Evaluation of the relationship between milk yield and the service period duration of cows

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Abstract. In the Sverdlovsk Region, the breeding stock of the black-and-white Ural breed was covered with the seed of servicing bulls of Canadian, Danish and German selection. They are able to show good average daily milk yields throughout lactation, to produce for a long time without a sharp decrease in milk yield, but at the same time, the problem of a decrease in the reproductive ability of cows and, as a consequence, a decrease in the productive longevity of the breeding stock was identified. The purpose of the work is to assess the relationship between the indicators of milk yield of Holsteinized black-and-white cattle of the Ural breed and the service period duration. It has been established that milk yield in first-calf cows increases with an increase in live weight to 600-624 kg, and then slightly decreases (P≥0.05). Calculation of the correlation coefficient between the characteristics of milk yield per lactation and live weight of first-calf heifers showed that it is different and varies depending on the live weight of cows from -0.36 for cows with a live weight of less than 550 kg to 0.28 for animals with a live weight of over 625 kg. There was a low positive relationship of these characteristics in cows with live weight of 575-599 kg. On average for the herd, it is positive and is 0.15. The service period for first-calf heifers ranged from 99 days (live weight 550-574 kg) to 162 days (live weight over 625 kg). Large milk yields were observed in animals with live weight of 575-599 kg and a service period of 138-140 days. A positive high and medium correlation between milk yield and the service period duration was established in groups of cows with live weight up to 550 and 575-624 kg and on average for the herd. It is impossible to draw an unambiguous conclusion about the influence of the service period duration on the quality indicators of milk, with the exception of the indicator service period – mass fraction of protein (MFP), where it was negative regardless of the live weight of cows.

1. Introduction
Continuous and sustainable supply of population with high-quality food, including milk, is the main necessity in ensuring the health of the nation and food security of any country [1-7]. At the same time, special attention is paid to the development of dairy cattle breeding, since the main amount, more than 97% of the total production, of a valuable food product and raw material for the dairy industry - milk,
is obtained from cattle. An increase in the productivity of cows is inseparably associated with an improvement in the milk quality [8-18]. The main livestock of dairy cattle belongs to the domestic black-and-white breed, in which offspring are distinguished, differing in economic and biological characteristics. In recent years, a related Holstein breed has been used to improve dairy cattle. The widespread, long-term use of the valuable gene pool of foreign breeding Holstein bulls led to the creation of a large array of Holstein cattle in various climatic and ecological forage zones of the country, which also differs in economically useful and biological characteristics, which is due to the breed resources of cattle breeding zone and country of origin of servicing bulls involved in crossing [19-21]. Thus, in the Sverdlovsk region, the breeding stock of the black-and-white Ural breed was covered with the seed of servicing bulls of Canadian, Danish and German breeding. As a result, highly productive animals were obtained, showing high productivity in industrial milk production. They are able to show good average daily milk yield throughout lactation, to produce for a long time without a sharp decrease in milk yield, but at the same time the problem of a decrease in the reproductive capacity of cows and, as a consequence, a decrease in the productive longevity of the breeding stock was identified [22-28].

Assessment of the relationship between the milk productivity of cows, their live weight and the service period duration is relevant and of practical importance. The purpose of this work is to study the relationship of milk productivity of Holsteinized black-and-white cattle of the Ural breed with different live weight and the service period duration.

2. Materials and method

The studies were carried out in conditions of one of the pedigree reproducers for breeding black-and-white cattle of the Ural type. The study included all the livestock of first-calf heifers that completed lactation to 01.10.2019, which were divided into groups by live weight: up to 550 kg, 550-574 kg, 575-599 kg, 600-624 kg and more than 625 kg. For the analysis, the data of zootechnical and breeding records of the Seleks base were used. Milk yield was taken into account by conducting control milking once a month, quality indicators of milk: MFF and MFP in milk, which were checked monthly from each cow in the conditions of the dairy laboratory of OJSC "Uralplemcenter" of the Sverdlovsk region. The live weight of cows was estimated by individual weighing after calving. The milk production coefficient and the correlation coefficients between the indicators of milk yield and the service period duration were calculated, taking into account the live weight of first-calf cows.

3. Results

The farm is engaged in breeding highly productive Holsteinized cattle of the black-and-white breed of the Ural type with a high proportion of Holstein blood (more than 91%). This is one of the few farms with a high duration of productive longevity of the breed stock - 4.1 lactations and a milk yield per cow of 8215 kg.

Figure 1 shows milk yield per lactation in cows with different live weights.

![Figure 1. Milk yield for 305 days of lactation of first-calf cows, kg.](image-url)
Milk yield in first-calf cows increases with an increase in live weight to 600-624 kg, and then slightly decreases (P≥0.05). Calculation of the correlation coefficient between the characteristics of milk yield per lactation and live weight of first-calf heifers showed that it is different and varies depending on the live weight of cows from -0.36 in cows with a live weight of less than 550 kg to 0.28 in animals with a live weight of over 625 kg. There was a low positive relationship of these characteristics in cows with live weight of 575-599 kg. On average for the herd, it is positive and amounts to 0.15.

The milk yield coefficient shows the constitutional orientation of cows towards one or another productivity. Data on the milk production ratio of first-calf cows depending on live weight are presented in table 1.

| Live weight, kg | Milk yield per lactation, kg | Live weight, kg | Coefficient milk content |
|----------------|-----------------------------|----------------|-------------------------|
| Up to 550      | 8017±1073.17                | 543.5±1.44     | 1475±168.99             |
| 550-574        | 8542±269.65                 | 561.4±1.44     | 1522±55.32              |
| 575-599        | 9234±137.67                 | 587.6±0.85     | 1571±47.72              |
| 600-624        | 9426±93.01                  | 611.5±0.67     | 1541±37.44              |
| More than 625  | 9207±257.73                 | 632.3±1.89     | 1456±69.48              |
| On average     | 9264±73.83                  | 600.1±1.21     | 1544±74.27              |

All heifers were milk-producing. The milk production coefficient exceeded 1000 kg of milk for every 100 kg of the animal's live weight. The highest milk production coefficient was found in cows with live weight of 575-599 kg, animals with live weight of 550-574 and 600-624 kg were somewhat inferior to these first-calf heifers. Low values of this coefficient were found in cows with low and high live weight. The difference between the groups is insignificant, one can only speak of a positive tendency to increase milk yield with live weight over 550 to 625 kg.

Holsteinized black-and-white cattle have a longer service period (table 2).

| Live weight, kg | Milk yield per lactation, kg | Service period, days |
|----------------|-----------------------------|----------------------|
| Up to 550      | 8017±1073.17                | 148±72.7             |
| 550-574        | 8542±269.65                 | 99±9.22              |
| 575-599        | 9234±137.67                 | 138±8.23             |
| 600-624        | 9426±93.01                  | 140±6.14             |
| More than 625  | 9207±257.73                 | 162±26.51            |
| On average     | 9264±73.83                  | 138±4.69             |

The service period in first-calf heifers ranged from 99 days (live weight 550-574 kg) to 162 days (live weight over 625 kg). Large milk yields were observed in animals with live weight of 575-599 kg and a service period of 138-140 days. This is presented in figure 2.

The calculation of the correlation coefficient between the live weight of cows and the service period duration ranged from a high negative -0.53 (live weight 550-599 kg) to a low positive 0.04 (live weight 600-624 kg). This difference does not allow drawing a conclusion about the influence of the live weight of cows on the service period duration.
Figure 2. Duration of the service period for first-time deliveries, days.

Figure 3 shows the correlation coefficients between the length of the service period and milk yield per lactation depending on the live weight of first-calf heifers.

Positive high and medium correlation was found in groups of cows with live weight up to 550 and 575-624 kg and on average for the herd. In cows with live weight of 550-574 and more than 625 kg, it turned out to be negative.

Table 3 presents data on the relationship between the service period duration and the quality indicators of milk.

Figure 3. Correlation coefficient between milk yield and service period duration, milk yield per lactation, kg – Service period, days.
It is impossible to draw an unambiguous conclusion about the influence of the service period duration on the quality indicators of milk, with the exception of the service-period indicator - MFP, where it was negative regardless of the cow's live weight. Correlation coefficients vary for groups of animals with different live weights and indicators from high negative to low positive (Service period – MFF and MFP) and high positive to low negative (Service period - Amount of milk fat and Amount of milk protein).

On average for the herd, the positive mean relationship was found to be in terms of the length of the service period and the yield of nutrients (amount of milk fat and amount of milk protein) and a low negative relationship in terms of the duration of the service period duration and MFF and MFP in milk.

4. Discussion
It was found that in a herd of first-calf heifers, an increase in milk yield is observed with an increase in live weight to 625 kg and a service period duration of up to 138-140 days, then decreases. Positive high and medium correlation between milk yield and the duration of the service period exists in groups of cows with live weights of up to 550 and 575-624 kg and on average for the herd. It is impossible to draw an unambiguous conclusion about the influence of the duration of the service period on the quality indicators of milk, with the exception of the service-period indicator - MFP, where it was negative regardless of the cow's live weight. Similar studies were carried out by N.V. Bogolyubova, V.P. Korotky, A.S. Zenkin, V.A. Ryzhov, N.P. Buryakov [23,24], Mymrin V and Loretts O [21], O V Gorelik, O E Lihodeevskaya, N N Zezin, M Ya Sevostyanov and O I Leshonok [25-27].

5. Conclusion
Based on the above, it can be concluded that there is a relationship between the indicators of milk productivity and the service period duration, which varies depending on the indicator and the live weight of cows from high and medium positive to medium and low negative.

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