Milk productivity and exterior of holsteinized cows of the Kholmogory breed of different generations

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Abstract. The indicators of milk productivity and exteriors of holsteinized cows of Kholmogory breed of different generations were studied during the work. An analysis of the change in the features of the physique with age and the increase in pedigree in the Holstein breed was carried out. As a result of the research, it was found that linear measurements of cows of different generations have certain differences. Thus, the first-calf cows of the 4th generation have larger latitudinal measurements than the herdmates of the 1st, 2nd, and 3rd generations. In height, at the withers, they exceed the herdmates of the 1st and 2nd generations by 7.54 cm, the 3rd generation by 4.7 cm, an oblique corpus length - by 6.79-5.55-2.75 cm, respectively. At the same time, the first-calf cows of the 4th generation have a more tender type, their chest girth is smaller than herdmates at 4.04-1.66 cm, the pastern girth - at 1.1-0.29 cm. Reduction of the chest depth from the first generation to the fourth by 2.63 cm is observed in cows of all ages. Full-grown cows of the 4th generation also outperformed their herdmates in the following measurements: the withers height by 7.03 cm of the herdmates of the 1st and 2nd generation and by 2.81 cm of the cows of the 3rd generation, the chest width by 0.12-2.27 cm, width at hips - by 0.23-0.58 cm herdmates of 2 and 3 generations, but gave way by herdmates of the 1st generation by 0.46 cm, an oblique corpus length exceeded the herdmates by 1.27-6.34 cm. The circumference of chest behind the shoulder blades of the 4th generation cows was smaller by 5.37-8.01 cm than in the case of herdmates. The pastern girth in the 4th generation cows was 0.41 cm larger than that of the 3rd generation cows and 0.37-0.45 cm less than in the ones of the 1st and 2nd generation. When comparing milk productivity in cows of different generations, it is clear that the cows of the 4th generation had the highest milk production and live weight.

1. Introduction
The main task of modern dairy cattle breeding is to increase the pedigree and productive qualities of bred cattle breeds and, thereby, to increase the production and processing of milk. In recent decades, the world's best genetic resources have been widely used to improve the cattle of the dairy direction of productivity. The scale of the genetic influence of Holstein cattle, which has the highest potential in the world for milk productivity, a good fat and protein content in milk have especially increased [1-4]. The use of the world gene pool makes it possible to improve, along with the productive qualities, the exterior and adaptability of animals to the conditions of intensive technologies [5-9].

The exterior of the animal is a pedigree sign. Each breed is characterized by specific exterior features, which are created mainly as a result of the appropriate planned selection and selection of
animals according to the exteriors, taking into account specialization, as well as under the influence of certain environmental conditions [10-14].

An animal's assessment of the exterior and constitution plays an important role in the breeding of dairy cattle. In countries with developed dairy cattle breeding and in our country, the assessment of the exterior is carried out using a linear method and is mandatory in assessing bulls-producers in terms of the quality of the offspring [2, 15-18], at the same time, the traditional estimation of the exterior did not lose its significance.

In Udmurtia over the past 30 years’ producers of Holstein breed different origins have been widely used in the development of Kholmogory and white-and-black cattle. They had a significant impact on the productive and exteriors of livestock [19]. Therefore, there was a need to study the dairy productivity and the exteriors of holsteinized cows of the Kholmogory breed of different generations.

2. Experimental research

The study of milk productivity and exteriors of holsteinized cows of the Kholmogory breed was conducted in JSC "Put Ilyicha", which is a breeding plant and a basic farm for the improvement of livestock. Data on milk productivity and basic measurements of cows with at least three complete lactations were taken for evaluation. Data of the program "Selax", zootechnical and pedigree accounting, as well as our own research served as a material for research. 580 cows born between 1995 and 2012 with at least three complete lactations were included in the sample for research. Depending on the year of birth, all animals were divided into four generations: 1 - born before 2000, 2 - born from 2000 to 2004, 3 - born from 2005 to 2009, 4 - born from 2010 to 2012. The pedigree at the Holstein breed in cows of the 1st group was up to 50%, the 2nd group - 51-75%, the 3rd group - 76-85%, the 4th group - 86-93%. The animals’ exterior was evaluated on the basis of seven measurements: height at the withers, chest depth, chest width, width at hips, oblique corpus length, chest girth, pastern girth. Biometric processing of the results of the assessment of the exterior was carried out using the program "Microsoft Excel" using the generally accepted formulas.

3. Results and Considerations

Analysis of the productive qualities and exteriors of the cows of the Kholmogory breed showed that the Holstein breed had a significant impact on both the cow's exterior (table 1) and the productivity level (table 2). Thus, measurements of the first-calf cows of all generations differ from the measurements of purebred Kholmogory cows. When compared with purebred Kholmogory cows [19], it is seen that the height at the withers increased by 2.6-8.9%, chest depth - by 2.0-4.7%, chest width - by 1.5-9.6%, width at hips - 0-3.0%, chest girth - at 2.01-0.4%, pastern girth of first-calf cows in the first-generation increased by 4.5%, and the 4th generation became less by 2.0%. This trend is observed in the second and third lactation.

Table 1. Measurements of cows the Kholmogory breed of different generations (X±m).

| Measurements           | 1 lactation | 2 lactation | 3 and older lactation |
|------------------------|-------------|-------------|-----------------------|
| Before 2000            |             |             |                       |
| n                      | 91          | 91          | 91                    |
| Height at the withers  | 130.47±0.32 | 132.23±0.24 | 133.43±0.20           |
| Chest depth            | 69.23±0.14  | 71.08±0.12  | 72.21±0.08            |
| Chest width            | 41.19±0.12  | 42.44±0.11  | 43.42±0.13            |
| Width at hips          | 49.79±0.28  | 50.98±0.23  | 52.24±0.21            |
| Oblique corpus length  | 151.13±0.47 | 153.62±0.47 | 155.01±0.51           |
| Chest girth            | 185.65±0.46 | 189.26±0.31 | 191.38±0.30           |
| Pastern girth          | 19.08±0.06  | 19.15±0.07  | 19.23±0.08            |
|                        | 2000-2004   |             |                       |
| n                      | 307         | 307         | 307                   |
| Height at the withers  | 130.91±0.12 | 132.38±0.15 | 133.41±0.14           |
| Measurement                  | 2005-2009          | 2010-2012          |
|------------------------------|--------------------|--------------------|
|                              | n 120 120 120      | n 62 62 62         |
| Height at the withers        | 133.31±0.24 135.67±0.23 137.65±0.29 | 138.01±0.35 139.33±0.33 140.46±0.31 |
| Chest depth                  | 68.75±0.22 71.32±0.23 73.00±0.27 | 66.60±0.15 68.12±0.24 69.29±0.28 |
| Chest width                  | 42.79±0.14 44.60±0.12 45.57±0.10 | 44.04±0.14 45.03±0.14 45.69±0.13 |
| Width at hips                | 49.41±0.15 50.60±0.11 51.20±0.11 | 50.33±0.11 51.22±0.13 51.78±0.14 |
| Oblique corpus length        | 155.17±0.46 158.19±0.35 160.08±0.41 | 157.92±0.49 159.69±0.55 161.35±0.56 |
| Chest girth                  | 183.27±0.33 187.07±0.32 190.67±0.46 | 181.61±0.21 183.66±0.21 185.30±0.30 |
| Pastern girth                | 18.27±0.05 18.38±0.05 18.45±0.05 | 17.98±0.01 18.61±0.06 18.86±0.06 |

A regular increase in linear measurements of cows of different generations with age is established by comparing the dynamics of their growth. So, the height at the withers increases to the third lactation by 2.45-4.34 cm (P≥0.95), the chest depth by 2.69-4.2 cm (P≥0.95), the chest width - by 1.65-2.78 cm (P≥0.95), the width at hips - by 1.45-2.77 cm (P≥0.95), the oblique corpus length - by 3.43-7.17 cm (P≥0.95), the chest girth - by 3.69-7.4 cm (P≥0.95), the pastern girth - by 0.15-0.88 cm (P≥0.95). In this case, the animals of the 3rd generation (except for the width at hips and the oblique corpus length) differed in the greatest intensity of growth with age, and the animals of the 4th generation – the lowest.

When comparing linear measurements of cows of different generations on the first lactation it is clear that they have significant differences. Comparing the measurements of the first-calf cows of different generations, it can be seen that the first-calf cows of the 4th generation have larger latitudinal measurements than herdmates of the 1st, 2nd and 3rd generations. In height at the withers they exceed herdmates of the 1st and 2nd generations by 7.54 cm (P≥0.95), the 3rd generation - by 4.7 cm (P≥0.95), the oblique corpus length - by 6.79-5.55-2.75 cm, respectively (P≥0.95). At the same time, the first-calf cows of the 4th generation have a more tender type, their chest girth is smaller than herdmates of the 1st - 3rd generations at 4.04-1.66 cm, the pastern girth - at 1.1-0.29 cm. Reduction of the chest depth from the first generation to the fourth by 2.63 cm is observed in cows of all ages (P≥0.95).

When comparing the measurements of cows of different generations for the 2nd lactation, it was revealed that the cows of the 4th generation retained their superiority over the ones of the 1st, 2nd and 3rd generations in height at the withers by 3.66-7.1 cm (P≥0.95), chest width – 0.43-2.59 cm (P≥0.95), width at hips – 0.24-0.85 cm, oblique corpus length – 1.5-6.07 cm (P≥0.95). Cows of the third generation outperformed their herdmates in the chest depth by 0.24-3.2 cm. The chest circumference behind the shoulder blades was 3.41-5.6 cm (P≥0.95) and was smaller in cows of the 4th generation than in the herdmates of the same age. The pastern girth in cows in the 4th generation...
was by 0.23 cm (P≥0.95) larger than that of the 3rd generation cows and by 0.54-0.68 cm lower than that of the 1st and 2nd generation herdmates.

Full-grown cows of the 4th generation also outperformed their herdmates in the measurements: the height of the withers by 7.03 cm (P≥0.95) of the herdmates of the 1st and 2nd generation and by 2.81 cm of the cows of the 3rd generation (P≥0.95), the chest width by 0.12-2.27 cm (P≥0.95), width at hips - by 0.23-0.58 cm herdmates of 2 and 3 generations, but gave way by herdmates of the 1st generation by 0.46 cm, an oblique corpus length exceeded the herdmates by 1.27-6.34 cm (P≥0.95). Full-grown cows of the 3rd generation outperformed their herdmates in chest depth by 0.79-3.71 cm (P≥0.95). The chest circumference behind the shoulder blades in cows of the 4th generation was significantly higher than that of the 3rd generation and by 0.27-0.81 cm (P≥0.95) larger than in cows of the 3rd generation and by 0.37-0.45 cm (P≥0.95) less than in herdmates of the 1st and 2nd generation.

Studies of milk productivity of cows (table 2) showed a regular increase in milk yield for 305 days of lactation and live weight of cows with age, regardless of generation. Cows of 3rd and 4th generations had the highest milk production and live weight. Thus, the yield of the first lactation was by 1676 kg, the 2nd generation had the highest milk production and live weight. The 3rd generation had the highest milk production and live weight. The 4th generation had the highest milk production and live weight. Regardless of generation, cows of 3rd and 4th generations had the highest milk production and live weight.

Table 2. Dairy productivity of cows of different generations (X±m).

| Generation | Indicators | 1 lactation | 2 lactation | 3 lactation |
|------------|------------|-------------|-------------|-------------|
| I          | Yield, kg  | 4237.7±79.3 | 4763.0±87.9 | 5022.7±82.7 |
|            | Fat mass fraction,% | 3.63±0.01 | 3.66±0.01 | 3.63±0.01 |
|            | Live weight, kg | 465.7±2.4 | 518.5±2.3 | 547.3±2.9 |
| II         | Yield, kg  | 4689.7±44.6 | 4979.3±53.8 | 5475.1±52.9 |
|            | Fat mass fraction,% | 3.70±0.01 | 3.74±0.01 | 3.75±0.01 |
|            | Live weight, kg | 485.1±0.8 | 521.6±1.0 | 545.6±1.1 |
| III        | Yield, kg  | 5570.9±53.8 | 6176.4±84.9 | 6940.7±52.1 |
|            | Fat mass fraction,% | 3.76±0.01 | 3.78±0.01 | 3.72±0.01 |
|            | Live weight, kg | 502.7±0.7 | 526.8±0.8 | 554.5±1.3 |
| IV         | Yield, kg  | 5762.5±30.9 | 6708.1±49.4 | 7151.3±80.1 |
|            | Fat mass fraction,% | 3.84±0.01 | 3.80±0.01 | 3.80±0.01 |
|            | Live weight, kg | 511.1±0.7 | 553.1±1.5 | 589.6±1.9 |

When comparing milk productivity in cows of different generations, it is clear that the cows of the 4th generation had the highest milk production and live weight. Thus, the yield of the first-calf cows of the 4th generation was higher than that of herdmates by 191.6-1524.8 kg (P≥0.95), the fat content in milk was 0.08-0.21% (P≥0.95), the live weight was more by 8.4-45.4 kg (P≥0.95). The yield of full-grown cows of the 4th generation was significantly higher than that of the 3rd generation cows by 210.6 kg, the 2nd generation - by 1676.2 kg, the 1st generation - by 2128.6 kg (P≥0.95). The fat content of milk in full-grown cows was also significantly higher than in herdmates of other generations by 0.05-0.17% (P≥0.95). Full-grown cows of the 4th generation were larger than their herdmates by 35.1-44.0 kg (P≥0.95).

4. Conclusion

The Holstein breed had a significant impact on the exterior and milk productivity of the Kholmogory breed cows. A new type of Kholmogory cattle, taller, with a delicate thin bone, with a high milk yield, was formed with an increase in pedigree in the Holstein breed.

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