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Features of Growth and Development in Heifers of Holstein and Black-and-White Breeds

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Abstract: The study of the characteristics of the growth and development of farm animals is of interest in breeding, as it will help to improve animal breeds, as well as serve for the organization of fast and economically rational raising of productive livestock. The research aims to study the characteristics of growth and development and indicators of reproduction of the Holstein and Black-and-White breeds. For research, three groups of 10-day-old heifers were formed. Body weight was considered by individual weighing at birth, at 3, 6, 9, 12, 15 and 18 months. The reproductive indices of heifers were studied according to the data of the log of inseminations and calving of cows: The age at the first insemination, the age at fertilization and the number of inseminations per 1 fruitful insemination were considered. The conducted studies led to a conclusion that the Holstein heifers had an advantage in live weight over the Black-and-White heifers at the age of 6 months by 19.5 kg and 15.5 kg ($P \leq 0.001$), at 12 months of age by 18.4 kg ($P \leq 0.01$) and 19.2 kg, at 18 months by 28.0 kg and 25.3 kg ($P \leq 0.01$), respectively and exceeded them in growth intensity during the entire study period. The Holstein animals matured faster and were inseminated 43.2-45.8 days earlier than the Black-and-White animals that were inseminated at 511 days. Profits from raising the Holstein heifers were higher by $48.79-54.79.

Keywords: Black-and-White Breed, Holstein Breed, Reproduction, Selection, Young Stock

Introduction

The growth and development of animals directly depend on genetic origin, feeding, housing, indoor microclimate, and health (Cherepchenko and Afanasev, 2017). In animal husbandry, the process of raising heifers that mate at an early age is considered promising, since this increases the period of their productivity (Nekrasov *et al*., 2013; Babich *et al*., 2019a).

The experience of different farms shows that stud bulls have an unequal effect on the growth and development of heifers (Delyan *et al*., 2018; Lyubimov and Isupova, 2019). Consequently, when planning work to improve the productive qualities of dairy cattle, it is necessary to consider the different influences of stud bulls on the economically useful qualities of the offspring, including the characteristics of growth and development (Mikhalev, 2019). Currently, one of the most priority areas for increasing the productivity of dairy breeds and the manufacturability of farmed cattle is the use of the genetic potential of the Holstein breed in cattle breeding.

Thus, in the studies of Panfilova *et al*. (2019), the researchers found that red-and-white Holstein heifers of German selection exceeded the purebred red-and-white peers of Russian selection in live weight during the rearing period and during insemination they had live weight of 410 kg, exceeding the Russian-bred heifers by 19 kg, or 4.8%. Fedoseeva *et al*. (2013) report that the use of Holstein bulls increased the number of heifers with a bowl-shaped udder by 8-45%, increased the intensity of milk flow by 0.08-0.56 kg/min, and the value of the udder index by 0.5-5.5%. Haertdinov and Saifutdinov (2017) concluded that to increase the productive indicators it was advisable to use the seed of stud bulls with the highest growth rate of heifers born from them.

Currently, there is a threat of extinction of the Black-and-White breed, which is inferior to the Holstein breed in productivity but has advantages in endurance, resistance to diseases, and adaptation to extreme environmental conditions (Basonov *et al*., 2016). Therefore, it is necessary to form a competitive breeding

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base, which will meet the needs of milk producers in high-quality breeding products and provide commercial enterprises with highly productive young animals (Haertdinov and Saifutdinov, 2017).

To form the competitiveness of the breeding base, it is necessary to carry out breeding work, examining heifers of various breeds under the influence of paratypical factors, in particular, natural and climatic conditions, as well as the food base, to determine the characteristics of their growth and development in the postnatal period.

The study aimed to study the characteristics of growth and development and indicators of reproduction of heifers of the Black-and-White and Holstein breeds.

The most responsible technological process is the rearing of replacement heifers from birth to adulthood since one can obtain high milk productivity without losing the reproductive capacity for a long time only from animals with well-developed cardiovascular, respiratory, and digestive systems and strong body composition. Rearing must be carried out taking into account the specific conditions of the zone, the intended purpose, and the hereditary characteristics of the animals. All work is aimed at maximizing the genetic potential, while scientifically grounded balanced feeding should meet the physiological and biological requirements of animals (Bradford *et al*., 2017; Ulimbashev and Kankulova, 2019; Sushkov and Lobanov, 2020).

An increase in the level of production of livestock products can be ensured only through the intensification of the industry, a more complete supply of animals with fodder, and an increase in the efficiency of breeding work in conditions of intensive milk production technologies. Special attention is paid to the technology of growing hybrid young animals, which is aimed at the formation of high productivity in animals (Lamonov, 2017). The processes of growth and development of farm animals occur unevenly and are subject to certain biological laws, which serve as indicators of their milk productivity (Neverova *et al*., 2020; Pavlova, 2017; Tsopanova *et al*., 2020).

The modern concept of the development of animal husbandry in Kazakhstan is focused on a significant increase in the production of agricultural products, in particular, dairy cattle breeding. It is, to a large extent, based on the determination and the fullest use of the genetic potential of the animal. The use of Holstein bulls on the broodstock of the Black-and-White breed had a positive effect on the realization of the genetic potential for the energy of growth and development (Fedorenko *et al*., 2019). Most of the developed countries of the world, such as Germany, Italy, and Russia, are making the transition to Holstein cattle in dairy cattle breeding, using the seed of stud bulls from North America (Tekeev *et al*., 2018; Babich *et al*., 2019b). This is one of the goals of selection and breeding work to improve the Black-and-White breed. By interbreeding animals one can achieve two goals at once: An effective method of the fastest creation of a more perfect hereditary generation, which is manifested in a significant restructuring of the body composition, and morphological and functional characteristics of the organism based on the effect of heterosis and crossing breeds of different breeding goals and severity of traits to create one breed that combines the best traits of the two parental breeds (Zelenov, 2017; Batanov and Starostina, 2020).

For some breeds of cattle, in particular the Black-and-White breed, interbreeding plays an important role, which is expressed in the appearance of positive traits. The combination of desirable properties in the breed leads to the creation of a group of animals with strong body composition, good adaptive ability, and the ability to produce competitive products on the market. Crossbred animals are more diverse in traits, and less stable during their transmission to offspring, but they have a high level of metabolic processes, their gas exchange and digestibility of feed are expressed by more effective indicators and their organs and tissues work more intensively, which indicates their high viability. The genetically determined high productivity of crossbred cattle is closely related to the complex and diverse metabolic processes occurring in the body and reflected in the morphological and biochemical parameters of the blood. As we know, being the internal environment of the body, blood and its components have a relative constancy of composition, while being a labile system that most fully reflects the physiological processes occurring in the body of an animal (Lamonov, 2017; Gontyurev *et al*., 2018). Thus, the study of the patterns of individual development of animals depending on the origin, as well as the study of the blood composition, which characterizes the direction and intensity of metabolic processes, create the prerequisites for the possibility of controlling the growth and development of animals at a certain stage of ontogenesis. Live weight and its dynamics with age are among the most important breeding characteristics of dairy cows. This indicator characterizes the general development of the animal's body. Highly productive cows should be well-developed and have a strong body composition and health (Lamonov and Skorkina, 2018).

A comparative assessment of the Telokgolshtinsky breed of German, Danish, and Dutch selection was carried out by Tsopanova *et al*. (2020). Denisov showed that the live weight at birth was almost the same. However, heifers of Dutch selection in terms of the dynamics of live weight exceeded their peers by 1.8-16.8 kg at all age periods (Tsopanova *et al*., 2020). To speed up the breeding processes and increase the production of livestock products, the introduction of intensive technology for raising young animals is of great importance, as it significantly reduces the time for raising cows. In this case, the formation of the qualities necessary for keeping in conditions of intensive technology is of particular importance (Batanov and Starostina, 2018). The increase

in the milk production of cattle is closely related to the selection, evaluation, and intensive use of high-value stud bulls. The experience of different farms shows that stud bulls have an unequal effect on the productivity of their offspring (Bikmatov *et al*., 2019). Consequently, when planning work to improve the productive qualities of dairy cattle, it is necessary to take into account the different influences of stud bulls on the economically useful qualities of the calves born from them.

According to Segodnya (2008), the main task is to obtain young animals with strong bones, and a developed rumen and prepare heifers for insemination. At the age of 3 to 15 months, it is necessary to achieve intensive growth of heifers, obtaining an average daily gain in live weight of 850-900 g. Salikhov and Kosilov (2008; Guterbock, 2013) associate the early first mating at dairy complexes with successful insemination, since with age, heifers obtain adipose tissue more actively, their nutritional status improves and reproductive qualities decrease. Chomaev *et al.* (2010) note that the determination of the optimal age and live weight during the first insemination is relevant when a unified technological procedure for rearing replacement young animals is used on the farm. Early insemination is undesirable since the endocrine status of heifers is not formed and excessively large gains in live weight during the rearing period negatively affect subsequent milk production. Calving at the age of 24-25 months is the most favorable time for obtaining the maximum milk yield in the future (Gorelik *et al*., 2019). Along with this, according to Nekrasov *et al.* (2013), the highest percentage of culling of first-calf heifers during the first lactation was noted among the slowest and fastest-growing animals. It is possible to grow healthy, well-developed, highly productive cows that can rationally use feed and are resistant to the adverse effects of the external environment if the peculiarities of their growth and development in certain age periods are taken into account during the rearing process (Shevhuzhev and Tumov, 2018).

In the studies of Gukezhev and Gabaev (2019) the authors found that out of paratypical factors the intensity of growth and development of young animals was significantly influenced by a change in diet and regrouping of animals. However, the offspring of individual bulls react differently to these processes. Offspring of bulls with a relatively low intensity of growth and development react weakly to the influence of paratypical factors, while offspring with a high intensity of these parameters have a more intense reaction and, in some genotypes, the growth rates significantly drop. Planning the growth and development of young animals based on feeding norms, according to average daily growth rates in different age periods, leads to an underutilization of the potential of some and over-expenditure of feed for other genotypes. The grouping of young animals by origin, taking into account the intensity of growth and development of the offspring of different bulls, makes it possible to inseminate heifers at the age of 15-16 months and reduce the unproductive period. Baimishev and Yakimenko (2015) report that the young Holstein breed surpasses the heifers of the Black-and-White breed in terms of growth rate by 7.9 %. The age of fruitful insemination in individuals of the Holstein breed was 63-70 days earlier and the insemination index was 1.5.

To organize the fast and economically rational raising of productive livestock, we conducted a study of characteristics of growth and development, and indicators of reproduction of the Holstein and Black-and-White breeds, which will help to further improve animal breeds.

Materials and Methods

Ethical Approval

The research protocol was discussed and approved at a meeting of the ethical commission of the Kazakh Research Institute of Livestock and Forage Production of the Ministry of Agriculture of the Republic of Kazakhstan on August 10, 2020.

Research Design

Our scientific and economic experiment was carried out in Sheminovka LLP in the Kostanay district, Kostanay region, the Republic of Kazakhstan in 2020-2021. The objects of research were animals of the Black-and-White and Holstein breeds. For research, three groups of 10-day-old heifers were formed, 20 heads each: Group I-the Black-and-White breed, Group II-the Holstein breed of American selection, and Group III-the Holstein breed of German selection.

The raising of heifers was organized in 3 stages: Stage 1 lasted up to 30 days of age in individual houses without a walking area, stage 2 lasted up to 3 months in individual houses with a walking area and stage 3 included loose keeping in cages with 10 heads per cage. The animals were fed according to the recommended diets and the diet was adjusted according to the feed intake. The data on feed consumption for growing heifers from birth to 18 months are presented in Table 1.

Study of Live Weight and Reproductive Indices

The dynamics of changes in the live weight of heifers were considered by individual weighing at birth, then at the age of 3, 6, 9, 12, 15, and 18 months, followed by the calculation of the absolute and average daily weight gain. The absolute increase for a certain period is determined by the formula:

$$A = W_1 - W_0$$

where,

A = The absolute weight gain, kg

W_1 = The live weight at the end of the period, kg
W_0 = The live weight at the beginning of the period, kg

The average daily gain was calculated using the formula:

$$D = \frac{w_1 - w_0}{N}$$

where,

D = The average daily gain, grams
W_1 = The live weight at the end of the period, kg
W_0 = The live weight at the beginning of the period, kg
N = The number of days between weighings

During the period of raising heifers, observations were made on the nature of the manifestation of sexual functions: The onset of the first heat and the average duration of the sexual cycles. Heifers were inseminated at the age of 15-18 months when they had reached 370-390 kg or 70-75% of the live weight of full-age Black-and-White and Holstein cows. The reproductive indices of heifers were studied according to the data of the log of inseminations and calving of cows: Age at first insemination, age at fertilization, and the number of inseminations attempts per 1 fertile insemination were considered.

Data Analysis

A significant value of the correlation coefficient (Td) was calculated by the formula:

$$Td = \frac{r - \sqrt{n-2}}{\sqrt{1-r^2}}$$

where,
r = The correlation coefficient
n = The number of observations in the sample

The Td standard value of the criterion was determined from Student's table (Lakin, 1990).

All digital material obtained as a result of the research was entered into the database and processed using the grouping method. Statistical processing of the obtained materials was carried out using the method of variation statistics using the Excel software from the Microsoft Office software package (Microsoft, USA).

Results

The data on the consumption of feed for heifers from birth to 18 months are presented in Table 1, which can be used to judge the level and type of animal feeding most fully.

The milk period in the heifers lasted up to 6 months. The newborn calves were kept in the dispensary for 10 days. From the day of birth, each calf was individually fed the mother's colostrum for 4-5 days, after which it was transferred to whole milk from newly calved cows. During this period, the heifers consumed the same amount of milk feed with a slight difference between concentrated and voluminous feed, which, per 1 EFU, provided 105-111 g of digestible protein.

One of the objective indicators that make it possible to obtain the most accurate characteristics of biological characteristics of animals of various origins is the assessment of their growth and development. The study of the dynamics of the live weight of heifers from birth to 18 months showed that under the same conditions of feeding and keeping the Holstein animals of American and German selection grew more intensively than their peers of the Black-and-White breed, Table 2.

Age-related changes in live weight indicate that the live weight of heifers at birth was influenced by their breed (Table 2). Thus, the Black-and-White animals were inferior to their Holstein peers of American selection by 2.4 kg, or 6.9%, at P≤0.001, and their Holstein peers of German selection by 0.9 kg, or 2.8%. The growth rate of replacement calves in the groups differed by period. In the dairy period, the Holstein specimens of American and German selection had an advantage in live weight, which surpassed their peers by 19.5 kg, or 11.4%, and by 15.5 kg, or 9.1%, at P≤0.001. Subsequently, this pattern persisted until the end of the growing period. At 9 months of age, the heifers of these groups had an advantage over the heifers of the Black-and-White breed by 14.4-22.4 kg, or 6.1-9.4%, at P≤0.01-0.001.

By the age of 12 months, the differences in live weight between the groups of heifers had increased and amounted to 18.4 kg, or 6.2%, respectively, with P≤0.01 and 9.2 kg, or 3.1%, in favor of the Holstein animals. Subsequently, at the age of 15 and 18 months, the advantage in live weight of the Holstein heifers increased and amounted to 28.4 kg (8.3 %) and 20.1 kg (5.8 %) with P≤0.01-0.001; 28.0 kg (7.1 %) and 25.3 kg (6.4 %) at P≤0.01, respectively. However, despite the difference, the animals of all groups had a live weight at 18 months of age within 70-75 % of the live weight of full-age cows of the Black-and-White and Holstein breeds.

Figure 1 clearly shows the increase in the live weight of the experimental animals.

The indices of the absolute increase in live weight, characterizing the growth rate of heifers, are presented in Table 3.

The difference for the entire period of rearing in the Holstein heifers of Group II was 25.7 kg or 7.12 % and in Group III 24.5 kg, or 6.78 %, at P≤0.01.

The data on the intensity of growth, i.e., the average daily gain in live weight, are reflected in Table 4.

In the first days of the postnatal period from birth to 6 months, the superiority in average daily gain was in favor

of the Holstein heifers relative to their Black-and-White peers and was 95 g (12.4 %) and 81 g (10.5 %) at P≤0.05-0.001, respectively.

Table 5 presents the main indicators characterizing the formation of the reproductive functions of heifers.

In the heifers of the analyzed groups, the onset of the first sexual heat was observed at different ages and with not the same live weight, which in the Holstein heifers was 220-217 kg, which is 29-26 kg, or 14.8-13.6 %, more than in their Black-and-White peers. The duration of sexual cycles in all studied groups was within 18-24 days and averaged 21.4-21.7 days.

The first insemination of heifers was carried out when they reached a live weight of 370-380 kg. The Holstein animals were inseminated 43.2-45.8 days or 9.2-9.8 % at P≤0.01 earlier compared to Black-and-White. The lowest number of inseminations per 1 fruitful insemination was noted in the Holstein heifers (1.83-1.86 times), which is 0.27-0.24 times lower than in Black-and-White.

Milk production largely depends on the economic effect of raising replacement heifers, creating optimal conditions for feeding and keeping. The economic efficiency of raising the Black-and-White and Holstein heifers is presented in Table 6.

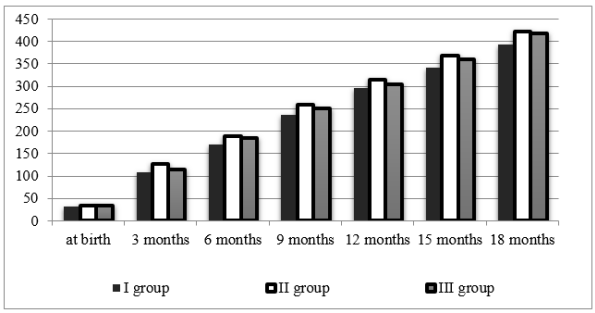

Fig. 1: Dynamics of the experimental heifers' live weight

Table 1: Feed consumption for the growing period per head, kg

	Group of animals		
Feed	Group I	Group II	Group III
Whole cow's milk	400.0	400.0	400.0
Fresh skimmed milk	500.0	500.0	500.0
Concentrates	680.0	720.0	720.0
Wheatgrass hay	1,590.0	1,820.0	1,770.0
Barley straw	720.0	720.0	720.0
Grain and legume-based haylage	2,955.0	3,170.0	3,060.0
Green mass (rapeseed)	1,190.0	1,450.0	1,420.0
Pasture grass (wheatgrass)	1,992.0	2,090.0	2,057.0
Nutrients consumed:			
Energy feed units (EFU)	4,275.5	4,438.4	4,408.9
Dry matter, kg	4,946.9	5,211.4	5,196.8
Crude protein, kg	589.4	632.3	624.5
Digestible protein	448.2	491.6	488.5
Crude fiber, kg	1,422.3	1,490.1	1,482.5
Crude fat, kg	178.4	202.1	198.5
Calcium, kg	32.8	38.5	37.7
Phosphorus, kg	14.9	18.3	17.8

Table 2: Age-related changes in the live weight of heifers, kg (X ± Sx)

	Group of animals		
Age, months	Group I	Group II	Group III
At birth	32.1±0.3	34.5±0.5***	33.0±0.4*
- at 3 months	107.5±1.5	126.0±1.7***	114.7±1.4***
- at 6 months	170.0±2.1	189.5±2.8***	185.5±2.5***
- at 9 months	235.9±3.0	258.3±3.9***	250.3±3.7**
- at 12 months	295.5±4.3	313.9±5.0**	304.7±4.6
- at 15 months	340.8±5.0	369.2±5.9***	360.9±5.3**
- at 18 months	393.1±6.2	421.1±7.3**	418.4±6.7**

Here and below: * — P≤0.05; ** — P≤0.01; *** — P≤0.001

Table 3: Absolute gain in heifers' live weight, kg (X ± Sx)

	Group of animals		
Age period, months	Group I	Group II	Group III
0-3	75.4±1.2	91.5±1.8***	81.7±1.4**
3-6	62.5±2.2	63.5±2.7	70.8±2.4
6-9	65.9±3.1	68.8±3.8	64.8±3.5
9-12	59.6±4.0	55.6±4.8	54.4±4.3
12-15	56.3±4.8	55.3±5.6	56.2±5.0
15-18	52.2±6.0	51.9±6.9	57.5±6.4
0-18	360.9±5.9	386.6±7.1**	385.4±6.8**

Table 4: Dynamics of the average daily gain in live weight with age, g (X ± Sx)

	Group of animals		
Age period, months	Group I	Group II	Group III
0-6	766±18	861±23**	847±15**
6-12	697±21	691±25	662±20
12-18	542±15	595±18	632±16*
0-18	668±17	716±15*	714±18

Table 5: Reproductive performance of heifers

	Group of animals		
Indicator	Group I	Group II	Group III
Age of the 1st heat, days	226.4±3.50	200.3±5.2	202.6±3.1
Live weight in the 1st sexual heat, kg	191.6±5.20	220.1±4.3	217.8±4.8
Age of establishment of a permanent sexual cycle, days	300.7±4.30	281.5±2.5***	279.7±3.1***
The average duration of the sexual cycle, days	21.5±0.40	21.3±0.6	21.6±0.3
Age at the 1st insemination, days	511.3±9.50	468.1±8.2**	465.5±8.7**
Live weight at the 1st insemination, kg	375.3±2.70	384.9±3.2*	379.5±2.3
Age at fertilization, days	576.3±3.80	530.4±4.1***	532.2±4.9***
Number of inseminations per 1 fruitful insemination, times	2.10±0.20	1.83±0.40	1.86±0.30

Table 6: Economic efficiency of raising heifers (per 1 head)

	Group of animals		
Indicator	Group I	Group II	Group III
Fed during the growing period:			
EFU	4,275.50	4,438.4	4,408.90
Raw protein	589.40	632.3	624.50
Digestible protein	368.20	391.6	388.50
The obtained absolute gain in live weight, kg	360.90	386.6	385.40
Spent on 1 kg of live weight gain:			
- EFU	11.85	11.48	11.44
In % of the I group	100.00	96.80	96.50
- Digestible protein, g	1,020.00	1,013.00	1,008.00
In % of the I group	100.00	99.30	98.80
Produced live weight of heifers, kg:			
- Based on every 100 EFU fed	8.44	8.71	8.74
In % of the I group	100.00	103.20	103.50
The selling price of 1 kg of live weight gain, is USD	3.30	3.30	3.30
The cost of gross growth, USD	1,190.97	1,275.78	1,271.82
The total cost of rearing, USD	970.45	1,000.47	1,002.51
Profit from the sale of manufactured products, USD	220.52	275.31	269.31
Profitability level, %	22.70	27.50	26.90

For 1 kg of live weight gain, 11.48-11.44 EFU had been spent, which is 3.2-3.5 % less than their Black-and-White peers. The analysis of economic efficiency showed that for the period of rearing from birth to 18 months of

the Holstein heifers, an absolute increase in live weight was obtained exceeding their Black-and-White peers by 25.7 kg (7.12 %) and by 24.5 kg (6.79 %); in the latter group, this indicator reached only 360.9 kg.

Discussion

The correct organization of rational feeding of dairy animals is based on the knowledge of their needs for energy, nutrients, and biologically active substances necessary for growth, development, milk synthesis, and normal preservation of reproductive functions and health. In conditions of balanced feeding on the main nutrients, the genetic potential of the animal is realized (Lamonov *et al*., 2017). The feeding patterns and rations used on the farm ensured optimal growth and development of the young. Feeding the heifers was organized considering the early habituation to coarse plant-based feed, which contributed to the better development of their digestive system.

The live weight of heifers at birth and in different age periods is of practical importance in raising highly productive cows. It indicates health and the strength of the body composition and also contributes to the manifestation of high milk productivity and long-term use in the farm, which increases the efficiency of milk production.

The studies of Chuvashov (2020), carried out at the Izhevsk Experimental Station, established the superiority of the Holstein bulls of American selection: At 6 months by 16.0 kg (10.0 %), at 12 months by 14.5 kg (5.4 %) and 18 months by 18.3 kg (4.9 %) and according to the average daily gain for the period of rearing from birth to 18 months by 637 g or 5.3 % over bulls of the Black-and-White breed. In our studies, the highest absolute gain in live weight for the entire period of rearing was observed in the groups of the Holstein animals in comparison with their Black-and-White peers (Table 3).

The growth rate of heifers in all groups was high, as evidenced by the data of the average daily increase in live weight, reflected in Table 4. Similar results were obtained by Adamczyk *et al*. (2017; Wang *et al*., 2017).

In our studies, the intense growth of the Holstein animals influenced the age of the first insemination (Table 5). Research by Chesnais *et al*. (2016) also demonstrated that early insemination was correlated with the growth rate of young animals in North America.

Regardless of the age of the heifers, after 3-4 cycles, the formation of full and regular sexual cycles was observed (Table 5). Since that time, animals were considered sexually mature. The age required for the first insemination and the body weight of the Black-and-White and Holstein heifers were different. The Holstein animals turned out to be the earliest to reach maturity. The lowest number of inseminations per 1 fruitful insemination was noted in the Holstein heifers. The results obtained are consistent with the studies of Masuda *et al*. (2016; Retallick *et al*., 2017).

The profitability of raising heifers, presented in Table 6, showed that the Holstein animals were distinguished by better payment for feed regarding the final product. The cost of gross live weight gain, as well as the total costs of growing heifers, allowed us to calculate the level of profitability, which in the groups of the Holstein animals exceeded their Black-and-White peers by 4.8 and 4.2 %, respectively.

Conclusion

In this research, the characteristics of growth and development and indicators of reproduction of heifers of the Black-and-White and Holstein breeds were studied. Based on the studies carried out, it was established that the Holstein animals were characterized by early maturity and a high growth rate. Throughout rearing from birth to 18 months, they received a bigger absolute gain in live weight by 25.7 kg and 24.5 kg, respectively, relative to their Black-and-White peers. The intensive growth of the Holstein heifers allowed for their fruitful insemination much earlier and shortened the unproductive period of use.

Profits from raising Holstein heifers amounted to more by $48.79-54.79. Therefore, raising and breeding Holstein animals of American and German selection is more economically efficient.

In this regard, it is recommended to conduct further research on endurance, disease resistance, and adaptability to extreme environmental conditions in American and German Holstein heifers, as well as the impact of these factors on the economic efficiency of their rearing in a sharply continental climate.

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Author's Contributions

All authors contributed equally to this study.

Ethics

This article is original and contains unpublished material. The corresponding author confirms that all of the other authors have read and approved the manuscript and no ethical issues are involved.

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