

6. Implementation of innovations as one of the strategic directions of development of dairy industry enterprises

The food industry is an important component of the economy of any developed country. It acts both as an employer and as a source of income for the economy. In addition, the food industry plays a central role in processing agricultural raw materials and providing the population with food products. In recent years, the food industry has undergone far-reaching technical and technological (new technologies and patents, new scientific and technical approaches, etc.) and economic changes (liberalization of the regional market, along with the liberalization of the world market, the global economic crisis, the increase in the number population, increase in demand, growth in purchasing power, changes in consumer behavior, structural changes in the food industry and retail sales of food products). The effect of these changes is easily traced in the production and processing of food products, as well as in society as a whole, and has a significant impact on the entire chain of production of agricultural products, their processing and the arrival of food products to the final consumer [138].

When considering innovative processes in the food industry, it should be noted that the food industry is not a homogeneous sector. It covers a large number of types of agricultural products and food production. Each branch of food production (meat, milk, sugar, fruits, vegetables, cereals, flour, etc.) is unique. The food industry is a rapidly developing sector. There is significant competition between entities operating in the market. Competition occurs not only at the level of individual companies and markets, or only in the sphere of economic activity of economic entities, it is also the object of making important political decisions. The food industry is considered one of the most important strategic sectors of every economy around the world, which is one of the reasons why food markets in many countries are subject to significant government protection.

The manufacturing industry has traditionally been described as a relatively mature and slow-growing business area that exhibits a relatively low level of investment in research and development, and is quite conservative in terms of the

innovations it brings to the market. It is believed that consumers of this sector are very cautious of radical new products and slow to change their consumption habits. Such caution, together with the necessary strictness of safety-related legal requirements, makes innovation in the food industry a complex that requires a long time to adapt and contains many risks, and therefore cannot be easily implemented.

At the same time, important changes in the nature of both demand and supply of food products, along with the growing level of competitiveness, have made innovation not only an inevitable component of enterprise activity, but also a necessary prerequisite for the growth of agribusiness profitability. Modern consumers demand unique tastes and products that are convenient to prepare and consume, the importance of health and dietary food products that would satisfy their individual requirements and preferences is increasing.

With this in mind, innovation, which can be seen as new products, processes or services, is an important tool for companies in the food industry that allows them to stand out from the competition and meet consumer expectations. In particular, during the last decade, consumer demands in the field of food production have changed significantly: in fact, consumers have realized that the food they consume directly affects their health. Therefore, products in the modern sense should not only satisfy the need for food and provide the necessary nutrients, but also help prevent diseases associated with improper nutrition and improve the physical and mental health of consumers.

In addition, the food industry faces economic changes both in society and in the production and processing of food products, which, in turn, have a significant impact on the entire food supply chain, including the arrival of products to the final consumer. This has forced companies to pay more attention to food products that would meet consumer demands for a healthy lifestyle.

Such demand requires a kind of improvement of the product, including its development (or at least improvement), innovative technological solutions and new business models. On the other hand, the general progress in areas such as biotechnology, nanotechnology and storage technology creates an unprecedented range

of opportunities for value-added actors in the food industry, many of which have the potential to adequately meet today's consumer demand.

According to studies, companies almost never innovate in isolation, and their innovative activity is part of the general activity in the market and the existing conditions of the market structure. Therefore, it is necessary to analyze not only the innovative activity of individual companies, but also all activities in the innovation system, starting from the accumulation of knowledge to the introduction and market penetration of new products, processes and services.

Given the large number of actors in different fields involved in the food supply and the difficulties faced by producers in meeting the diverse demands of intermediate customers, end consumers and legislators, innovation management should be a common practice in food supply chains.

Innovations in the food industry are often aimed at developing important substitute products that would meet the requirements of a healthy diet. They are usually new or improved variants of products or services that already exist in the markets and may be focused on one of the areas of the latest technology in the food industry (for example, the development of new processes, the development of new products, the improvement of the quality characteristics of products or a new level of achieving consumer needs). In addition, technological innovation must be combined with social and cultural innovation in order to develop products that meet the nutritional, personal and social needs of the entire society.

Innovation can occur in all parts of the food chain, and can be classified as follows:

- 1) New food ingredients and materials;
- 2) Innovation in finished products;
- 3) New food processing technology;
- 4) Innovation in the quality of food products;
- 5) New packaging methods;
- 6) New methods of distribution and retail sale of products.

So, if you analyze individual companies in the food industry, you should distinguish four main categories of innovation: product innovation, process innovation, marketing innovation and organizational innovation. At the same time, companies behave differently in the field of innovation and choose types of innovation depending on their dominant orientation towards products, processes or the market, their type of ownership, size, market share and capabilities. In addition, innovative activity also depends on the cultural and geographical characteristics of the market.

Research shows that the innovative activity of enterprises in the food industry is significantly influenced by their orientation to the market or demand. Market orientation is seen as the component of the innovation strategy with the highest potential for success, and the most successful companies try to integrate and balance their marketing, research and development activities.

Cooperation also play a very important role in innovative activity. According to research, companies almost never innovate in isolation, but build their innovation activities using vertical or horizontal cooperation, creating a whole network of actors. The effect of scale and export orientation also exert a significant influence on the level of innovative activity.

A very good example of such a policy and attitude to the food sector can be seen on the example of the European Union. The European market for agricultural and food products is unique due to the presence of the Common Agricultural Policy (CAP) and its general trade policy. At the same time, it became the reason why European countries are often criticized by international partners.

Reform processes led to greater liberalization of European agriculture and food industry. This process of liberalization, both in relation to the EU's own internal market and in relation to the EU's external environment, puts pressure on individual producers. They are forced to improve their competitiveness, both within the EU and internationally. The dairy industry can be considered as an example of this process.

The dairy industry is a fast-growing sector, not only in the EU, but worldwide. In addition, the market is also expected to grow significantly in the future. Considering this, the dairy industry in the European Union is also undergoing significant changes.

The new conditions of the market environment have a direct impact on individual producers; they all have to compete for market places.

Considering the above, in our opinion, it is appropriate to show the possibilities of innovative activity in the dairy industry using the example of one of the European countries. We propose to carry out an analysis on the example of the dairy industry of the Czech Republic.

Since the 1990s, the Czech dairy sector has undergone significant institutional and structural changes. These changes occurred due to changes in the structure of the Czech economy and the accession to the European Union, an event that significantly affected the activity, structure and volume of the dairy sector. The development of the dairy sector after 2004 is characterized by a decrease in the number of cows, an increase in productivity, a significant dependence of domestic prices on world market prices, an increase in the share of milk produced on specialized farms and the dependence of the dairy sector on political decisions, such as quotas and subsidies [139].

Milk production in the Czech Republic ranges from 2,700 million with an average productivity of 6,936 kg per cow and the number of cows in the range of 561,000. About 60% of the dairy herd grazes in mountainous areas. More than half (58%) of milk production takes place on specialized dairy farms. The rest of the milk comes from farms engaged in both crop cultivation and cattle breeding. The share of specialized dairy farms is very small compared to other EU member states, where it is about 95%. This situation affects the competitiveness of the Czech dairy sector, as specialized dairy farms are generally more technically efficient than mixed ones. Most of the milk produced in the country is sold through milk producer organizations (MPOs). Their share in the volume of sales of raw milk is about 70%.

A typical specialized dairy farm keeps about 140 cows with a production of about 942 tons of milk per year. Compared to other countries of the European Union, specialized farms in the Czech Republic have a lower productivity (1.4% less than the EU average), although the volume of milk production is higher (due to a larger number of dairy herds), which is reflected in significantly lower milk prices.

Production of dairy products in the Czech economy is one of the key sectors of the food industry. Its contribution to revenues from the production of its own products and services amounted to 14%, according to data for 2013. The number of companies in the analyzed industry was 156 in 2013, which is 2% of food industry enterprises in the Czech Republic. This year, 8,546 people worked in the industry (this is 8% of food industry workers). It is the fourth largest employer. According to Food and Drink Europe, the production of dairy products in the country ranks third in the overall production of food products (after beverages and meat products) [140].

Milk and dairy products are a key area in the Czech agricultural trade. These types of products are also the basis of the diet in the country. It should also be noted that the country's dairy industry is significantly supported by the Rural Development Program.

Since 2007, the Czech Ministry of Agriculture has approved a number of projects within the Rural Development Program aimed at financing innovative activity. The purpose of the grant was to create and implement new technologies, new processes or products, or improve existing technologies or products, which would lead to increased efficiency and increase the competitiveness of the industry. The database contained information about the participants, the name of the project, its details, the process being evaluated, the total amount of investment, and the absolute and relative amount of invested subsidies. Data from these projects were compared with financial statements obtained from the Bisnode Albertina Gold Edition database, which contains data on the financial statements of companies in the Czech Republic, as well as an overview of head offices, industry, number of employees and total turnover [138].

Projects on cooperation and innovation in the dairy industry can be divided into 4 phases:

1. Cooperation. Joint agreement on the rights to use utility models to protect the idea and formulation of the product under development and know-how, which involves cooperation in the implementation of the project. Provision of recommendations and materials to support healthy eating. Preparation of graphic design, product design, consulting, preparation of marketing strategies. Collaboration

on marketing innovation was not as common as collaboration on technology or product innovation.

2. Research and development. Laboratory attempts to create new formulas, determine specific technological procedures, technical product standards. Laboratory and operational examinations, development of production documentation, assessment of physical and chemical properties, microbiological quality, quality and stability of food products.

3. Technology. Development of a production line and project documentation that would correspond to the technological level of the project. Identification, specification and ordering of certain types of equipment. Making changes in the design and other preparation for the installation of the proposed equipment. Installation of equipment.

4. Production. Commissioning of the production line, testing of the new product and verification of the technological process in accordance with technical standards. Packaging and checking the durability and stability of the product. Creation of production know-how and its transfer to manufacturers.

In all cases, the cooperation between the applicant and the research center consisted of consulting and advisory services, identifying problems and proposing possible solutions, providing a complete work methodology and preparing a technological process. An integral part of the cooperation was research and development, production testing in laboratory conditions and testing of the properties of the new product and technology. The research center and the milk processing companies collaborated to try to find energy-saving technological solutions to reduce costs and solve environmental problems.

The dairy industry of the Czech Republic had two important partners in innovative projects: the Prague Institute of Chemical Technologies and MILCOM a.s.

The Prague Institute of Chemical Technologies was the most frequent contract partner for innovations in the dairy industry (in more than 60% of cases). It is a state university specializing in all areas of chemical research. Specialists of the Institute develop recommendations for the optimal use of research results, in particular the

protection of intellectual and industrial property, patent applications, license agreements, as well as the publication of scientific results.

MILCOM a. s. it is a private enterprise. It is an important partner for all food manufacturers, in particular for dairy companies, developing new products, technologies and reliable food diagnostics. The company offers quality services in the field of milk processing and packaging, research of food products in laboratory conditions.

Project participants were also able to choose other partners, such as the Food Research Institute of Prague.

The overall goal of innovation in the dairy industry is to increase the competitiveness of dairy companies. Almost all projects were also aimed at achieving higher sales. Some projects were aimed at creating a more efficient storage system and focused mainly on cost savings. Increasing the competitiveness of milk processing enterprises was also influenced by the increase in profits due to more efficient processing or storage.

So, 4 types of innovations can be identified in the dairy industry of the Czech Republic:

1) product innovations. Enterprises focused on product innovation are those that, during the considered period, presented new or significantly improved products and / or services in terms of their main characteristics, technical characteristics, software or other intangible components, target needs or user convenience. Changes of purely aesthetic nature and simple resale of new goods and services purchased from other enterprises were not considered as innovations.

2) process innovation. Businesses that implemented process innovations implemented new and significantly improved production technologies or new and significantly improved methods of providing services and supplying goods. The result of such innovations had to be quite significant in terms of production level, product quality (goods or services) or production and distribution costs. Purely organizational or managerial changes did not belong to this type of innovation.

3) marketing innovations. Businesses that innovated marketing activities offered new marketing methods that included significant changes in product or packaging design, product placement, promotion, or pricing.

4) organizational innovations. Enterprises implementing organizational innovations implemented new methods in business practices, work organization or external relations.

Product and process innovations together can be considered as "Technological Innovations".

In this area, five main types of innovative trends in the dairy industry can be distinguished in recent years.

(1) Processing and efficient use of by-products (whey, buttermilk).

(2) Production of new health food products.

(3) Improved processing of dairy products, with special emphasis on long-life products with better taste parameters.

(4) Improving the efficiency of transportation and storage of milk and milk products.

(5) Improvement of wastewater treatment.

The five types of innovation are often interrelated. For example, whey processing can lead to new products that are beneficial for health, focusing at the same time on improved taste parameters.

A significant proportion of the projects focused on by-product processing, including whey processing. Whey (milk whey) is a by-product of cheese or casein production that has several commercial uses. The most significant barrier to the more effective use of whey until now has been the low content of dry matter. Another problem was the different composition of serum from different production facilities within the same company. Any fat must also be removed before processing the whey. The process is further complicated by the presence of acidic whey, which is a by-product obtained during the production of acidic types of dairy products (cheese, tinted yogurt). Therefore, it is very important to develop the technology of pre-treatment of serum.

In the Czech Republic, whey is traditionally used for fattening animals. Dairy companies try to take advantage of the high nutritional value of whey components. The purpose of the innovations is the search for new technologies for the processing of milk whey and the use of processed whey to improve the nutritional properties of sour milk and other types of dairy products.

Those project participants who improved whey processing did so either by purchasing processed whey from processing plants or by trying to add processed whey to dairy products themselves. The end product of whey pre-treatment and processing is a more concentrated and stabilized whey that can be added to dairy products for better storage and transportation. The quality of the stabilized, condensed whey is also improved by increasing the filtration to remove the cheese powder. Moving the processing of whey to a special space, separated from the preparation of raw materials for cheese production, ensures greater safety in cheese production. The use of reverse osmosis increases the amount of dry matter, and the filtrate can be completely used as water for industrial use. Whey is not only a by-product, it also has positive nutritional value. Thus, processing and efficient use of by-products are often linked.

Another by-product processed in dairies is buttermilk. Traditional buttermilk is the liquid left over from churning butter. The raw buttermilk is processed to achieve the desired fat content, pasteurized, condensed through an evaporator, dried, and usually packed in large bags. It is then used in the food industry, especially in bakeries, after emulsification. The innovation consists in new methods of storing buttermilk before its processing, the emulsification process and new types of packaging not only for the wholesale but also for the retail market. An effective way of storing buttermilk in tanks allows you to keep it cool and safe, as well as to improve its further processing. In order to increase sales, you can sell both condensed buttermilk in cans and dried in bags.

The development of new products aimed at improving health is a valuable innovation that follows trends in consumer demand for a healthy lifestyle. The development of new products with health benefits and the improvement of dairy processing, with a special emphasis on long-term storage products with better sensory

parameters, is the innovation combination that is ranked 2nd most frequently. Improving the nutritional properties of dairy products can be achieved by adding microbial cultures to the products or by careful processing with preservation of nutrients.

Specific innovations were developed in the segment of foods for special medical purposes (special liquid food products with a high energy content and low lactose content, intended as dietary supplements during malnutrition associated with the disease).

The production of new products with health benefits is often combined with improved dairy processing, as well as the production of products with a special emphasis on long shelf life with improved taste properties. At the same time, useful and tasty products with a long shelf life and attractive packaging are in great demand among consumers.

Dairy products that are attractive to the consumer must have a positive nutritional value. Dairy products can be enriched with probiotic cultures, most often *Bifidomacterium*, *Lactobacillus acidophilus* and *Lactobacillus casei* in combination with classic milk and yogurt cultures. Innovations are based on new probiotic cultures, such as *Enterococcus faecium*, which can have a positive effect on the human body. However, some microbiologists have doubts about the safety of probiotics containing *Enterococcus faecium* bacteria.

Probiotic cultures regulate intestinal microflora by suppressing unwanted microorganisms and can have a positive effect on the body. In addition, the nutritional value can also be increased by adding processed whey with a significant proportion of whey proteins (whey proteins consist mainly of α -lactalbumin and β -lactoglobulin). Whey protein is often marketed as a nutritional supplement for bodybuilders. Fortified foods can also help people prevent serious complications (colon cancer, cardiovascular complications, etc.).

Milk processing enterprises strive to ensure a longer shelf life of milk and dairy products. The shelf life of milk and dairy products can be extended in the following

ways: a) addition of artificial preservatives; b) addition of microbial cultures; c) physical effects (heat, cold); d) special packaging.

Addition of microbial cultures is not related to physical storage. Dairy processing enterprises, like enterprises in other branches of the food industry, try not to use artificial preservatives. Some businesses use microbial cultures to extend the shelf life of dairy products. They solve the problem of extending the shelf life of dairy products through the use of lactic acid bacteria. Preservation is carried out in a natural way, as it is a fermented product containing lactic acid. Other businesses use physical methods to extend the shelf life of dairy products; however, preserving milk without harsh heat treatment remains a major problem in the dairy industry. Milk processing enterprises most often extend the shelf life of dairy products using ultra-high temperature treatment, pasteurization or drying.

Packaging innovation is an important area of innovation not only in the dairy industry. Packaging is a very important object of innovative activity, as it ensures safety, storage, provides information and performs sales functions. The combination of product, process and marketing innovation is the most important type of innovation. Dairy companies are trying to use new types of packaging that would protect the contents, extend the life of dairy products, attract consumers and facilitate storage and transportation of the contents. The new packaging must also be environmentally friendly. The shelf life of dairy products can be extended by using passive packaging that provides sufficient protection for the products, or by using active packaging elements containing bactericidal substances or substances that have a bactericidal effect (nisin, purax, natamycin, etc.), to reduce spoilage.

Products for further processing are packed in packaging capacities (tanks, bags). Products for retail consumers are packaged in attractive active or passive packaging (Tetra Pak°, Pure Rak", Bag-in-Box™, Doypack", cans, glass, membrane, polyethylene film, foil, resealable packaging, etc.). The medical packaging is designed for ease of use and can be directly connected to the nutrition sensor. Collaboration on new product and/or packaging design took place between dairy companies, research center and graphic design studios.

A special area of innovations in the dairy industry was the improvement of wastewater treatment. The production of milk and dairy products is accompanied by the generation of a certain type of wastewater, which has a higher fat content and, thus, has much more stringent disposal requirements. Currently, industrial wastewater from the production of dairy products is pre-treated by mechanical cleaning at the enterprise. After that, pre-treated wastewater is pumped to the wastewater treatment plant for further treatment. The goal of improving wastewater management is to make changes to the system to achieve lower volumes of wastewater.

It is worth noting that Czech milk processing enterprises that introduce innovations in their activities are, as a rule, medium and large companies that have enough funds to introduce new technologies. Innovation and public support for innovation allowed dairy enterprises to stabilize their profits during the crisis and increase their competitiveness. Further support for innovative processes in the dairy industry was an important decision for the country's economy.

As for Ukraine, the dairy industry remains one of the leading in the structure of the food industry. Both the well-being of the population and the food security of the country as a whole largely depend on its functioning. However, the problems that have arisen in recent years for the enterprises of the industry force to look for new, alternative ways of development and increasing competitiveness. One of these ways is the implementation of innovative processes in the activities of enterprises. After all, it is innovations that can ensure the development of new types of products, a high level of quality and price advantages, and create conditions for the active promotion of products to the market [141].

One of the key problems of the industry, which requires an urgent solution, is providing enterprises with quality raw materials. It should be noted that, without waiting for the results of rather inconsistent steps taken by the state to improve this situation, most of the powerful enterprises in the industry are trying to solve the problem on their own, using the principles of vertical integration. Vertical integration involves the creation of a single structure that controls and comprehensively develops

the entire process: from milk production to the sale of finished products, and includes milk producers, processors and market operators.

Thus, milk processing enterprises – industry leaders conclude long-term cooperation agreements with the most powerful agricultural enterprises-suppliers of milk. Their example shows that the development of relations with wholesale suppliers should be carried out using the following directions:

- providing enterprises with the necessary material resources in the period of spring field work and harvesting;
- signing of contracts for the supply of high-quality fodder to the largest farms in the region in exchange for supplies of dairy raw materials;
- financing the construction of milking parlors at the main supplier partners;
- provision of enterprises with breeding cattle at the expense of payment for milk;
- providing assistance in preparing food rations;
- provision of loans to agricultural producers on favorable terms;
- advancing spring-autumn field work;
- making prompt payment for delivered milk of the appropriate grade and heat resistance;
- providing consultations on improving the quality of raw materials and implementing educational programs for representatives of farms, etc..

In addition, really high-quality milk that meets the standard can be produced by large specialized agricultural enterprises that are able to control the quality at all stages, including by conducting laboratory analyzes of the milk produced. One of the primary tasks of these enterprises is to increase milk yields in conditions of stable herds. The solution to this problem is achieved both by improving the brood stock and by using the latest biotechnological developments, in particular probiotic preparations to increase the productivity of cattle, which allow solving a number of problems, such as increasing milk yield and milk fat content, preventing rumen acidosis, improving grain

digestion corn silage, replacement of dry fats, sterilization of mastitis milk for its further use for feeding young animals, increasing the preservation of young animals.

Innovations in dairy farming should be aimed primarily at increasing productivity and expanding reproduction of dairy cattle; use of the best global and domestic genetic resources; radical modernization of fodder production, animal husbandry technology; milking technologies with the involvement of leading technical developments; prevention or implementation of effective and relatively inexpensive disease treatment schemes [142].

The newest concept of "smart farm" is an integrated complex of ensuring effective management of production, which includes 8 constituent parts of elements of an interconnected technological cycle (Fig. 1) [143].

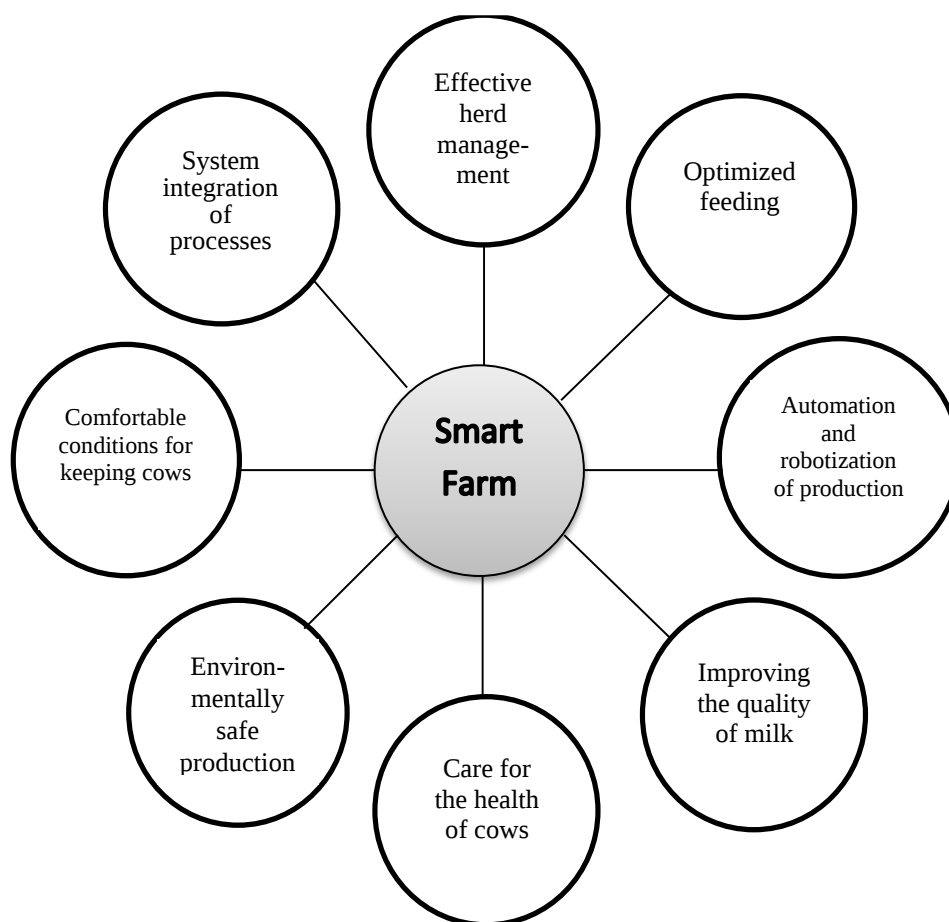


Fig. 1. The main components of the "smart farm" concept

Source: [143].

So, the main elements of such a cycle are: optimized feeding, automation and robotization of production, improvement of milk quality, care for the health of cows, ecologically safe production, comfortable conditions for keeping cows, system integration of the main processes at the enterprise, effective management of the herd. As experience shows, the implementation of such a complex allows to significantly increase the efficiency and competitiveness of milk-producing enterprises.

For example, in Ukraine, in March 2013, the first stage of a dairy farm with 4 robotic milking machines manufactured by the DeLaval company was opened in the village of Vilna Tarasivka, Bilotserkiv district, Kyiv region. The farm was built on the innovative principles of the Voluntary milking system (VMS), which is carried out with the help of a computerized production process management system and 4 manipulator robots. Cows are served by two operators in one shift. After milking, the milk goes to two coolers, each with a capacity of 10 tons [143].

Thus, thanks to such farms, automation can be introduced into the activities of enterprises as one of the innovative technologies, which reduces the cost of milk and provides competitive advantages of products [142].

Another new trend in the development of agricultural milk-producing enterprises is the setting up of their own mini-factories for milk processing. These factories allow processing milk directly at the place of its production on modern equipment in compliance with all technological requirements. Specialized milk processing lines allow the production of original products such as pasteurized milk, sour milk cheese, soft and hard cheese, cottage cheese, sour cream, butter, cream, condensed milk and condensed skimmed milk with sugar, kefir, yogurt, bio-yogurt, ryazhanka, oil pan, etc. Establishing own dairy plant allows to solve the problem of underdeveloped infrastructure for milk production and processing, when milk is transported for processing over tens or even hundreds of kilometers and, at the same time, to provide the population with really high-quality and fresh dairy products. In addition, production ceases to depend on the price policy for raw materials, livestock farmers have capital,

the number of buyers increases, the financial situation of farms improves, and therefore, we can talk about the revival of a highly productive herd [145].

In the dairy industry, there is also a process of consolidation, that is, smaller branches are joining large dairy plants. The production of finished dairy products is increasingly concentrated in large enterprises, which invest significant funds in the modernization of production, mobile react to changes in the market situation, systematically increase the assortment and expand the sales market both on the territory of Ukraine and through export deliveries. Manufacturers of dairy products are focusing their efforts on increasing market share, directing the entire volume of investments to the purchase of new equipment and spending significant funds on advertising and promotion of manufactured products.

Production at many enterprises is diversifying, along with dairy products, they produce products that are not traditional for the dairy industry: natural juices, candies, mayonnaise, carbonated flavored drinks, etc. This allows small businesses not to look for ways to develop their company or new technologies, but to focus their efforts on the production of the desired product [142].

At the same time, in the situation of a catastrophic shortage of raw materials, milk processors are forced to look for new alternative ways to solve this problem. One of these ways is the development and implementation in the production of combined products with partial replacement of milk fat with vegetable fat. It should be noted that the use of vegetable fats is associated not only with economic and raw material problems, but also with overcoming the public health crisis. This trend is especially relevant in cheese and butter production. At the same time, the production of really high-quality products with the use of vegetable fats allows to solve a number of the following problems: increase production volumes, smooth out the seasonality of production, expand the range of products taking into account the requirements of healthy nutrition, preserve traditional technological schemes of production, increase the biological value of products due to enrichment with polyunsaturated fatty acids, to significantly reduce the cost of products, increase the shelf life, etc.

The main process innovations in the milk processing industry are aimed at the use of energy-intensive and low-waste technologies, the company pays special attention to the introduction of low-temperature processing in order to preserve the beneficial properties of milk, nanotechnologies and technology for extending the shelf life.

Another direction in the development of milk processing enterprises is the expansion of the product portfolio due to the introduction of innovative products into production. Thus, Ukrainian manufacturers are beginning to develop and introduce into production functional products and products with high added value, as well as new types of organic and fermented milk products for baby food.

Among the functional products developed in Ukraine, four main groups can be distinguished: food products for the elderly, diabetic products without sugar substitutes, products for improving immune functions in the human body, products for correcting intestinal dysbacteriosis. These products are produced without the addition of stabilizers, artificial dyes, preservatives; enriched with vitamins, minerals, extracts of medicinal plants, bifido- and lactobacteria, etc..

In the category of products with high added value presented on the Ukrainian market, it is worth highlighting cheese desserts, most of which are complex products from the standpoint of combining different ingredients in the recipe. For example, in addition to basic sour milk cheese, such desserts contain butter, cream, yogurt, sugar, confectionery glaze, toppings (chocolate, caramel, fruit), fruit and berry supplements in the form of syrups, jams, pieces of fruit, etc.. As a result, cottage cheese desserts turn into an independent dish, designed for a certain consumption situation, which gives the product additional value and increases its value in the structure of retail trade. Such products form the so-called "modern segment", which includes various categories of modern innovative products.

In the cheese industry, the share of so-called "elite" cheeses with extended ripening periods is increasing, the popularity of cottage cheese is increasing, some companies are setting up the production of high-quality and environmentally friendly kosher cheese.

Consumers are increasingly switching to eating healthy and high-quality food, without the addition of preservatives and other additives. In order to maintain competitive advantages and expand the production of goods, the manufacturer must ensure the naturalness of the ingredients and a wide range of dairy products as much as possible. Moreover, the consumer is ready to pay a higher price for naturalness, which is an incentive for the producer. Therefore, in order for food products to be in demand on the market, they should be as natural as possible. As a result of the existence of this trend, there is a reorientation of consumers in their tastes — a departure from exotic tastes (desserts, yogurts) to traditional dairy products (kefir, sour cream, ryazhanka, cheeses). To ensure their successful development in the future, domestic producers of dairy products should actively expand their product range thanks to such natural products, primarily organic, and develop strategies for their promotion.

The production of new types of products from the secondary products of milk processing - whey and lactose - is also an actual direction of expansion of the assortment line of milk processing enterprises. In addition, the increase in the degree of use of secondary raw materials is closely related to the production of milk-containing products, the composition of which includes not only whey, but also raw materials of plant origin. This direction is relevant not only from the point of view of efficiency, but also from the point of view of environmentalization of dairy production [144].

The issue of whey processing in Ukraine today is extremely relevant, and not only from the point of view of environmental safety: whey is a valuable dairy raw material, because it contains 6–6.5% of milk solids. Therefore, in conditions of insufficient production of raw milk, whey processing has great economic potential. Many factories in Ukraine already have some experience in partial or complete processing of whey using the latest filtration methods, other enterprises are working on this problem and plan to solve it in the near future.

In general, in recent years there has been a tendency to increase the production and consumption of low-calorie and low-fat dairy products, in the production of which secondary dairy raw materials are widely used. Both drinks for direct consumption and

semi-finished products for the production of desserts, puddings, ice cream, jelly products, etc. are produced from skimmed milk, buttermilk and whey.

Products with non-standard organoleptic properties (taste, consistency, satisfaction of consumer wishes) also find their buyer. It can include yogurts with a high fat content, various yogurt desserts, cottage cheese desserts, cottage cheese in glaze, cakes, whipped and frozen desserts, milk with juices, alcohol, ready-made breakfasts with a high milk content, etc.

In order to increase sales volumes, most enterprises began to produce products with extended shelf life based on natural preservatives. Thermalized fermented milk products (for example, sour cream) have appeared on the market, the shelf life of which can reach 30 days.

Ukraine is also witnessing the growth of the "vegetable milk" sector. It can be considered as a substitute for animal products. The influence of this fashion trend is already visible in developed countries, where many young people have abandoned classic dairy products. The demand for products of plant origin is also growing in Ukraine. Consumers refuse classic milk for reasons such as: lactose intolerance, religious beliefs, veganism, tribute to fashion, etc.

Plant milk is made from different types of nuts, seeds and cereals. Its main types are soy, almond, rice, oat and coconut. Some types of such milk can be used ready-made, others need to be diluted to the required consistency, and some are used only for cooking. Its main advantages are that plant milk does not contain cholesterol, lactose and casein. However, there are also disadvantages: it cannot completely replace cow's or goat's milk, since calcium from animal milk is absorbed more easily and efficiently. Some types of vegetable milk can cause allergies and be more caloric than usual. The price of vegetable milk is also a significant argument: depending on the producer, it is almost three times more expensive than cow's milk [145].

Milk processing enterprises also pay great importance to the development and use of new types of convenient and effective packaging that would satisfy the needs and preferences of consumers. Thus, the demand for hard cheeses in small packaging, for whole milk products in packaging of various sizes is growing. Trends in the use of

different types of packaging for different segments of consumers (children's group, schoolchildren and teenagers, adults, elderly population) are determined. Creating a kind of unique packaging enables the consumer to quickly recognize the product, forms the image of the product, positions it among many similar competing products.

Taking into account the ever-increasing requirements for the quality and preservation of dairy products, the introduction of innovative technologies in the development of new types of packaging and packaging materials for the dairy industry is also relevant. So, for the packaging of oil, along with laminated foil, they began to use the latest materials based on lime and polymer. The main feature of these materials is that they are close to eggshell in terms of properties: the ability to self-decompose over a certain period, including under the influence of ultraviolet rays, as well as safety for human health and the environment.

Analysis of the dairy products market and examples of the implementation of innovative technologies at enterprises of Ukraine allows us to identify the advantages of innovations and the factors that prevent their implementation (table. 1) [142].

Along with the introduction of innovations, the implementation of the HACCP system is extremely important for the development of enterprises in the industry, because, as the experience of advanced enterprises in the industry shows, it is not only a tool for food safety, but also increases the efficiency of food production, saves costs, contributes to the growth of sales, attracting investments, increasing the value of enterprises, allows to minimize reputational risks, which is extremely important in conditions of fierce competition.

The implementation of quality management systems at enterprises makes it possible to improve all production processes, increase the general culture of production and the responsibility of employees, ensure the production of high-quality, safe and competitive products, create the image of a reliable and responsible manufacturer, ensure access to foreign sales markets, and is also one of the important factors contributing to the attraction of foreign investments.

Table 1

Advantages and restraining factors of innovation implementation

<i>Factors restraining innovative activity</i>	<i>Benefits from the introduction of innovations</i>
Unpreparedness of enterprises to master the latest scientific and technical achievements, lack of information about new technologies, sales markets	Simplification of the process of transportation of finished products, protection against the consequences of the risk of violation of the temperature regime
Lack of own funds, high economic risks, long payback periods of innovative projects	Much cheaper milk and dairy products, extension of the storage period of raw materials and finished products, as well as simplification of storage conditions
Insufficient level of legislative and regulatory documents, lack of a standardized mechanism for evaluating intellectual property, lack of systematicity in measures to implement innovative potential	Reduction of environmental pollution, reduction of energy and material costs
Insufficient innovative development of the technology market, lack of an effective system of priorities for the development of the scientific and technological sphere	Preservation and expansion of traditional sales markets, creation of new sales markets in Ukraine
Lack of incentives for innovators (the only incentive is an uncertain chance to sell an invention abroad) and entrepreneurs themselves	Ensuring compliance of products with modern consumer preferences and standards, improving the taste qualities of products, their color, smell, etc.
Uncoordinated actions of subjects of innovative activity	Increasing the flexibility of production, improving working conditions
Ukraine's innovation sphere is unattractive to domestic and foreign investors	Reduction of labor costs, growth of production capacity

Source: [142].

So, as evidenced by the results of the conducted analysis, at present, the majority of enterprises in the milk processing industry have recognized the need for innovative activities. Among the main areas of application of innovations by milk processing enterprises, the following should be highlighted:

- creation of new integration structures that control and comprehensively develop the entire process: from milk production to sale of finished products;
- application of the latest biotechnological developments to increase cattle productivity;
- installation of modern technological equipment, including specialized milk processing lines at the places of its production;
- development and production of combined products with partial replacement of milk fat with vegetable fat;
- expansion of the product portfolio due to the production of functional products and products with high added value, as well as new types of organic and fermented milk products for baby food;
- implementation of modern filtration systems;
- active use of secondary raw materials in the production of dairy products;
- use of modern packaging materials, which allow to improve environmental friendliness and increase product shelf life, etc.

Thus, despite the fact that innovative activity in the food industry of Ukraine is at the stage of implementation and is carried out in difficult economic conditions, the use of innovations in the enterprises of the industry (including enterprises in the dairy sector) is an effective factor in increasing their competitiveness.