Intensive milk production technologies on a modern complex

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Abstract. The article presents the results of research confirming the influence of intensive technologies used in modern dairy complexes on the level of reproduction and productivity of milking herds. It is noted that when heifers are bred intensively in the specialized farm, at the first successful insemination the animals reach a high live weight (350-360 kg) at the age of 330-340 days. A high efficiency of intensive technology of dairy herd reproduction using sexed semen has been established. Thus, the pregnancy rate of heifers from the first insemination was 61.5% and that of cows of the first lactation, taking into account their health condition and the diseases they had undergone, was 41.1%. During calving, 82.9 - 94.3% of replacement heifers were obtained from the control stock of heifers and cows of the first lactation. Researches have shown that intensive technologies of the maintenance, feeding and reproduction herd realized on modern dairy complex provide high milk productivity of animals (the level of milk yield 10,240 kg of milk, mass fraction of fat in milk - 3.98% and that of protein - 3.17%). In the herd more than 3% of animals completed the sixth lactation (the level of milk yield - 9,940 kg of milk, the mass fraction of fat in milk - 4.35% and protein - 3.2%), which demonstrates the prospects of forming the dairy herd with a long period of economic use of cows. Consequently, intensive milk production technologies in modern complexes contribute to the increase of productivity of young cattle and milking cows, ensure high efficiency of reproduction of the dairy herd and, to a certain extent, increase the duration of productive use of animals.

1. Relevance

The country's food security is largely determined by the development of the livestock industry. Of particular importance is dairy cattle breeding [1]. The competitiveness of each livestock sector in the foreign and domestic food market is determined by its intensification. In dairy cattle breeding, particular importance is attached to the modernization of milk production in highly industrialized dairy farms and complexes. In many regions of Russia, along with the reconstruction of old farms, new dairy complexes are being built with modern technological equipment, where innovative technologies for animal housing and feeding are implemented, and the breeding stock is mainly formed by imported, highly productive Holstein cattle.

Stocking farms with foreign-built calves not only requires large financial investments, but also creates problems in adapting the imported animals to the local climatic conditions, which affects their health and productivity. The optimal solution is to organise domestic breeding of elite calves. It is very difficult to obtain an adequate number of replacement heifers each year using traditional reproduction methods. Therefore, in recent years, an innovative technology of using sexed semen to inseminate cows and heifers is in demand [2,3]. Sex regulation in dairy cattle is of considerable practical importance, as it accelerates genetic progress in breeding and pedigree work.
The creation of comfortable conditions for animals that meet the optimal requirements of housing and feeding contributes not only to higher productivity of cows, but also increases the duration of their economic use [4,5].

Biological and technological parameters of cows under conditions of production intensification are manifested in different degrees depending on genetic, technological and individual qualities of animals, and, therefore, require continuous study.

2. Methods and Materials
Cattle breeding in Penza Region is an important sector of agricultural production, with dairy farming actively developing. In 2020, the gross milk yield in commercial farms was 207,300 tonnes, exceeding the 2019 figure by 23.2%, while agricultural organisations produced 8,515kg of milk per cow. The intensification of dairy farming is supported by the region's main milk producer, Rusmolko Group (a subsidiary of Singapore-based Olam International), which is one of the largest milk producers in the Russian Federation. In Penza region the company has production facilities that include three dairy complexes and Russia's largest modern herd reproduction centre for 5,200 animals, designed to supply its own dairy farms with replacement stock. At the beginning of 2021, the total number of cattle at Rusmolko Group increased to 30,750 heads, including 14,000 cows. By the end of 2020, 131,000 tonnes of raw milk were produced, and the milk yield per forage-fed cow was 11,000 litres.

The research was carried out in the production conditions of Rusmolko Group farms on the livestock of Holstein breed of cattle. The following were studied: the technology of breeding replacement heifers and the efficiency of using the biotechnological method of herd reproduction in the specialized enterprise "Megaferma" in Kuznetsk District, as well as the duration of economic use of cows of the milking herd of OAO "RAO "Narovchatskoe" (LLC) in Narovchatsky District of Penza Oblast.

The breeding technology of replacement heifers was monitored taking into account the dynamics of live weight in separate technological periods (0 - 2 months, 2-5 months, 5-10 months, before insemination). The efficiency of using the sexed semen was studied on heifers and first-calf cows of Holstein breed taking into account individual characteristics of health status, reproductive properties and productive indices. The duration of economic use of the cows was estimated according to the milk yield for 305 days in each of the six completed lactations. The evaluation of the studied traits was presented on the basis of recorded data in Dairy Comp 305 herd management software.

3. Results
In intensive dairy farming, one of the most important issues in organising milk production and breeding is the rearing of replacement cows. At the present stage of cattle breeding development this is especially important, since in many countries the level of cow productivity in some herds exceeds 12 thousand kg of milk per lactation. The goal of Rusmolko's Reproduction Centre is to create an optimal environment for efficient breeding of young cows from birth to the breeding age and to provide for the planned live weight gain, as well as to detect animals in heat and inseminate them in a timely manner. The intensive technology for breeding replacement animals at OOO "Megaferma" (LLC) provides for inseminating heifers at the following parameters: age - 330-345 days, rump height - 130 cm, live weight - 340-360 kg.

Table 1 shows the dynamics of live weight of replacement heifers of OOO "Megaferma" (LLC) from birth to insemination.

Table 1 shows that in each technological period, the live weight of heifers corresponds to the indicators established by the protocols for controlling the development of animals, taking into account their age. The average daily gain for the whole period from birth to the first fruitful insemination is more than 900 g.

Thus, the intensive technology of breeding replacement heifers in the specialized enterprise OOO "Megaferma" (LLC) of Rusmolko Group ensures that the animals achieve the development parameters recommended for a highly productive dairy herd.
The intensification of milk production on modern dairy farms involves not only the creation of optimal conditions for keeping and feeding heifers in order to increase the intensity of growth and development, but also the use of methods that facilitate the rapid and cost-effective replenishment of the dairy herd.

Rusmolko Group's dairy farms keep cattle imported from the Netherlands, Germany, the USA, Hungary and Denmark, as well as domestic cows. The annual renewal of the herd requires an appropriate number of replacement heifers. Therefore, in order to maximize the number of heifers from total calving, the young heifer breeding site (OOO "Megaferma" (LLC)) and dairy complexes of Rusmolko Group use modern biotechnological method of heifer insemination using sexed semen, which allows to produce mainly heifers in offspring.

Table 2 shows the efficiency of the first insemination of animals with sexed semen.

According to the results of the first successful insemination with sexed semen, fertility of heifers was 20% higher than that of first lactation cows. At the same time, a significant number of animals (38.5-58.9%) remained unfertilised.

The pregnancy rate of heifers in our studies is quite high (61.5%) and is consistent with the scientific data of other scientists [6, 7]. And the result of the low pregnancy rate of the cows of the first lactation (41.1%) can be explained by health problems. Absolutely healthy first-calf heifers show a high degree of fertility, while animals with at least one disease (gynaecological or metabolic) in their
history from calving to first insemination have a lower insemination efficiency (35.8%). With regard to diseases such as lameness and mastitis, animals that had these diseases had a successful insemination rate of 47.6% and 40.7% respectively.

A successful insemination should result in litter production. A high efficiency of insemination of animals of studied age groups (96.5 and 98.4 %) with sexed semen not only in producing calves, but also in producing heifers (82.9 and 94.3 %) should be noted. Similar results are noted by other authors in their works [8].

Thus, when using sexed semen, a farm obtains significantly more heifers from high value Holstein bulls, and genetic progress in the herd is much faster. However, the study showed that the efficiency of the use of sexed semen depends on the health status of the animal and the presence of diseases suffered during the period from calving to first insemination, in particular gynaecological diseases.

Increasing demands on the economic component of the dairy cattle breeding industry under the intensification of production highlight the problem of extending the use period of breeding stock and especially of high-yielding cows. Therefore, a special condition for effective breeding work with dairy cattle breeds is their longevity. Evaluation of breeding stock by the duration of economic use is of great importance for the prospective formation of highly productive dairy herds.

At Rusmolko Group, on average, the period of the use of cows is 2.7 lactations, however, there are animals with longer productive longevity in the herd.

Table 3. Changes of milk productivity of Holstein cows of the milking herd of OOO "RAO "Narovchatskoe" (n=139) over age.

| Number of lactation | Milk yield for 305 days of lactation, kg | Mass fraction in milk, % |
|---------------------|-----------------------------------------|--------------------------|
|                     |                                         | of fat                   |
|                      |                                         | of protein               |
| 1 8474.2±175.8      | 3.43±0.015                              | 3.12±0.013               |
| 2 9682.6±229.4      | 3.52±0.027                              | 3.15±0.012               |
| 3 9642.3±217.8      | 3.87±0.035                              | 3.19±0.020               |
| 4 10356.2±234.7     | 4.38±0.074                              | 3.19±0.012               |
| 5 9958.5±246.1      | 4.12±0.039                              | 3.22±0.017               |
| 6 9940.0±294.1      | 4.35±0.042                              | 3.20±0.023               |

Table 3 shows that the milk production of the cows in the study population varied with age. Thus, the milk yield of cows in the first lactation was lowest and differed from each subsequent lactation by 14.2%; 13.7%; 17.5%; 22.2%; 17.2%, respectively. The highest increase in milk yield was noted from the first to the second lactation -14.2%.

It is necessary to note the ability of the studied milking cows to increase the milk yield. From the first to the fourth lactation it increased by 22.2%. The achievement of such indices in cows with high level of milk productivity requires the creation of optimal conditions of keeping, feeding, milking, milking herd servicing and the appropriate selection and breeding work. Of the 139 cows, 31.7% finished their sixth lactation with a milk yield of 10,000 kg or more.

In the herd, more than 3% of the total number of animals completed the sixth lactation (the milk yield of 9,940 kg of milk, the mass fraction of fat in milk - 4.35% and that of protein - 3.2%), indicating the prospects of forming the breeding stock with a long period of economic use of cows.

Thus, the research results have shown that in the conditions of modern industrial complexes, following technological discipline, Holstein cows are capable to keep a high level of milk productivity during the long period of economic use (six lactations). The individual characteristics of the animals should be taken into account and highly productive cows with a production period of three or more lactations should be included in the breeding nucleus of the breeding herd.
4. Conclusion

The intensive technology of producing replacement heifers at the specialized enterprise OOO "Megaferma" of Rusmolko Group ensures that animals achieve a live weight of 350-360 kg at the first successful insemination at the age of 330-340 days (11-12 months).

The intensive technology of reproduction using the sexed semen allows to obtain 82.9-94.3% of replacement heifers from pregnant animals.

In conditions of modern industrial complexes the intensive technology of keeping and feeding animals, with observance of technological discipline, contributes to prolongation of the period of economic use of cows (six lactations) with preservation of a high level of milk productivity.

References

[1] Stolyarova O, Salahub N and Reshetkina Y Maintaining food security through the development of milk and dairy products market in foreign countries and Russia 2020 Scientific documents, management, economic education in agriculture and rural village development 20 465-69

[2] Usenbekov E S, Aliyev M, Spanov A A and Siyanbekov S T 2016 Implementation of the method of embryo transplantation and insemination of heifers with sexed sperm on the dairy farm of "Baiserke - Agro" (Moscow) p 199

[3] Gonzales-Marin C, Lenz R W and Gilligan T B 2016 Sexed Ultram, a new method of processing sex sorted bovine sperm improves post-thaw sperm quality and in vitro fertility Reproduction Fertility and Development 1 205

[4] Kulikova N I, Eremenko O N, Koschkaev A G, Kalashnikova T V, Evdokimov N V, Amerkhanov K A and Dunin I M 2019 Productive longevity of Holstein bulls female offspring International Journal of Engineering and Advanced Technology 5 435-39

[5] Loretts O G, Chechenikhina O S, Bykova O A, Shatskikh E V, Gridin V F and Topuriya L Yu 2018 Productive qualities of cattle in dependence on genetic and paratypic factors International Journal of Advanced Biotechnology and Research 1 587-93.

[6] Yeghiazaryan, A V and Lantukh M N Experience of working with sexed semen in Russia and abroad 2016 Dai. and Beef C. Farm 1 6-8.

[7] Kalmagambetov M B, Abushakipovich S A, Alentaev A S and Baimukanov D.A. Effectiveness of the use of sexed semen in dairy cattle reproduction 2021 Vestnik of the Mari State University 1 40-9.

[8] Golovan V, Yurin D and Kucheryavenko A 2019 Increase the percentage of heifers yield Anim Husb Dairy Vet Sci. 3 43-5.