A comparative technological indicator analysis of bred cow productivity of main breeds in the Voronezh region

V V Krupitsyn, A V Vostroilov, E I Ruzhkov and Y A Shilov

Voronezh State Agrarian University named after Emperor Peter the Great, 1, Mitchurina st., Voronezh, 394087, Russia

E-mail: wolkrufwolf@mail.ru

Abstract. According to the solution of many tasks of the Russian Federation state policy on the agro-industrial complex development, the dairy cattle breeding industry is considered a priority. Milk and dairy products is one of the most important food products in the world, it is consumed by various age population categories, which results in necessity for state stimulation of the dairy industry development [1]. This article substantiates the effective results of technological indicators of the cow productivity bred in the Voronezh region of the main breeds, since Simmental, red-motley and Holstein, with the technology of their tie-up year-round and yard housing. Based on the research results, it was noted that these breeds have a high potential for indicators of productivity and quality of raw milk. However, the influence of intensive industrial and technological conditions affects the duration of the productive cow use. The work presents the results of average productive indicators of imported cattle of Holstein and Simmental breeds, taking into account their acclimatization in the Voronezh region for 5-6 years and their technological use proving the effectiveness of raw milk production. On this basis, it can be noted that imported cattle have high acclimatization rates. In a comparative aspect, the perspectivity of using the yard cattle housing in large livestock complexes are justified. The economic efficiency of raising imported and domestic selection cows in the dairy farm conditions of an agroholding agricultural company is calculated.

1. Introduction

A priority and important state policy direction is the development of the agro industrial sector. It is noted that the development level of the agro industrial sector of any country reflects its food security, affects the economic condition, social status, as well as public health and a number of other indicators that emphasize its status and competitiveness among other countries. Agriculture, including livestock, is the main occupation and the main source of income and the nation's economy [8, 12, 13].

Based on the economic essence of the "competitiveness" concept of dairy farms, it is possible only with profitable management of the livestock industry. In general, we can raise the question of the competitive advantages and competitiveness of each type livestock production in a market economy in accordance with the price and product quality, as well as the conditions of its production. Based on this, the consistent state policy pursued by the Department of Livestock and the Ministry of Agriculture of the Russian Federation in the field of dairy cattle breeding has brought the industry to a competitive position in all product areas [9].

Today, the dairy subcomplex of the Russian agro-industrial complex (AIC) is faced with the task of increasing volumes and increasing production efficiency to ensure import substitution for milk and
dairy products. Lack of own investment resources for expansion or technical re-equipment of production is a problem for many milk producers [10, 11].

Under the conditions of the Russian Federation, taking into account various socio-economic and climatic factors, as well as a number of other factors, the sustainable development of agro industrial business in various regions is an important task providing the stability of agricultural production, as well as import substitution of agricultural products.

In the Voronezh region and in a number of other central Chernozem regions, based on the implementation of the State Program for the agricultural development and the regulation of agricultural products, raw materials and food markets, AIC development is occurring taking into account the implementation of targeted programs for the development of dairy cattle breeding. The development and steady operation of this particular area of the agro-industrial complex is a priority area of national food security along with other state programs. Successful overcoming of the economic crisis period in our country was achieved thanks to the measures taken by the state to increase investment activity. One of the stimulating factors was the adoption of state support measures in our region which aimed at the development of breeding activities in the field of animal husbandry [6].

In modern economic and political conditions, the sustainable development of dairy cattle breeding, its intensification is a complex system of interrelated measures for keeping, fodder production, feeding and breeding animals, as well as technical modernization, rational use of resources [7].

Over the past decade, many dairy farms have undergone reconstruction, as well as the construction of large dairy complexes, which are high-tech for the production of raw milk. Based on our own experience in handling the dairy cattle breeding industry as a unit structure of the technological organization of the dairy complex in Russia, this industry additionally took the experience of world technologies in the field of raw milk production by introducing effective technological methods.

In recent decades taking into account its own and world experience in dairy cattle breeding in many areas, the maintenance of dairy herds has become more effective as a result of the intensification of the livestock industry. The introduction of computerization in dairy cattle breeding has made it possible to conduct individual electronic accounting of zootechnical and veterinary control in a herd of cows; new effective possibilities of electronic herd control have appeared.

At the moment, there are a number of technological problems in the field of dairy cattle breeding, as well as the quality and safety of raw milk and the production of organic dairy products. As a result, there was a necessity to systematize technological solutions in the field of dairy cattle breeding, with the task of conducting scientifically based work, taking into account the rationale for the introduction of intensive technologies for more efficient production of raw milk in various farms of the country.

Taking into account the complexity of livestock breeding systems in underdeveloped livestock regions, the main direction of growth in developing an effective management strategy is to provide animals with nutritious food, rational use of feed, the development of breeding work for livestock breeding [3].

We set a goal according to the solution of a number of work tasks on the study of modern technological features of raw milk production in the Voronezh region territory, as well as a general literature review. Based on them, we have analyzed the efficiency of growing the main cattle breeds on the territory of the Voronezh region in relation to the technology of tie-up and yard housing of cows, both domestic and imported selections.

2. Materials and methods
The main basis for the practical part of the work was the agriholding agricultural complex «EkoNivaAgro» LLC of the Voronezh region, Liskinsky district. During the research period from 2014 - 2018, quantitative and qualitative indicators of milk productivity of cows were analyzed and their average values were taken out in accordance with the technology of their content. Modern large dairy complexes and reconstructed farms for the raw milk production have been conducted using the technology of loose and year-round tethered keeping of cows, both dairy (Holstein and red-motley breeds), and meat and dairy (Simmental breed) types of productivity.
During the work, we used general zootechnical research methods using statistical obtained data processing of zootechnical and breeding records using computer programs.

3. Results

Modern livestock systems have low overall productivity in some countries, which leads to an ineffective increase in herd productivity. The reasons are mainly associated with the use of poor-quality feed and it determines its low digestibility and poor health in animals. Risks associated with climate change are more serious for the population growth and health, as well as animals, in which the production of crops and livestock production is most dependent. It ensures the general food security of the country population [3, 4].

The effectiveness of any technological process depends primarily on the balanced operation of its constituent parts. In the technology for the production of raw milk, the main component is the creation of optimal conditions in which the animals do not have additional stress on the body as a result of intensive industrial technological use. Therefore, the creation of optimal conditions that meet the physiological norms of the cow’s body is one of the main tasks of any raw milk technology. At present, in various country regions, the main technology is yard and tie-up housing, allowing for the fact that the technology of yard housing is the most promising in the industrial production of raw milk in recent years. A number of large dairy complexes are being built in the Voronezh region that meet world standards for the production of raw milk. The existing dairy farms and the farms themselves were reconstructed and improved, taking into account the intensification of technological approaches to the production of raw milk, which are mainly part of the «EkoNivaAgro» LLC agriholding group.

Table 1 shows the average indicator for the study period of the cow number and the class rating of the herd of breed in the agriholding enterprise «EkoNivaAgro» LLC.

| Livestock and cattle herd class | Holstein breed | Red-motley breed | Simmental breed |
|---------------------------------|---------------|------------------|----------------|
| Cows – total number             | 5649,2        | 784,6            | 897,5          |
| of which: purebred              | 5649,2        | 784,6            | 897,5          |
| Class elite-record, elite       | 5597          | 783,2            | 886,5          |
| I class                         | 65,2          | 8,5              | 64             |
| Recorded animals in book        | 242,2         | 39,2             | 80             |

Based on the data shown in table 1, it can be noted that the largest number of cows is represented by breeds of milk productivity, such as Holstein and Red-motley, less Simmental, which belongs to the meat and dairy type breed. The cows of the Holstein and Simmental breeds are imported purebred cattle, in contrast to the domestic red-motley breed of cows.

Table 2 shows the reproduction results of a herd of Holstein, red-motley, and Simmental cows in yard and tie-up year-round housing.

From the table data of the herd reproduction, it is noted that the artificial insemination technology of cows and heifers is used. Based on the results of growing calves in the fresh air (cold method), it can be seen that the indicator of the greatest number of live calves was in animals of red-motley breed compared to Holstein and Simmental. This is due to the fact that the processes of acclimatization, taking into account the adaptation of imported livestock to the climatic conditions of the Voronezh region, are not as expressed as in red-motley calves of domestic selection. The calf crop is also influenced by a number of external production factors that must meet norms of young cattle raising.
Table 2. The reproduction results of a herd of cows, cow number (n_{average})

| Indicators                                      | Holstein breed | Red-motley breed | Simmental breed |
|------------------------------------------------|----------------|------------------|-----------------|
| Served and inseminated cows and heifers - total number | 10202,8        | 1240,8           | 1098,2          |
| Artificially inseminated – total number: cows    | 7185,8         | 778,8            | 886,5           |
|                   heifers                          | 3017           | 462              | 211,7           |
| Including improvers – total number: cows        | 8321,8         | 1039,2           | 886,2           |
|                   heifers                          | 6155,4         | 716              | 724,5           |
| Received live calves– total number              | 7469,8         | 968              | 901,2           |
| from cows                                        | 4256,2         | 668,2            | 526             |
| Live calves crop from 100 cows                  | 74,6           | 84,2             | 76,5            |

Table 3 shows an effective analysis of raising heifers and first-calf heifers with the technology of yard housing.

Table 3. Zootechnical indicators of raising heifers and first-calf heifers(n_{average})

| Indicators                                      | Holstein breed | Red-motley breed | Simmental breed |
|------------------------------------------------|----------------|------------------|-----------------|
| Heifers, Introduced into a heard of first-calf heifers animal units | 3435,8         | 305,2            | 396,5           |
| %                                              | 2881,8         | 265,2            | 217             |
| Live weight of heifers at the first insemination, kg | 43,7           | 34,48            | 24,3            |
| Age of heifers at the first insemination, months | 389,6          | 353,6            | 405,2           |
| Average daily weight gain of heifers aged 0-18 months, grams | 15             | 14,8             | 15,2            |

From the data shown in table 3 it is seen that the age of heifers at the first insemination is an average between 15 months. The average daily live weight gain corresponds to a breed of dairy or meat and dairy type of productivity. Compliance zootechnical requirements of raising, insemination of first-calf heifers and the control of the first heifers is one of the keys to high milk productivity of a future cow.

The milk productivity of cows, as a rule, reflects all the work with the herd and affects the indicators of its efficiency in the farm with any technology of livestock keeping. Table 4 shows the
productivity data, taking into account the technological use of cows in the dairy and meat and dairy types of productivity in relation to the technology of tie-up year-round and yard housing.

Table 4. Productivity indicators in the technological use of bred cows, (n_{average})

| Indicators                                      | Holstein breed | Red-motley breed | Simmental breed |
|------------------------------------------------|----------------|------------------|-----------------|
| Average milk yield per cow, kilogram           | 8859,8         | 6263,4           | 6946,2          |
| - according to the production report           | 8426,2         | 6338,8           | 6805            |
| Cow yield milk for 305 days of the first lactation, kilogram | 7928,8         | 6140             | 6326,4          |
| Cow yield milk for 305 days of the third lactation and older, kilogram | 9424,5         | 6542,8           | 7133,2          |
| Average milk flow rate, kilogram / minute     | 2,15           | 1,8              | 1,85            |
| Live weight of cows of the third lactation and older, kilogram | 567,2          | 541,4            | 705             |
| The number of cows with milk yield 8000(7000, 6000) and more, animal units | 3296,4         | 213,2            | 841,6           |
| The duration of the productive cow use (middle age of leaving), calving | 1,84           | 2,8              | 3,18            |
| Cows and heifers left for the year, animal units | 2057           | 317,6            | 348,6           |
| %                                              | 32,4           | 39,3             | 24,9            |

The research results shown in table 4 indicate that the main average productive and technological indicators of the Holstein, red-motley and Simmental cows correspond to their breed characteristics of their productivity type. Based on the analysis, it can be noted that the highest average milk yield per cow according to the production report (n_{average} 8859.8 kg) and judging practice (n_{average} 8426.2 kg) was noted in Holstein cows. Almost the same values were obtained from cows of Simmental and red-motley breed. High indicators of milk productivity are determined by the genetic factor of the Holstein cows of the dairy productivity type. However, the duration of the production use of Holstein cows (average leaving age) is 1.84 calving. This technological indicator is the highest for cows of the Simmental breed, although it does not meet the standards of physiological and technological longevity. The relatively low average leaving age of cows of this breed does not allow to reveal the genetic potential of milk productivity. The intensive use of cows in large dairy complexes with the technology of yard housing is the main reason for the indicator when the body has the limitation of its capabilities.

According to the data of leaving cows and heifers of red-motley breed under conditions of tie-up year-round housing, the greatest number of culling (39.3%) is occurred due to this technology. Hypodynamia of the body is the main cause of this indicator. For example, under the conditions of yard housing, the amount of retention of placenta in cows after calving is minimal, but under the conditions of tie-up year-round housing, the number of culls for gynecological diseases is high. As a result, it can be noted that any industrial technological use of cows with the task of obtaining raw milk, both in large complexes and dairy farms, should provide optimal functions for normal physiological metabolic processes in the body and minimize the occurrence of stressful situations affecting the longevity and productivity of cows. Creating the most favorable conditions that meet the natural habitat of animals in livestock buildings, when animals can not only have a limited access to daylight and fresh air in accordance with their physiological needs, but also provide technological support for natural or artificial pastures, is a necessary condition for increasing efficiency of dairy farming [5].
We also evaluated the quality raw milk indicators of the analyzed breeds of cows, the results of this evaluation are presented in table 5.

**Table 5.** The quality raw milk evaluation of cows of dairy and meat and dairy productivity type, (n\text{average})

| Indicators                                      | Holstein breed | Red-motley breed | Simmental breed |
|------------------------------------------------|----------------|------------------|-----------------|
| The fat content of milk, %                      | 3,9            | 3,82             | 4,0             |
| - according to the production report            |                |                  |                 |
| - by judging practice                           | 3,8            | 3,80             | 3,9             |
| The protein content of milk, %                  | 3,26           | 3,21             | 3,3             |
| - according to the production report            |                |                  |                 |
| - by judging practice                           | 3,27           | 3,22             | 3,25            |
| The production of milk fat from one cow (by judging practice), kilogram | 317,7 | 240,8 | 268,9 |

According to the results of quality raw milk assessing in cows of the meat and dairy productivity type, these indicators are relatively high compared to dairy cows; however, the indicator of milk fat production per cow (by judging practice) is more in cows of the Holstein breed.

**Table 6.** The economic efficiency evaluation of the technological use of cows of dairy and meat and dairy productivity type, (n\text{average})

| Indicators                                      | Holstein breed | Red-motley breed | Simmental breed |
|------------------------------------------------|----------------|------------------|-----------------|
| Cost of 1 centner of milk, rubles               | 1805,2         | 2119,4           | 982             |
| Cost of 1 centner gain, rubles                  | 8040           | 7357,8           | 5700            |
| Annual feed consumption per conditional head, centners of feed units. | 59 | 58,4 | 59,6 |
| Profit (+), loss (-), thousand rubles including: from the sale of milk | +160790,8 | +2508,4 | +4336,3 |
| from the sale of young breeders                | +173420,7      | +2508,4          | +3084,6         |
| Profitability of dairy cattle breeding, %       | 15,6           | 5,2              | 11,6            |

Further, as a result of our studies, we considered indicators of economic efficiency in the technological use of Holstein, red-motley and Simmental cows in large dairy complexes and dairy farms. The calculation data of economic indicators are presented in table 6.

According to the data of the economic efficiency of bred cows in the conditions of an agriholding agricultural enterprise, the economic condition is relatively stable when the cows are kept in both dairy and meat and dairy productivity type. The highest growth rates were observed in the breeding of Holstein and Simmental cows of imported breeding. The lowest results were obtained at breeding cows of red-motley breed in the conditions of dairy farms using their tie-up year-round housing.
4. Conclusion
In conclusion, it can be noted that at the moment the construction of large dairy complexes in many areas of our country is proceeding quite intensively and the system of agriholding enterprises of the agro-industrial complex is widely used. It is a very important indicator to ensure food population security. However, livestock enterprises are still in conditions of uncertainty of both internal and external market relations, taking into account market fluctuations of milk and low state support for agricultural enterprises [2].

Taking into consideration the progressive rate growth of production technology in conditions of dairy enterprises, the metabolic processes of the animal’s body are very intense, as noted that the indicator of industrial longevity of cows, and in some cases productivity is very low. As a result, the cow’s animal body is considered as a kind of inanimate mechanism and it is used for profit. An effective disclosure of the genetic cow potential in accordance with its breed, as well as an increase of longevity level, is possible when the technological conditions meet the requirements of the animal’s body, where the metabolic processes will meet physiological norms. It is one of the main tasks of the research work in the field of dairy cattle breeding and its realized results.

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