Innovative solutions used in Holstein breeding by Osnabrück livestock association (OHG)

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Abstract. The article analyzes the dairy farming industry in Russia and the Samara region, presents the experience, achievements and strategy of innovative technologies in the breeding of the Holstein breed - the selection of the Osnabrück livestock breeding association in Germany. The aim of the research is to study the efficiency of selection and genetic work with cattle of German selection and transfer the experience gained to the conditions of the Samara region. In Germany, the main goal is to achieve the following indicators: to obtain from each bull at least 100 daughters in at least 80 farms for the indicator of productive breeding value and at least 80 daughters in at least 60 farms for the indicator of exterior breeding values. The use of the German genomic selection of the Holstein breed in Russia puts all selection and breeding work on a new intensive path of development of dairy cattle breeding, resulting in an increase in the number of pedigree animals and an increase in their milk productivity. The study and application of the experience of creating a German breeding service in the Russian Federation and the Samara region will significantly increase milk production, improve the genetic quality of pedigree livestock, and reduce the unit costs for breeding due to the timely identification and removal of animals with low genetic potential from reproduction.

1. Introduction
The dairy industry analysis of recent years elucidates a number of issues that objectively hold back the development of dairy production in Russia [1-3]. Positive trends in this sub-industry may be strengthened through the search for opportunities and ways to increase milk production [4-6]. To bridge the existing gaps, we should apply innovative measures that can increase the milk productivity of cows. The innovative solutions described herein present effective ways to intensify the development of dairy production [7-11]. It is possible to increase the milk production and achieve the world’s top performance indicators through the enhancement of selection and genetic control methods based on genomic selection with high breeding values or with offspring quality estimated by the world’s geneticist leaders with 99% reliability [12-18].

2. Methodology
The study analyzed the situation in the dairy farming of the Samara region. Problems related to the breeding state in the region were identified. The German experience of creating a breeding service on the example of the Holstein cattle breed and the results achieved are considered. Perspective directions for the development of the Samara region breeding service were outlined, taking into account the Germany positive experience.
The research aim is to study the efficiency of selection and genetic work with German selection cattle and transfer the experience gained to the Samara region conditions.

Tasks solved within the framework of the goal:

- the advantages analysis of the German Holstein breed using breeding material;
- the experience study of the breeding services development in Germany;
- the introduction of promising directions for improving the breeding service in the Samara region.

3. Discussion and results

Today, the Russian Federation is one of the world’s top milk producers. In 1990, milk production amounted to 56 million tons, which was the country’s highest level and the world’s second. In 2019, the Russian milk production reached 31.3 million tons, showing an increase of 2.4% as compared to 2018, thus taking the third place in the world after the USA (99.0 million tons) and India (76 million tons). The European Union’s total milk production was 155 million tons [19-25].

The recent positive trends in the Russian dairy farming have been partially achieved thanks to the State Program for the Development of Agriculture and Regulation of Raw Materials and Food Markets approved by the Russian Federation Government Decree of 14 July 2012. No. 717 [26, 27].

To overcome the significant competition with the European dairy markets, especially after Russia’s accession to the European market and opening of its economic borders, the innovative development of the dairy cattle breeding is the only way for Russia to ensure the competitiveness of the domestic milk producers. To stay highly competitive under the current conditions, it is necessary to make a sharp turn towards milk production intensification, and to reorient dairy producers towards the use of high-quality economic growth factors [28-31].

The country may achieve further growth in milk production and reach the world’s dairy top levels through the use of the innovative solutions applied in Holstein breeding based on the cattle genomic selection performed by the German Osnabrück Livestock Association.

The major goal of this dairy breed is around economics. The Holstein breed represents the world’s success according to its characteristics. It is one of the few breeds whose maintenance is paid back through its products. All the records in the world’s milk production have been achieved with the Holstein breed [32].

European countries: Germany (30%), France (21%), Netherlands (19%), Scandinavia (Denmark, Sweden, Finland) (20%), Spain (5%), and other countries (5%) organized a joint training data sampling named EuroGenomics, which now represents the common European and North American Holstein genetics [33].

EuroGenomics is a leading global value. Its genomic selection is based on the largest population of offspring-tested bulls that additionally passed genome testing. Thanks to the cooperation with the EuroGenomics association, Germany has the world’s largest database with the control sample of 37,000 bulls (as of 2019) [34].

The genomic evaluation system used by the independent computing center VIT estimates the German Holstein’s breeding value according to the state-of-the-art expertise under the control of state supervisory authorities.

The genomic evaluation system of the independent computing center VIT was one of the first in the world to receive official recognition from the International Committee for Animal Recording (ICAR) and the International Bull Evaluation Service (Interbull), and the quality of these indicators is the highest in the world. Germany has the world’s largest population of Holstein cows with over 1.8 million heads (70%).

The German breeding values are very high due to the frequent control (90% or 2.3 million cows) of milk production. Their estimation of the cattle breeding value is one of the most reliable in the world.

Genomic selection is an innovative top solution used for obtaining reliable Holstein breeding results. The evaluation of genomic breeding value is a method that provides hereditary characteristics of an
animal long before the identification of its inherent and inherited productivity. The breeding value indicators based on genomic analysis are more reliable than pedigree indices.

The genetic progress in dairy farming can be accelerated through the enhancement of intensive selection by breeders, for whom the most important rule is to maximize the genetic capacity of the Holstein breed based on verified offspring quality or high breeding genomic values. The effectiveness of intensive selection is characterized by rapid reproduction of cattle with desired valuable genotypes.

The breeding work surpassed all national boundaries a long time ago, and the majority of Russian breeds (to 75% or more) have been absorbed by foreign breeds, such as Holstein, Schwyz, Jersey, Ayrshire.

The German Holstein breed genomic selection in Russia puts all the selection and breeding work on a new path of intensive development of dairy cattle breeding, bringing forth an increase in the headcount of breeding animals and their milk productivity.

Quality strength of the Osnabrück Association’s Holstein breed are:

- historical success of Holstein breeding in the breed’s country of origin;
- long commercial use and high productivity of this breed through continuous breed enhancement work;
- excellent adaptability to various production conditions;
- accurate breeding value forecasts based on genomic analysis;
- modern and highly reliable breeding value estimation;
- extensive and accurate data collected on animals, providing for high quality of recording and breeding progress;
- novel effective technologies of the future serve as the basis for the top genetics;
- optimal pedigree livestock sale structure and logistics;
- the highest level of cattle health, transportation and genetic material export solutions.

The reliable export of bull semen by Holstein breeders ensure high standards and reliability:

- wide selection of bulls, verified offspring or genomic values with high indices that ensure the best genetics and highest breeding levels
- bull semen is collected at insemination stations approved by the state authorities in accordance with the current EU directives
- continuous control by the German and European veterinary authorities
- high requirements to the sperm quality, including fertilizability control.

To achieve equally high genetic levels, agricultural enterprises should use uniform genetic control approaches, as well as high-value genetic material in the form of semen or embryos. The sources of top genetics are sires that are actual leaders in the world genetics with 99% reliability estimation, or high indices of paternal and maternal genomic values.

Since 2009, all young bulls have been genome-tested under the OHG GeneScan program used in the selection for breeding farms. As a member of the EuroGenomics project, OHG has access to the world’s largest and highest quality genomic selection control sample. OHG also maintains a strong leadership position through the combination of local concentration, extremely high genetic levels and a large breeding core size (with approx. 40,000 cows registered in the herd-book). Besides, close cooperation with partner farms allow OHG to maximize the progress in the general population breeding through the optimized breeding work and forecast of selection impact of the chosen sires, while minimizing inbreeding and other risks. Also, the Osnabrück breeding program ensures reliability.

From 1988 to 2010, Osnabrück’s sire mothers were tested at the central testing station that has no analogues in the world. Only the best sons of the best mothers were used to make further estimation of the offspring quality.

All young bulls have passed genome tests under the OHG GeneScan breeding program since 2009. Along with bull testing, the offspring quality is evaluated by insemination at all the farms of the region.
and use of the bulls in various environmental conditions, climatic zones, as well as various production and maintenance conditions. The highest accuracy estimation and implementation of genetic future effects of using sires under the OHG GeneScan program are achieved through the collection and recording of accurate and undistorted data on new management and health indicators.

The milk productivity of the tested bulls’ daughters is not verified by their owners. It is controlled using the internationally recognized and independent A4 testing method, used for determining the milk productivity of cows.

The exterior of all first-calf heifers in all farms is classified regardless of their paternal origin.

In Osnabrück, the main goal is to achieve the following indicators: each bull should provide at least 100 daughters for at least 80 farms in order to obtain productive breeding value, and at least 80 daughters for at least 60 farms in order to obtain exterior breeding value.

For many years, OHG has been committed to the improvement of animals’ genetic health and endurance characteristics. A significant foundation was laid for systematic collection of health data from OHG member farms through the project Gkuh (Healthy Cow) from 2010 to 2012 and the subsequent project Gkuhplus. This experience was pivotal to the implementation of the KuhVision project (2016-2019), under which a training data sample of 100,000 animals was collected using the uniform guidelines applied across Germany, which included additional data on health and hoof diseases. As a result, in April 2019, health became one of the breeding value indicators in the German Holstein breeding value estimation (VIT).

The Osnabrück Association has supplied the highest quality semen and embryos on a long-term basis with the goal of improving the Holstein cattle population in the Samara region, with prospects of creating a donor-cow selection core and further bull production in the Volga region.

The Osnabrück Livestock Association provides Russia with unique Holstein bull genetic material. For example, the phenomenal heritage breeding value of the bull Boss 262400 allows him to occupy top positions in international ratings for many years - 9000 daughters in 10 countries of the world. His daughters’ first lactation productivity was 8828 kg of milk, with 4.02% fat and 3.5% protein, which was the highest milk productivity in 2019. The daughter of Osnabrück’s bull BOSS 262400 showed the highest productivity figures in Austria in 2019: The cow ALMA 51 produced 19 274 kg of milk with 5.45% fat and 3.38% protein during the second lactation. With a total of 1701 kg of fat (5.45%) + protein, she was ahead of the runner-up cow (of the third lactation) by over 320 kg of fat and protein.

BOSS 262400 is a complete upgrader in all respects with 99% accuracy and reliability.

Sinus 264290ET is a real phenomenon. His breeding value is still growing. In December 2019, his overall breeding value was RZG-146; in April 2020 - RZG-149; in August - RZG-155. He ranked second in Germany in the ranking of all bulls. His daughters are extremely highly productive (long living, having excellent udder quality, healthy hooves, high metabolic stability and endurance), and he is among the best in Germany in terms of seed fertilization. The daughters’ productivity during the first lactation was 9717 kg of milk, with 4.08% fat, 3.47% protein, BB kappa casein (the allele of the B gene in kappa casein has a positive effect on the technological properties of milk).

4. Conclusions

To summarize, we should note that thorough German geneticists, who have highly accurate and reliable data, do not aim at gaining quick profits. They take into account the wishes of German farmers as well as their partners around the world, living in various climatic zones, including Russia. Thus, they have created the unique highly-productive Holstein breed cattle with strong limbs, stably producing milk, not only in artificial favorable conditions, but also in the conditions of large seasonal temperature changes, in drought years and with the feed quality that is not always optimal. The study and application of the experience of creating a German breeding service in the Russian Federation and the Samara region will significantly increase milk production, improve the genetic quality of pedigree livestock, and reduce the unit costs for breeding due to the timely identification and removal of animals with low genetic potential from reproduction.
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