

Monitoring of resource-efficient provision of Ukrainian dairy processing enterprises with high-quality raw milk on the basis of international requirements

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Abstract. The article provides information on the main problems of development of dairy enterprises in Ukraine on the criteria of sustainable development and taking into account the vector of the European integration course of the country. The level of providing milk processing enterprises with the quality of raw milk is analyzed. The main trends in the supply of raw milk from agricultural enterprises and households of Ukraine by varieties are presented and analyzed. The dynamics of milk supply and its price are also presented. It is established that the use of quality raw milk directly affects the efficiency of milk processing enterprises. Important aspects of quality control of raw dairy products at enterprises are outlined. High-quality dairy production and reduction of production costs are impossible without the functioning of the raw material quality monitoring system. To this end, it is necessary to introduce the principles of hazard analysis and critical control points in the management structure of dairy companies. It is proved that the key factor of global economic development is the state of the environment, so monitoring the supply of milk - raw materials should also be accompanied by the definition of a set of resource efficiency indicators.

1. Introduction

The dairy industry of Ukraine is one of the most important in the food industry, because its products have a high and stable demand. The main problems of the dairy sector of the Ukrainian national economy directly stem from the general problems of the domestic agro-industrial complex. These problems are accompanied by the peculiarities of the dairy industry, including the significant dependence of producers on resources and raw materials, as well as the limited time of sale of finished products. Dairy enterprises are characterized by slow implementation of advanced technologies for the production of quality dairy products, unstable indicators of small and medium enterprises in Ukraine, which are under pressure from large competitors and can not significantly affect the overall market, high share of borrowed funds in the capital structure, low the level of updating the material and technical base [1]. Today, milk production for milk processing enterprises is a guarantee of food security in Ukraine. Therefore, the introduction of advanced technologies for the production of raw milk and dairy products, based on the concept of BAT (Best Available Techniques), will effectively use the available resources of enterprises and provide the population with quality and safe food.



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2. Related works

Such Ukrainian economists as Bezsmertna O [1], Grechko A [2], Dzhedzhula V [3], Karpenko V [4], Sviderskaya I [5] Kharkivsky D [6] and Fedulova I [7] studied the state and prospects of the dairy industry of Ukraine, development problems and ways to solve them.. Research on the current problems of the dairy industry, the price situation in the milk market in Ukraine and dairy products is carried out by the analytical company Infagro [8], as well as the Association of Milk Producers (AVM), a non-profit non-governmental professional association of farms specializing in dairy [9]. The Organization for Economic Co-operation and Development, together with the Food and Agriculture Organization of the United Nations (OECD-FAO) [10], analyzes and forecasts data on the functioning of global and regional dairy markets.

3. Presentation of the main material

Organizational and economic mechanism of production of quality dairy products combines monitoring of all stages preceding the receipt of finished products - from procurement and processing of milk to packaging and transportation. Quite a lot of technological processes for different milk processing enterprises are universal (Fig. 1).

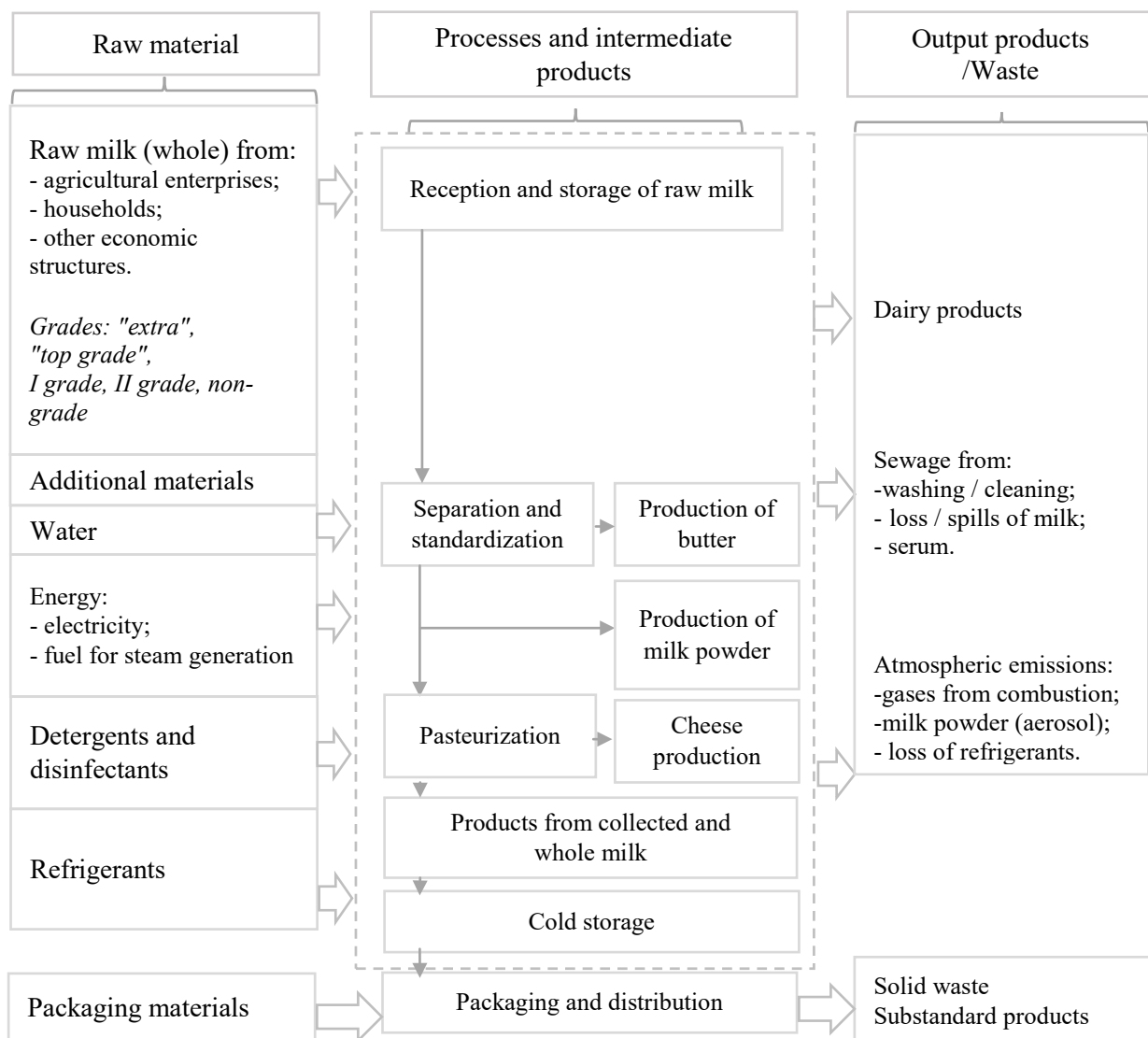


Figure 1. Generalized scheme of production at dairy enterprises [11].

In the production of basic types of dairy products, high-quality components of raw milk are used in different ways. In the manufacture of whole milk products, virtually all components of milk remain in the finished product. During the production of cheese in the finished product is used up to half of the dry matter from milk, up to 92% fat and 75% protein, and the rest remains in production waste. Therefore, the improvement of milk processing technologies at enterprises will allow to fully use its components at the same cost [11].

The system of crisis management and monitoring should be integrated into the management of milk production and supply, control of its quality in the processing process. The tasks of anti-crisis management of raw milk supply include the following:

- development of a system for monitoring the supply of milk, quality control in the implementation of its admission to the milk processing plant;
- formation and organization of logistical approaches to the supply of raw milk and management of its stocks [1].

Quality control of milk supplied to re-equipped enterprises cannot be fully carried out after recovery to raw materials coming from the private sector, there is no mechanized addition and subsequent cooling. Therefore, in the absence of investment in private farms, dairy companies spend their own resources to control milk on receipt.

Fluctuations and the level of purchase prices for milk, and as a consequence, for the output of dairy products, are also a problem that must be addressed through government regulation. According to the production technology, 60% of the cost of finished products is raw milk, and in some dairy products this value may exceed 80%.

Taking into account also the seasonal dependence of milk yield, the capacity of processing enterprises in winter decreases several times compared to the spring-summer period. Milk pricing policy in Ukraine, thus, is formed spontaneously under the pressure of milk suppliers, who do not seek to improve its quality [6].

The problems of achieving the quality of raw milk and finished products that would comply with the level of European legislation are associated with a significant amount of milk from households. In 2020, about 22% of the total amount of purchased milk came from OSG (private farms), which do not supply milk of "extra" grade.

In 2012, households received 51.5% of the total volume of milk coming from all categories of suppliers. During the period from 2012 to 2020, the volume of raw milk purchased by milk processing enterprises from households decreased significantly. During this period (2012-2020), the volume of raw milk production in households decreased by 70%, and in 2020 compared to 2019 - by 13.9%. This is due to the fact that most milk-producing households have not been able to cover the costs of maintaining their own production due to rising resource costs and rising feed prices and have been forced to reduce or close down.

In 2020, the share of raw milk received for processing from agricultural enterprises was 77.7%, and compared to 2017 (the lowest value), production increased by 24.4%.

The placement of active raw material bases takes place mainly with the concentration in the central part of Ukraine, in the region of which in 2020 received an average of 380 thousand tons of milk from different categories of farms.

According to the normative document DSTU 3662: 97 "Whole cow's milk. Procurement requirements" [14] standards were spread in Ukraine, according to which five types of raw milk were distinguished (Table 1) depending on density, acidity, mass fraction of dry matter, protein content, mass fraction of fat and other indicators. These standards were in force until 2018, but these requirements for milk quality did not meet European standards, so they were replaced by DSTU 3662: 2018 "Whole cow's milk. Procurement requirements" [14], which was adapted to EU norms and standards on safety, quality, hygiene of production and circulation of milk.

Until 2017, non-grade milk was processed from agricultural enterprises for processing. Due to the introduction of DSTU 3662: 2018, milk of this variety, which was supplied to enterprises mostly from households, was determined to be unsuitable for dairy production. According to the new standards,

grade II milk should also not be delivered for processing due to the introduction of stricter requirements for the quality of raw materials [14].

The volume of milk of the first grade in 2020 decreased by 40% compared to 2012. In 2012-2020, there was a positive trend towards an increase in the purchase of extra milk, which has increased more than seven times since 2012. Extra milk has a lower degree of bacterial contamination, fewer somatic cells and less acidity compared to other grades. The fat content of extra-class milk in the EU is determined at the level of 3.8-4% [1].

Chilled milk (up to 10 ° C), which in 2020 was supplied from households, accounted for 57.1% (of the volume of revenues from OSG), and chilled milk raw materials from agricultural enterprises accounted for 72.6% of milk received at enterprises, which indicates about the insufficient level of appropriate conditions for storage of milk from its producers, especially from households.

Table 1. Receipts of raw milk to processing enterprises by grades (from agricultural enterprises) [13].

| Year | Purchased milk in terms of milk of the established basic fat content, t | Including by grades | | | | | | | | | |
|------|---|---------------------|-------------------|--------------|------------------|----------------|------------------|-----------------|------------------|--------------|------------------|
| | | Extra grade, t | In % to the total | Top grade, t | In% to the total | First grade, t | In% to the total | Second grade, t | In% to the total | Non-grade, t | In% to the total |
| 2012 | 2277689 | 120480 | 5,3 | 710502 | 31,2 | 1311412 | 57,6 | 127885 | 5,6 | 7410 | 0,3 |
| 2013 | 2325067 | 226980 | 9,8 | 798741 | 34,3 | 1181983 | 50,8 | 113677 | 4,9 | 3686 | 0,2 |
| 2014 | 2428239 | 223202 | 9,2 | 820685 | 33,8 | 1250536 | 51,5 | 128657 | 5,3 | 5159 | 0,2 |
| 2015 | 2412817 | 247633 | 10,3 | 849929 | 35,2 | 1196910 | 49,6 | 113001 | 4,7 | 5344 | 0,2 |
| 2016 | 2511882 | 366363 | 14,6 | 923017 | 36,7 | 1055968 | 42,0 | 160185 | 6,4 | 6349 | 0,3 |
| 2017 | 2053887 | 489964 | 23,9 | 735358 | 35,8 | 809859 | 39,4 | 184706 | 9,0 | - | - |
| 2018 | 2719887 | 586213 | 21,6 | 1036222 | 38,1 | 894588 | 32,9 | 193827 | 7,1 | - | - |
| 2019 | 2610352 | 710277 | 27,2 | 937946 | 35,9 | 844422 | 32,4 | 97069 | 3,7 | - | - |
| 2020 | 2556024 | 885152 | 34,6 | 874271 | 34,2 | 776106 | 30,4 | 15795 | 0,6 | - | - |

Processing enterprises that use extra and higher grades of raw materials in their production achieve a reduction in the cost of goods sold compared to enterprises that process grade II milk. This is due to the fact that the milk of higher grades (extra, higher and I grade) have a basic fat content of more than 3.4%, so the yield of finished products of the required quality from the same amount of raw milk will be different. Using lower grade milk, the company can not get the right amount of products.

The development of a system of quality control of milk supplied to the enterprise should be a necessary condition for economic activity and relationships with suppliers. The solution to this issue is possible through the formation of a set of measures that help monitor the input quality of milk and finished products. Modern milk processing enterprises, which adhere to the necessary conditions of safety management of raw materials and own products, as well as control of their physical and chemical parameters monitor the quality parameters according to the scheme in Figure 1 [1]. As not only milk from agricultural enterprises is processed, but also from the population, the premises should be equipped with available cooling equipment and laboratory devices to determine the level of acidity and analysis of other quality indicators. This prevents the intake of low-quality raw materials and prevents the entry into production of substances that are added to milk (usually in households) to increase its shelf life [15-16].

One of the factors of effective production activity of milk processing enterprises is the availability of developed anti-crisis milk quality management system for early prevention of risks (Fig. 2) that may arise at production stages and lead to failures, production losses and breach of contract.

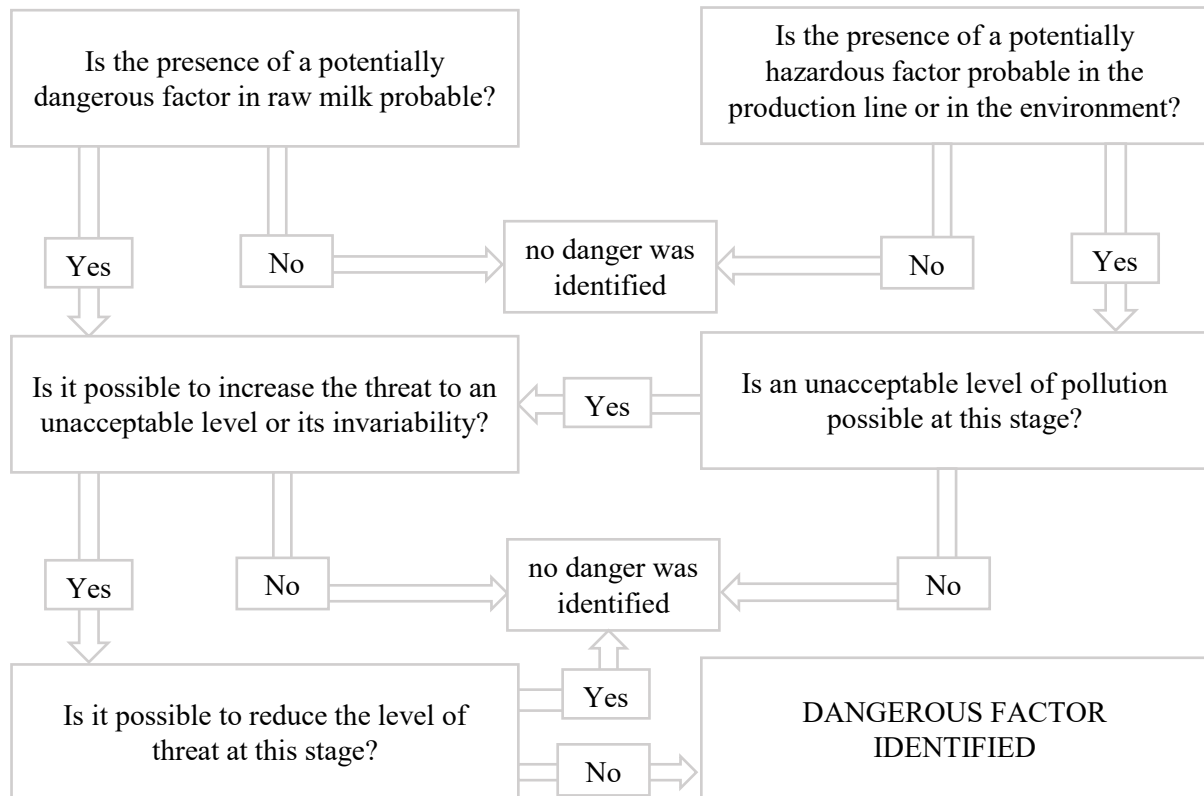


Figure 2. Algorithm of the dangerous factors monitoring procedure during the receipt and processing of raw milk (according to the HACCP system) [15].

In Ukraine, there are standards and developed methodologies for assessing the quality and safety of raw materials and products according to the principles of HACCP (Hazard Analysis and Critical Control Point) [17]. HACCP is a system of risk analysis, hazard monitoring and control of critical points in food production and guarantees compliance with the international quality standard ISO 22000. Milk production by enterprises is also a critical point of production safety, so the monitoring algorithm at this stage takes the form of a "decision tree" (Fig. 3). The HACCP plan includes:

- risk analysis;
- introduction of the procedure of verification, reporting and document flow;
- definition of critical control points (CCP);
- establishment of critical limits;
- establishment of a monitoring procedure;
- introduction of corrective actions.

Therefore, to increase competitiveness in the market, companies seek to eliminate shortcomings in the quality management system of dairy products. The introduction of HACCP at the dairy will allow it to receive the following benefits:

- certification of the safety management system of raw materials and dairy products that meets international requirements;
- HACCP system is based on principles that are recognized at the global level;
- the management system uses measures to prevent the influence of dangerous factors, and does not use the means of current control;
- the introduction of the system allows to obtain documentary evidence of safety of production, and gives the company the opportunity to enter the international market;

- the growth of consumer confidence in the products produced at the enterprise will increase competitive positions [17].

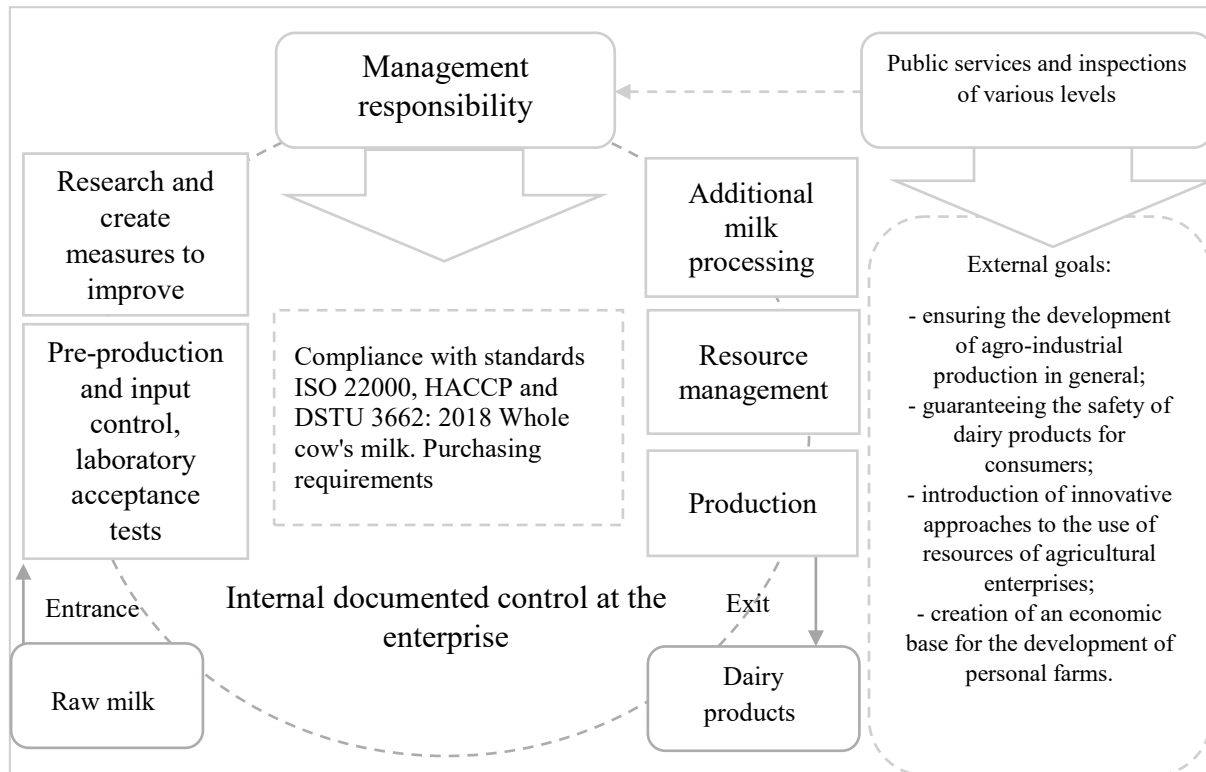


Figure 3. Milk quality management model in the system of monitoring the milk processing enterprises activity.

The effective creation of the HACCP system at the enterprise should be preceded by: conducting appropriate training of employees in accordance with the methodology and principles of HACCP, including the acquisition of competencies in the fields of microbiology, chemistry and technology; set the stages at which the system will be implemented; to analyze each product, as well as raw materials and materials included in it (identifying hazardous factors that may obscure the danger to quality) and apply appropriate measures, directing resources to critical control points of the CCP of the production process; to establish CCT, to carry out the characteristic of raw materials and materials which are in direct contact with the made production; develop a system of management monitoring of CCT and corrective actions; introduce a procedure and procedure for corrective action; to develop a system of primary documentation, to introduce obligatory keeping of protocols, maps, logs, records. The subjects of the HACCP system implementation at the enterprise can be the chairman of the board or the owners, the management of the enterprise together with economists and technologists [17].

The management system for safety and quality of raw milk should include the following parameters:

- characteristics related to safety (organoleptic parameters, physicochemical parameters, content of microorganisms and somatic cells in milk);
- origin and method of production
- methods of packaging, transportation and delivery;
- storage conditions and shelf life;
- preparation and / or handling before use or processing;
- eligibility criteria or specifications for purchased materials and ingredients related to their intended use.

In addition to the quality of milk, the efficiency of milk processing enterprises is strongly influenced by the level of supply of raw milk, continuity and rhythm of its supply. The connection between the seasonality of production and uneven supply of raw materials with the results of the dairy industry is significant. The capacity utilization of such enterprises fluctuates during the year, with raw material suppliers exerting price pressure on enterprises in the conditions of seasonal reduction of milk yields. In addition, the supply of raw materials to the enterprise is often carried out by obsolete vehicles and from raw material bases, which may be located in other areas, which leads to an increase in transport and logistics costs. Enterprises that are bona fide dairy producers are forced to cover the losses of their activities in the spring and summer, when production increases.

Thus, the market economy encourages dairy producers to search for ways to implement optimal supply channels for raw materials with further management of its stocks. To assess the level of efficiency of raw material supply operations, a certain system of indicators can be used [1].

The ratio of the benefits obtained as a result of the implementation of the logistics supply system (economic effect) and the capital invested in this system can be used as an integrated indicator of the efficiency of supply of raw materials to dairy enterprises. The capital invested in the creation of a logistics system for the supply of raw materials includes the cost of raw milk purchased at contract prices, the cost of vehicles and other fixed assets involved in the supply of milk, labor costs involved in the supply of raw materials, losses on analysis of the quality of purchased milk. The result of the implementation of the supply system, presented in value terms, is a financial benefit from lower costs for raw milk (as a result of analysis and selection of suppliers with lower purchase prices), reduced costs for transporting milk from producers located in nearby areas, reducing unproductive losses and waste of raw materials in the production of dairy products by controlling the quality of incoming milk.

One of the functions of the division of supply of raw materials to dairy enterprises is to determine the optimal size of its stocks and the formation of the supply schedule. Raw milk (whole milk) refers to stocks that spoil quickly. Therefore, the management of milk stocks is possible mostly in accordance with the concept of "Just in Time", which provides for the entry of raw materials into production almost immediately after transportation to the plant and laboratory control. Under the terms of this concept, the production capacity of the enterprise must be prepared for the processing of all raw materials received several times a day.

4. Conclusions

Thus, the supply of raw milk is one of the main factors of effective operation of dairy enterprises and their competitiveness in the dairy market. Identified areas for solving problems with the supply of raw milk should be implemented in conjunction with the monitoring functions of the crisis management system.

Thus, based on the analysis of current trends in the dairy industry of Ukraine, we can conclude that the main problem of most domestic dairy producers is the lack of quality milk raw materials and the steady rise in milk prices. Also, one of the obstacles to the further development of the dairy industry is the tendency to reduce the consumption of dairy products by the population and reduce effective demand for them due to lower household incomes. This in turn reduces the production of more expensive types of dairy products - grated cheese, powdered and blue cheese, condensed milk and cream, yogurt, ice cream and edible ice. The study of the state of the dairy industry, the main external factors affecting dairy producers, allows managers of dairy companies to assess the relevant threats and market opportunities, to establish their impact on the final results of the monitoring process.

References

- [1] Bezsmertna O, Shvarts I and Tarasiuk N 2015 Milk quality management in the crisis management system. *Bulletin of Vinnytsia Polytechnic Institute* **1** 43-48
- [2] Hrechko A 2018 Ways to increase the profitability of dairy enterprises in Ukraine. *Modern problems of economy and entrepr* **21** 126-133

- [3] Karpenko V 2020 Assessment of ensuring the functioning of milk processing enterprises of Ukraine. Institute of Accounting, Control and Analysis in the context of globaliz **3-4** 62-75
- [4] Sviderska I 2017 Improving the financial resources management system of domestic dairy enterprises. Innovative economy **9-10** 118–124
- [5] Kharkivskiy D and Myroniuk T 2009 Improving the efficiency of investment development of dairy enterprises. Economics of the food industry **3** 11-16
- [6] Fedulova I 2018 Dairy market of Ukraine: opportunities and threats. Goods and markets **1** 15–28
- [7] Infagro 2020 News of the dairy market of Ukraine and the world. <https://infagro.com.ua>
- [8] Milk Producers Association 2021 Industry news. <http://avm-ua.org/uk>
- [9] OECD 2020 OECD-FAO Agricultural Outlook 2020-2029. OECD iLibrary. <https://www.oecd-ilibrary.org> (
- [10] Center for resource efficient and clean production 2017 Strategies and practices of resource-efficient and cleaner production in the dairy industry
- [12] Shevchenko O, Yasko A and Riabova T 2012 The state of the food market in the region: integration challenges. Bulletin of Chernihiv State Technological University. Series: Economic Sciences **2 (58)** 135–143
- [13] State Statistics Service of Ukraine 2021 Agriculture, forestry and fisheries. www.ukrstat.gov.ua
- [14] DSTU 3662: 2018 Raw milk. Technical conditions (grounds: order of 27.06.2018 №188) (Kyiv, Information and documentation)
- [15] Koval V, Kovshun N, Plekhanova O, Kvitka S and Haran, O 2019. The role of interactive marketing in agricultural investment attraction. SGEM 2019 **19(5.3)** 877-884
- [16] Kvasha S, Pankratova L, Koval V and Tamošiūnienė R 2019 Illicit financial flows in export operations with agricultural products. Intel. Econ. **13(2)** 195-209.
- [17] Kapitula P and Khimicheva H 2020 Evaluation of quality and safety of dairy products according to the requirements of HACCP principles and standards DSTU ISO 22000. ΛΟΓΟΣ. <https://ojs.ukrlogos.in.ua/index.php>

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