Advances in Economics, Business and Management Research, volume 162
Proceedings of the XV International Conference "Russian Regions in the Focus of Changes"
(ICRRFC 2020)

The Importance of Digitalization in the Innovative Development of the Dairy Subcomplex of the Ural Region

Olga Petrova[1] Michail Barashkin[2] Igor Milshtein[2] Anna Barkova[2,*] Abdukarim Muminov[3]

[1]*Department of Infectious and Non-infectious Pathology Federal State-Funded Educational Institution Ural state agrarian university, Ekaterinburg, Russia*
[2]*Department of Surgery, Obstetrics and Microbiology Federal State-Funded Educational Institution Ural state agrarian university, Ekaterinburg, Russia*
[3]*Institute of biological safety problems of the Tajik academy of agricultural sciences, Dushanbe, Republic of Tajikistan*
** Corresponding author. Email: barkova.as@mail.ru*

ABSTRACT
Currently, the dairy farming industry of the Ural region is undergoing significant changes associated with increasing the intensification of the industry, the creation of large modern livestock complexes, in particular robotic farms, as a result of which, the dairy farming industry occupies a leading position in the introduction of high-tech and automated processes. Despite the fact that the Ural region is rightfully an industrial region, there are more than 6,000 dairy farms on its territory, which contain more than 1.5 million heads of cattle with an average annual productivity of more than 7,000 kg of milk per feed cow. State quotas for dairy raw materials are increasing every year, creating positive prerequisites for the development of sub-sectors of milk production and processing.The high level of enterprises of the milk processing industry in the Ural region is ensured by the introduction of digitalization in the dairy cattle industry, as well as selection work on breeding highly productive animals. There is a tendency to increase the requirements for the safety and quality of the products obtained, and therefore, the problems of improving technological processes for food enterprises are becoming more and more relevant. The modern way to solve this problem is the introduction of comprehensive quality management based on digitalization in the innovative development of dairy farming. The goal is to study the effectiveness of digitalization of dairy farming in the Ural region. **T**he methods of statistical and analytical analysis, expert assessments were used. The activation of innovative processes together with digitalization in livestock farming is shown, which is a real tool for achieving sustainable development of agribusiness in dairy farming

Keywords: *Digitalization, Innovation, Cattle, Milk, Livestock, Digital technologies, Technological processes, Qualit.*

1. INTRODUCTION

At the present stage of development of production in dairy farming, the issues of digitalization, as well as the introduction of innovative technologies, are becoming increasingly relevant. A modern and technological way to develop the industry is to identify ways to develop and solve problems that are most economically safe at various stages of production and create a model. Important requirements for the developed model are the ability to control the quality of raw materials and finished products, determine the causes that reduce the quality of raw milk, affect its biological and other safety, by inactivating harmful components, a model should be developed to establish the most economical way to solve the problem [1,5].

Factors such as the quality of raw milk and technologically competent production processes have

an important impact on the quality of the resulting product, such as yoghurts (Figure 1).

Storage conditions, which are mainly determined by microclimatic parameters (in particular, room temperature, relative humidity), have an important influence on the safety of the quality of the obtained products, as well as the quality of packaging, transportation conditions and other indicators play an important role.

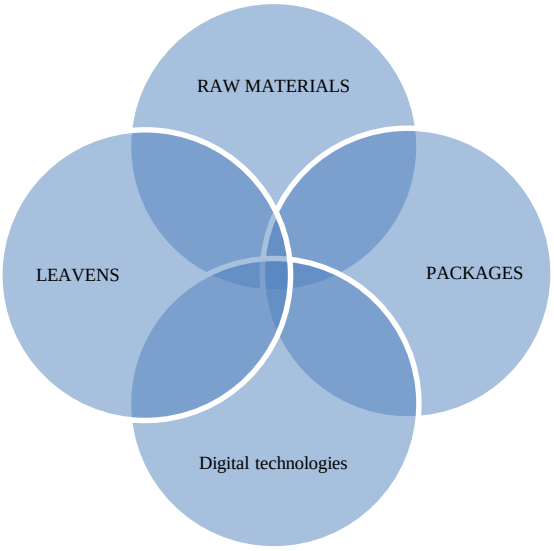

Figure 1 Factors affecting the quality of fermented milk products.

An important quality criterion is the stability of the properties of the resulting product, which determines possible changes in its nutritional value and harmlessness during storage, as well as transportation and subsequent sale [2, 4]. In this regard, it is possible to reliably judge the biological value of the product and changes in its quality only by taking into account an extensive set of indicators that directly characterize the technological process.

According to modern researchers, a significant amount of foreign chemicals enters the human body from the environment, while from 30 to 80% enters the body directly with food. In this regard, it is important to identify critical points in the production of products from local raw materials and further movement of goods, which can only be carried out with strict control of safety indicators directly on the territory of the region, which can be one of the possible ways to solve this problem [3,6,7].

Any contamination of food products and raw materials can have a potential negative impact on the health of consumers, and therefore, the concept of "dangerous factor"is introduced. Physical, chemical and microbiological pollutants of raw materials and finished products that exceed the permissible level are most often recorded, in addition, the creation of prerequisites for the growth and development of pathogenic microflora, while it is in relation to dairy and fermented milk products that the composition of microflora must be clearly defined and strictly observed [2,10].

To identify predisposing factors, it is necessary to analyze each stage of technological production of products and determine its inherent factors directly from the receipt of raw materials for production to the stage of sale to consumers.

To identify potentially dangerous factors, it is necessary to formulate a number of questions:

- at what technological stage from the receipt of raw materials to its processing, the appearance of a dangerous factor is possible and at what technological level;

- to what extent does the technological process make it possible to obtain a safe finished product or prevent an increase in the negative impact on the product that is dangerous for human health;

- is it possible to use the product after appropriate processing (defrosting, cooking, etc.) safely for health, and in the presence of a dangerous factor – the degree of its impact on the product and the definition of risks;

Due to the fact that food production is associated with increased risks of hazardous factors, it is necessary to pay significant attention to the following important points, in particular the composition of the product, which includes determining the raw materials and other components necessary for production. A huge impact on the safety of the final product has the technological process of its production, and in particular strict compliance with technical conditions, sanitary conditions in the premises, as their violation can reduce the safety for the health of the resulting products. Equally important is the packaging of finished products, which allows you to protect goods from contamination by chemicals and microorganisms, as well as prevent its mechanical contamination. The conditions of storage and sale of products, in particular compliance with the terms and conditions of storage, are the key to the safety of consumers health both in retail stores and wholesale centers. Also, end users must strictly observe the

conditions of consumption of products and, if necessary, carry out pre-cooking [11, 12][1].

Milk processing enterprises often receive raw milk of poor quality, which is associated with either increased microbial or chemical contamination, an important problem for obtaining safe products remains the technological process of its production. Obtaining safe products of normal quality from low-grade raw materials is possible with the introduction of new technological methods for processing raw materials at milk processing enterprises.

However, despite this, quite often there are cases of spoilage of finished products associated with the oxidation of fats and microbiological contamination. In addition, the quality of the resulting products is also affected by the components of the animal's diet, which get into the milk and can reduce its technological qualities. In this regard, the introduction of innovative technologies and digitalization is promising both directly at livestock complexes and at milk processing enterprises [7-9].

The goal of the research: to show the effectiveness of digitalisation based on innovations in livestock dairy industry of the Ural Region.

2. METHODOLOGY

Methods of statistical and analytical analysis, expert assessments were used in the work. Works of Russian scientists in the field of digitalization and innovation, their own research.

Research includes several types of sources:

- materials of the Federal State Statistics Service, territorial bodies of the Federal State Statistics Service;

- basic legal documents of the Russian Federation: Constitution of the Russian Federation;

regulatory legal acts of the federal and regional levels regulating the investment and innovation system of the agro-industrial complex.

The mathematical model AGLINK-COSIMO is applied (the model AGLINK-COSIMO belongs to the class of recursive dynamic models of partial equilibrium (supply-demand) for forecasting the development of world markets of agricultural products) (Forecasting the development of agri-food markets using the international system of economic and mathematical models Aglink-Cosimo-Materials of the International Scientific and Practical Conference " Informatization in the AIC: state, trends, prospects"[2].

3. RESULTS AND DISCUSSION

According to the quality of the resulting products, raw milk in the Ural region belongs to several classes, depending on the level of somatic cell content, in particular premium class (less than 220 thousand somatic cells in 1 cm3) and classes A (up to 280 thousand somatic cells in 1 cm3), B, C, D.

Currently, the Ural region has implemented a program (NOA) that provides automated herd management, in particular, control and maintenance of zootechnical and breeding records. This program has been operating in the leading breeding and commodity farms for more than 5 years (Irbitsky, Bogdanovichsky, Krasnoufimsky districts of the Sverdlovsk region, Vavozhsky district of the Republic of Udmurtia, Uvelsky district of the Chelyabinsk region) [11,14].

All major dairy cattle-breeding complexes, containing highly productive dairy cattle, the average milk yield per cow more than 7 thousand kg of milk per year are developed and implemented prevention programs improve the quality of raw milk and the health of the udder of animals that can be considered together with the quality control system HACCP, the main function of which is the identification, assessment and control of risks in raw milk.The introduction of the HACCP system in livestock complexes allows achieving compliance with European standards with the requirements and rules for all normalized milk quality indicators [5,6].In the Sverdlovsk region, the dairy farming industry is mainly developed. Despite the fact that the region belongs to industrial milk production, it is among the top ten in the country, in particular, it is on the 9th place in terms of average daily milk production, and in terms of average daily milk yield per feed cow, it occupies the 9th place. There is also an annual increase in the productivity of cows, so relative to the indicators of the past year, the average annual milk yield per feed cow was 5551 kg of milk, which is 387 kg of milk more than in the past [13].

[1]Program “Digital Economy of the Russian Federation” (approved by order of the Government of the Russian Federation 28.07.2017 №1632-p.2. Decree of the Government of the Russian Federation of December 8, 2011 "Strategy of Innovative development of the Russian Federation until 2020"

[2] Nikonovskie chteniya-20102, http://www.viapi.ru/download/2015/31341.pdf

A promising strategy for the development of the Sverdlovsk region is the innovative transition of both the food and processing industries to a modern development model, in particular, contributing to increasing its competitiveness in a free market, as well as the production of a new generation of high quality products. Special attention should be paid to the issues of import substitution, which is associated with ensuring the country's food security, strengthening production cooperation, as well as providing the industry with high – quality and safe material and raw materials, as well as, which is not a little important, professional personnel. The development of small and medium-sized businesses is also of great importance [11, 14].

When implementing the developed programs, a significant increase in the growth rate of the dairy economy sectors is predicted (Table 1).

Table 1. Short cut keys for the template

	2010/2007	2015/2010	2020/2015	2020/2007
The accumulated growth rate				
The consumer sector	120,7	144,0	176,9	307,6
High-techsector	132,0	161,9	257,3	550,0
Traditional sector	117,6	134,2	188,2	297,0
Infrastructure sector	126,3	152,8	213,2	411,6
Averageannual growth rate				
The consumer sector	106,5	107,6	112,1	109,0
High-techsector	109,7	110,1	120,8	114,0
Traditional sector	105,5	106,1	113,5	108,7
Infrastructure sector	108,1	108,8	116,4	111,5

Source: authors' calculations based on statistics data by Department of the Federal State Statistics Service for the Sverdlovsk Region (agriculture)

The introduction of digitalization based on innovations in the agricultural sector is actively supported by the state agrarian policy. The vast majority of agricultural economists recognize their importance for the modern development of the dairy farming industry and support their introduction into this sector of agriculture[3].

To increase the profitability of the dairy farming industry, the priority tasks are to increase production volumes by increasing the productivity of animals, since currently there is a tendency to reduce the number of dairy cattle with an increase in the milk productivity of cows by improving the breed composition of the herd. Also, in addition to the quantity of products, it is necessary to improve its quality, which is possible only if the material and technical means, conditions of maintenance, quality of feeding, as well as investment in this industry are improved [15,16].

The innovation process in the period of digitalization in general, and in animal husbandry in particular, is a complex interconnected system with many direct and feedback links, including subsystems:

- scientific research;
- scientific and technical developments;
- experimental and pilot production;
- production of products;
- marketing research;
- sales of marketable products.

Analyzing the investment processes in animal husbandry, we can distinguish three types of innovations:

- selection and genetic studies;
- production and technological;
- organizational and managerial innovations.

One of the main conditions for the survival of agricultural producers of the agro-industrial complex of Russia at present is the introduction of innovative processes related to the digitalization of production.

[3]Decree of the President of the Russian Federation of May 7, 2018 "On National goals and Strategic objectives of the Development of the Russian Federation for the period up to 2024»

The main obstacle to the widespread adoption of these technologies is insufficient financial and material support, and therefore the focus of digitalization processes is limited.For example, those innovations that make it possible to develop and implement an innovation with minimal costs, in particular, these are innovations of an organizational and economic nature, are becoming more popular on the part of agricultural producers. At the same time, such important innovative and digital solutions related to the construction and reconstruction of production facilities, the introduction of new technologies for keeping, feeding, and exploiting animals bypass the stages and procedures required in the innovation system [11,14].Thus, there is a gap in economic relations between production and the sphere of scientific research, in particular, specialized research institutions dealing with the adaptation to the conditions of a particular region of modern technologies for growing and keeping farm animals, breeding new breeds of animals with outstanding qualities, which practically minimizes the use of scientific and technological progress [11].

A critical point is the development of a set of organizational, economic and tax tools that ensure the widespread introduction of digitalization in the production environment, as well as the stimulation of commodity producers to use them. At the same time, the main feature of the innovation system should be the complexity in the study of the issue, in particular, it should include various subjects and elements that contribute to solving a wide range of tasks. If we consider the design of the production facility of any agricultural, in particular modern cattle-breeding complex and innovative processing plant need is for the use of available modern scientific research related to land, including the intended prey, as it is a fundamental part in the agricultural sector of the economy and foundations of the innovation process [11,14,16].

One of the main conditions for the introduction of innovations for the progressive development of the dairy farming industry is possible only if a number of the following mandatory conditions are met, such as the presence of the necessary digitalization in the innovation structure, which have now become widespread and have proven themselves in terms of social significance for the industry and have high economic efficiency. Another important criterion is the state's support for enterprises that actively introduce and disseminate innovations, as well as the dissemination of information about the economic effect of developed innovations and the effect of initially implemented technologies. In addition, the introduction of digitalization in production is not possible without the majority of business leaders understanding the need for innovation and readiness for entrepreneurial risk. To support the process of spreading innovations, it is necessary to create special organizational structures that guide the process along the most rational path of implementation.

Thus, the real tool for the modern development of the dairy industry is to increase the introduction of innovative digitalization processes, which confirms the high efficiency of managing the introduction of innovations in a significant number of enterprises. In this regard, the main task in production is to analyze the existing problem points and identify the leading production, technological and organizational innovations to overcome them. However, positive results of the implementation of innovative processes during the re-equipment of agriculture, and, in particular, the dairy farming industry, are possible only with the active support of state structures, which is confirmed by both domestic practice of industrialization of production and wide world experience [11,14,15].

Scientific and technological progress on the part of the state can be supported by two levers, on the one hand as a direct stimulation of the development of innovative technologies, on the other hand – with the use of economic impact measures. In this regard, an important aspect of the breakthrough and sustainable development of dairy farming is the change in the system of state support and financing of the industry at the expense of the budget. The development and implementation of breakthrough innovative projects is possible only if there is state support at all stages of its development-from the formation of an idea to direct implementation in the conditions of agricultural enterprises [11].

Also, the creation of specialized innovation funds and production modernization funds at the federal and regional levels would contribute to the development of innovative activities.

In particular, to ensure the conditions for sustainable development of livestock production in the regions, it is necessary to solve the following priority tasks:

- introduction of intensive technologies in dairy cattle breeding;

- creation of a guaranteed feed base by improving the structure of sown areas while increasing the production of vegetable protein;

- improvement of selection and breeding work and annual growth in the sale of breeding young animals.

We have developed a project based on digitalization and innovation for the implementation of measures for the development of processing of livestock products, which is aimed at providing the population with dairy products by increasing the production of whole milk products, cheeses and cheese products, butter, improving the quality of dairy products.

In terms of increasing milk production, it is planned to:

1) To carry out the construction of modern and modernization of existing enterprises for primary milk processing;

2) To introduce new technological processes for integrated milk processing on the basis of innovative resource-saving technologies with the use of robots and energy efficient equipment;

3) To expand the range of products produced and increase the shelf life from 7 to 30 days; increase the collection and processing of secondary raw materials (serum)

4) To reduce the environmental impact on the environment in the area of operation of enterprises.

5) To carry out the construction of new, reconstruction and technical re-equipment of existing enterprises for the production of whole milk products, butter and cheese, workshops and sites processing and drying of whey based on innovative technologies and modern resource-saving equipment;

6) Introduction of innovative technologies for the falsification of dairy products;

7) To ensure the involvement in the economic turnover of secondary resources obtained in the production of dairy products;

8) To expand the range of products through the introduction of innovative technologies that increase the nutritional and biological value of products, the use of packaging materials of a new generation;

9) To reduce the resource intensity of butter and cheese production through the use of modern technologies, reduce energy consumption and improve the environmental situation in the area of operation of milk processing enterprises.

10)To attract state support by reimbursing part of the cost of paying interest on short-term and investment loans received in Russian credit institutions and loans received in agricultural credit consumer cooperatives. The implementation of infrastructure development and logistics markets of livestock products to be used for increasing capacity of agribusiness organizations irrespective of their organizational-legal forms of points for acceptance and primary processing of milk, including refrigerating processing and storage of dairy products. As part of the implementation of the event, provide for:

1) Construction, reconstruction and modernization of milk acceptance and primary processing points, including refrigeration and storage of dairy products;

2) Purchase of milk trucks for milk transportation.

State support is provided by reimbursing part of the cost of paying interest on investment loans received in Russian credit institutions and loans received in agricultural credit consumer cooperatives

Among the innovations implemented in the Urals region in dairy cattle in the APC "Kilachevsky" Irbitsky district of Sverdlovsk region, APC “Koelginskoe” of the Uvelsky district of Chelyabinsk region, APC "Molniya" M-Punginskiy district of the Republic of Udmurtia introduced in the operation of the dairy complexes of loose housing 1200 dairy cows.

The first stage of the complex (cowshed for 600 heads, maternity ward, milking parlor) on the example of the APC "Kilachevsky" was put into operation in January 2008, the second stage (cowshed for 600 heads) - in the summer of 2009.Milking of cows is carried out in a milking parlor of the "Carousel" type with 50 seats(Figure 2).

Figure 2 “Carousel” type milking parlor.

Manure removal is carried out using the hydraulic manure removal system "Walking delta scraper" (Figure 3) .

Table 2. Technical parameters of the “Orbita

with CRPG head.431111.001	129,0±0,75
with CRPG head.431111.001-01	150,0±0,7
Output radiation power, mv	100
Range of setting the time of a therapy session, min	1...9
Discreteness of setting the time of the therapy session, min	1
The ratio of the generation time to the time of off generation in the cyclic mode of the therapy session	2/5 и 3/1
with CRPG head.431111.001	129,0±0,75
with CRPG head.431111.001-01	150,0±0,7

Figure 3 Walking Delta Scraper.

Watering of animals - from group overturning drinkers (Figure 4).

Figure4 Group overturning drinkers.

Supply and exhaust ventilation is provided by curtains installed in the wall openings and in the ridge (Figure 5).

Figure 5 Supply and exhaust ventilation.

Selection and breeding work in the APC "Kilachevsky" are carried out with the participation of LLC "MK "Genetika".

The farm is one of the leaders in gross milk production in the Sverdlovsk region. Milk yield per cow per year at the dairy complex is 10,400 kg of milk. Taking into account the growing level of automation in the production and processing of milk, it is necessary to develop measures for operational control and registration of the quality of dairy raw materials, including dairy farms, new generation milk trucks, specialized laboratories.

Also, at present, in the Sverdlovsk region, robotic complexes with minimal human influence on the process of obtaining raw milk are becoming more and more popular, which has a positive impact on the health of animals and, accordingly, the quality of the products obtained.

Training for milk producers was organized in the Sverdlovsk region. The project is supported by the Ministry of Agriculture and Food of the Sverdlovsk region, the Union of Livestock Breeders of the Urals and dairy producers of the region. The training is structured in such a way that at the end of each training

block, the student has the opportunity to assess the situation in their household and outline measures for improvement in a particular area of their activity.

An innovative technology for improving the quality of milk and dairy products has been introduced in the APC "Koelginskoye" of the Chelyabinsk region, which consists in the use of electromagnetic radiation of the EHF mm-band at a frequency of 129 GHz when exposed to the mammary gland by the "Orbita" apparatus during milking cows (Figure 6,7).

The electromagnetic field of the EHF mm-band leads to a change in the process of milk synthesis, its physical and chemical properties due to the activation of the molecular spectrum of absorption and radiation of oxygen gas-metabolite and its information interaction with the alveolar system of the breast. As a result, the content of fat, total protein, protein fractions and albumins in milk increases, the concentration of immunoglobulins, lactoferrin, lactose, muramedase and rennet coagulability increases, and the number of somatic cells, lactoperoxidase, SOMO, density, acidity and dry matter content decreases.

Figure 6 The device of EHF therapy "Orbita".

Irradiation of milk used for the production of cheese leads to a reduction in the duration of coagulation by 2 minutes, and the maturation period of cheese by an average of 2 days. At the same time, there is an increase in fat in mature cheese by 0.5 % and an increase in protein by 0.2...0.4 %, a decrease in moisture in mature cheese by 0.8 %, as well as milk consumption per 1 kg of products by 0.2...0.3 kg.

Figure 7 Application of the "Orbita" device.

The forecast assessment of economic and production indicators of this development shows the possibility of increasing the productivity of dairy cows by 10-15 %, reducing the cost of dairy production technology by 15-20 %, increasing the efficiency of the modernized innovative production of environmentally friendly dairy products by 25-35 %. [11]

4. CONCLUSION

The analysis of the current state of development of digitalization in dairy farming in the Sverdlovsk region showed that the ongoing reforms at the regional level are now beginning to give positive results. One of the most important results of the reform is the gradual stabilization of the economic situation in the sectors of the agro-industrial complex and the increase in the production of most types of agricultural products , including milk and dairy products, as well as the decline in the number of cattle. A model of a strategic management system for the development of dairy farming based on digitalization and innovations in the region has been developed, suggesting the search for new ways of development through the implementation of the concept of increasing efficiency based on investment business processes that are risky. This model assumes innovative changes through the planning and implementation of direct investment projects. A distinctive feature of our proposed model is that at the initial stage of its implementation, an active innovative idea is formed, which is subsequently worked out in detail in a business plan and is implemented in practice by implementing an investment project.

AUTHORS' CONTRIBUTIONS

Petrova O.G. - participation in the development of a digitalization and innovation project for the

implementation of measures for the development of dairy products processing. Barashkin M.I. - identification of hazardous factors in dairy products. Milshtein I.M. - development of an interactions scheme in the system of forming quality characteristics of dairy products at the stage of production technology. Barkova A.S. - development of innovative processes within digitalisation period in the form of interconnected system. Muminov A.A. - identification of innovative processes activation together with digitalisation in livestock dairy industry.

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