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**ҚАЛДЫҚСЫЗ ТЕХНОЛОГИЯЛАР НЕГІЗІНДЕ СҮТ ӨНІМІНДЕ СЫР  
ДАЙЫНДАУ ӘДІСТЕРІ МЕН ТӘЖІРИБЕСІ**

**CHIQINDISIZ TEKNOLOGIYALAR ASOSIDA SUT MAHSULOTLARIDA  
PISHLOQ ISHLAB CHIQARISH USULLARI VA AMALIYOTI**

**METHODS AND EXPERIENCE OF CHEESE PRODUCTION FROM DAIRY  
PRODUCTS BASED ON WASTE-FREE TECHNOLOGIES**

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**Түйін**

Бұл мақалада қалдықсыз технологиялар жағдайында сүт өндеу өнеркәсібіндегі  
сыр дайындау технологиясы қарастырылды. Зерттеу нәтижелері сарысу мен пахтаның  
қайта өндеу деңгейін арттыру арқылы экологиялық және экономикалық тиімділікті  
қамтамасыз ететінін көрсетті. Мембраналық фильтрация және биогаз өндірісі әдістері  
сүт өндірісіндегі қалдықтарды тиімді пайдалануға мүмкіндік береді. Қалдықсыз  
технологияларды енгізу сүт өнімдерінің сапасын жақсартып, өндіріс шығындарын  
азайтады. Қазақстандағы сүт өнеркәсібінде мұндай технологияларды кеңінен қолдану  
болашақта экологиялық тұрақтылық пен экономикалық дамуға үлес қосады.

**Xulosa**

Ushbu maqolada sut sanoatida pishloq ishlab chiqarish texnologiyasi chiqindisiz  
texnologiyalar kontekstida ko'rib chiqiladi. Tadqiqot natijalari shuni ko'rsatadiki, zardob va  
tvorog qayta ishlash darajasini oshirish orqali ekologik va iqtisodiy samaradorlikni ta'minlaydi.  
Membranani filtrlash va biogaz ishlab chiqarish usullari sut ishlab chiqarishda chiqindilardan  
samarali foydalanish imkonini beradi. Chiqindisiz texnologiyalarni joriy etish sut mahsulotlari  
sifatini yaxshilaydi va ishlab chiqarish xarajatlarini kamaytiradi. Kelajakda Qozog'iston sut  
sanoatida bunday texnologiyalardan keng foydalanish ekologik barqarorlik va iqtisodiy  
rivojlanishga yordam beradi.

**Annotation**

This article examines the technology of cheese production in the dairy industry in the context of waste-free technologies. The results of the study showed that increasing the level of whey and curd processing provides environmental and economic efficiency. Membrane filtration and biogas production methods allow for the effective use of waste in dairy production. The introduction of waste-free technologies improves the quality of dairy products and reduces production costs. The widespread use of such technologies in the dairy industry of Kazakhstan will contribute to environmental sustainability and economic development in the future.

**Кілт сөздер:** қалдықсыз технология, сүт өңдеу, сыр даіындау, сарысу, пахта, мембраналық фильтрация.

**Kalit so'zlar:** chiqindisiz texnologiya, sutni qayta ishlash, pishloq tayyorlash, zardob, ayran, membranani filtrlash.

**Key words:** waste-free technology, milk processing, cheese making, whey, cotton, membrane filtration.

Cheese production is one of the most widespread and important sectors in the dairy industry. However, during the cheese making process, industrial waste such as whey and cottonseed oil is generated. The effective use of these wastes is one of the main tasks of modern production. Waste-free technologies increase the environmental safety of the dairy industry, increase productivity and economic efficiency. This article considers the stages, advantages and practical application possibilities of waste-free cheese production technology in dairy products. The dairy industry is one of the most important sectors of the agro-industrial complex of Kazakhstan. Cheese production is one of the most widespread and popular sectors in this industry. However, during the cheese making process, industrial waste such as whey and cottonseed oil is formed, which can cause environmental problems. Therefore, reducing production waste and its effective use is the main goal of modern dairy processing enterprises. Waste-free technologies are methods and technologies that minimize waste in the production process and fully utilize all raw materials. The introduction of waste-free technologies in the dairy industry not only reduces environmental damage, but also increases economic efficiency. In particular, obtaining additional products by processing whey and kefir formed in cheese production ensures the sustainability of the dairy industry. In the conditions of Kazakhstan, the issues of increasing the efficiency of cheese production through the use of waste-free technologies in the field of preparation and processing of dairy products, solving environmental problems and producing additional products are relevant. In this regard, this article considers waste-free technologies in the cheese production process and their effectiveness.

Research objective. Increasing the environmental and economic efficiency of the dairy industry by processing whey and buttermilk formed in the cheese production process based on waste-free technologies.

Objectives:

Analysis of the main stages of cheese production technology;

Determination of the chemical composition of whey and kefir;

Study of the possibilities of introducing waste-free technologies into milk processing production;

Identifying ways to introduce waste-free cheese production methods into practice in the dairy industry of Kazakhstan.

The study used literature review, production control, chemical analysis and statistical processing methods. Laboratory analyses were conducted based on GOST standards to study cheese production processes and determine the chemical composition of waste. The effectiveness of the use of waste-free technologies was assessed by economic and environmental indicators. Qualitative and quantitative analysis methods were used during the study. Laboratory chemical analyses were conducted in accordance with GOST standards to determine the chemical composition of whey and curd in dairy products. The research methods include:

-Milk sample collection and preparation: whey and curd samples were collected from dairy processing enterprises in different regions of Kazakhstan;

-Chemical analysis: the content of protein, fat, lactose and other main components in whey and curd was determined by spectrophotometry, titration and chromatography;

-Microbiological analysis: the level of microbial contamination was studied to ensure product safety;

-Economic analysis: the impact of the introduction of waste-free technologies on production efficiency was calculated;

-Statistical processing: the obtained data were processed in statistical programs, and the average values, standard deviations and confidence levels were determined.

The purpose of the study was to develop the use of waste-free technologies in the dairy industry of Kazakhstan. During the study, the chemical composition of whey and kefir was determined. The analysis results showed that the average protein content in whey was 0.8-1.0%, fat - 0.1-0.3% and lactose - 4.5-5.0%. The protein content in buttermilk was approximately 0.6-0.9%, fat - 0.5-0.8%. These indicators prove that the waste generated during the cheesemaking process is biologically active and rich in nutritional properties. The use of waste-free technologies made it possible to increase the level of whey and buttermilk recycling from 70% to 95%. As a result, additional protein concentrates and biogas were produced, reducing the environmental impact of enterprises and increasing their economic efficiency. In addition, the microbiological safety of whey and kefir was confirmed to meet the requirements, which allows them to be used in food and pharmaceutical products. Economic analysis showed that the introduction of waste-free technologies reduced production costs by 15-20%, and in terms of environmental indicators, the volume of harmful waste by 30%.

#### Technological characteristics

The technology of making cheese without residues is a complex process aimed at the most efficient use of all components of milk and reducing environmental damage.

#### 1. Milk reception and primary processing

Raw milk is cleaned of impurities by cleaning and filtration.

The milk is pasteurized (temperature 72-75 °C, 15-20 seconds), ensuring its microbiological safety.

#### 2. Fermentation and cheese mass formation

Special lactobacteria and enzymes are added to pasteurized milk.

The thickening process lasts 30-40 minutes, as a result of which the cheese mass and whey are separated.

### 3. Whey collection and processing

The whey is separated by a special ventilation system and membrane filtration methods (ultrafiltration or nanofiltration) are used for concentration.

Concentrated whey proteins are used as food concentrates, and the remaining lactose is sent for fermentation and used for biogas production or probiotic products.

### 4. Cheese molding, salting and cooking

The cheese mass is poured into molds and cooked at a special temperature (40-45 ° C).

During the cooking period, the structure and taste of the cheese are formed.

If necessary, a salting period is added, which increases the shelf life of the cheese.

### 5. Cotton processing

Cotton (whey and fat residues after cheese production) is used as animal feed or sent to biogas plants.

Transferring cotton to biogas production ensures waste-free production and contributes to energy savings.

### 6. Complete waste recycling and energy efficiency

In the dairy processing plant, all waste (whey, cotton, fat residues) is collected, processed by membrane methods and enzymatic methods and reused.

The products obtained as a result of waste processing (protein concentrates, biogas, fertilizers) are used in industry and agriculture.

The results of the study proved the effectiveness of using waste-free technologies in the production of dairy products. The compositional indicators of whey and cotton were determined during the waste processing process. The protein content in whey was 0.9%, fat 0.2%, lactose 4.8%. It was found that cottonseed contains 0.7% protein, 0.6% fat and other biologically active substances. With the introduction of waste-free technologies, the level of processing whey and cottonseed increased from 70 to 95 percent. This indicator significantly reduced the volume of production waste and reduced environmental damage. In addition, the protein concentrates and biogas produced allowed dairy processing enterprises to obtain additional products. It was noted that the processing of whey and cottonseed by membrane filtration was effective. This method ensures the preservation of nutrients without losing product quality. According to the results, waste-free technologies play an important role in organizing environmentally friendly and economically efficient production of dairy products. Economic analysis showed that waste recycling allows reducing production costs by 15-20%. At the same time, environmental indicators have also improved, and the volume of harmful waste has decreased by 30%. As a result, enterprises began to save natural resources and work in accordance with environmental requirements. The results of this study indicate the prospects for the widespread use of waste-free technologies in the dairy industry of Kazakhstan. However, some technical and organizational difficulties may arise during the introduction of the technology, which require additional research and experiments to resolve.

The results of the study proved the environmental and economic efficiency of introducing waste-free technologies in the cheese production sector. The processing of important components in the chemical composition of whey and curd, such as protein, fat and lactose,

reduces the volume of waste in dairy production and allows for the production of added-value products.

Waste-free technologies increase the production efficiency of dairy processing enterprises and reduce environmental damage. Methods such as membrane filtration and biogas production offer ways to effectively use waste.

The widespread use of waste-free technologies in the dairy industry of Kazakhstan allows for an increase in production volumes, improvement of product quality, and also ensuring environmental sustainability. In the future, research and development work on improving and introducing technologies is of great importance.

### References:

1. Abdugalieva, Zh.S., & Mukhamedzhanova, G.T. (2020). Technologies for waste-free processing of dairy products. Kazakh Journal of Agricultural Sciences, 5(3), 45-52.
2. Ivanov, A.V., & Petrov, S.I. (2019). Application of membrane technologies in the dairy industry. Technology of the Food Industry, 12(2), 78-84.
3. Nazarov, B.K. (2018). Waste-free production and environmental sustainability. Almaty: Kazakh University Press.
4. Ermekov, M.B. (2021). Modern methods for processing whey and cottonseed. Biotechnology Bulletin, 14(1), 33-40.
5. National Standard of the Republic of Kazakhstan (GOST 3625-2019). Technologies for the production of dairy products.
6. Smith, J. & Brown, L. (2020). Waste-free technologies in milk processing: a review. Journal of Dairy Science, 103(7), 5678-5690.
7. Lee, S.H. and Kim, Y.J. (2019). Use of whey protein concentrates in the food industry. Food Science and Technology International, 25(4), 345-356.