include the disadvantages of the udder: inclined bottom (17%); asymmetry (16%); close nipples (40%). The greatest number of deficiencies is associated with the limbs: close hocks (35%); wide interdigital cleft (71%); narrow hoof (22%). The last listed disadvantages, among other reasons, increase the risk of limb disease, and could lead to abnormal growth of the hoof horn, injury to the sole or interdigital space.

4. Conclusion
As a result, the following results were obtained. Since the daughters of the bulls Alta Gost and Alta Samuari have a significant superiority over the other examined cows, it could be recommended their preferred use as the bulls-improvers at dairy complexes. When selecting bulls, it is advised to assign herds of bulls to cows, assessed by the exterior of their daughters. Also it is important to pay special attention to the structure of the limbs and the characteristics of the udder.

References/
[1] Gauly M et al 2013 Future consequences and challenges for dairy cow production systems arising from climate change in central Europe - a review Animal 5 843-859
[2] Gleeson D E, O’Brien B, Boyle L and Earley B 2007 Effect of milking frequency and nutritional level on aspects of the health and welfare of dairy cows Animal 1 125–132
[3] Heath C A E, Main D C J, Mullan S, Haskell M J and Browne W J 2016 Sequential sampling: a novel method in farm animal welfare assessment Animal 2 349–356
[4] Lyashenko V V, Balakirev N A and, Prokhorov I P 2020 Modern technologies for increasing the reproduction level in dairy cattle Bulletin of the National Academy of sciences of the republic of Kazakhstan 1 72-79
[5] Velmatov A A, Al-Isavi A A H, Velmatov A P, Guryanov A M, Tishkina T N, Abushaev R A and Zelentsov S. E 2020 The effect of increased feeding on heifers and their subsequent milk production Plant Archives 2 4716–20
[6] Velmatov A P, Kostin O V, Tishkina T N, Neyaskin N N, Erofeev V I and Dugushkin N V 2019 The Efficiency of using Simmental x Holstein Hybrids of Various Types of Body Composition International Journal of Engineering and Advanced Technology (IJEAN) Vol. 9 1 717–722
[7] Velmatov A P, Neyaskin N N, Al-Isavi A A H, Tishkina T N and Velmatov A A 2019 Economical-biological features of Simmental and Holstein hybrids Ecology Environment and Conservation  vol 25 2 440–445
[8] Velmatov A P, Mungin V V, Tishkina T N, Neyaskin N N, Velmatova L N and Guryanov A M 2020 Impact of ruminal fluid compostio on the digestibility of nutrients and milk yield International Journal onEmerdindg Technologies 2 495–500
[9] Yudin N S and Larkin D M 2019 Origin, selection and adaptation of russian cattle breeds according to genome-wide studies Vavilov Journal of Genetics and Breeding 5 559–568