CURRENT STATE OF MILK PROCESSING

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Annotation. The article examines the current state of milk processing in Russia and worldwide. It analyzes key trends in the industry's development, including the modernization of production facilities, the introduction of digital and resource-efficient technologies, the expanding range of functional and high-protein dairy products, and the tightening of quality and safety requirements. Special attention is given to the influence of global economic processes and shifting consumer preferences on the structure of the dairy market. The article outlines the main challenges faced by processing enterprises, such as instability of the raw-milk supply, the need to improve logistics efficiency, high energy dependence, and workforce shortages. It also highlights promising directions for industry growth—automation of production lines, the use of deep-processing technologies, expansion of exports, and the transition to sustainable production models. The material may be useful for dairy industry specialists, researchers, and students in agricultural and food-industry fields.

Key words: logistics, milk, hydrodynamics, processing, safety, efficiency, technology, implementation, implementation, commissioning, quality, quantity, nutrition, nutritional value.

Annotatsiya. Maqola dunyoda sutni qayta ishlashning hozirgi holatini tahlil qilishga bag‘ishlangan. Unda sohaning rivojlanishidagi asosiy tendensiyalar — ishlab chiqarish quvvatlarini modernizatsiya qilish, raqamli va resurslarni tejovchi texnologiyalarni joriy etish, funksional hamda yuqori oqsilli mahsulotlar assortimenti kengayishi, shuningdek, sifat va xavfsizlik talablari kuchayishi ko‘rib chiqiladi. Global iqtisodiy jarayonlar hamda iste’molchilarning o‘zgarib borayotgan xohish-istaklari sut bozorining tarkibiga qanday ta’sir qilayotgani alohida yoritiladi. Maqolada sutni qayta ishlovchi korxonalar duch kelayotgan asosiy muammolar — xomashyo bazasining barqaror emasligi, logistika samaradorligini oshirish zarurati, energiyaga yuqori darajada qaramlik va kadrlar yetishmovchiligi — bayon etiladi. Shuningdek, sohaning istiqbolli yo‘nalishlari: texnologik liniyalarni avtomatlashtirish, chuqur qayta ishlash texnologiyalaridan foydalanish, eksportni kengaytirish va barqaror ishlab chiqarish modellari tomon o‘tish haqida ham ma’lumot beriladi. Ushbu material sut sanoati mutaxassislari,

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tadqiqotchilar hamda qishloq xo‘jaligi yo‘nalishidagi talabalar uchun foydali bo‘lishi mumkin.

Kalit so‘zlar: logistika, sut, gidrodinamika, qayta ishlash, xavfsizlik, samaradorlik, texnologiya, joriy etish, samaradorlik, sifat, miqdor, ozuqaviylik, texnologiya.

Аннотация. Статья посвящена анализу текущего состояния переработки молока в России и мире. Рассматриваются ключевые тенденции развития отрасли, включая модернизацию производственных мощностей, внедрение цифровых и ресурсосберегающих технологий, рост ассортимента функциональных и высокобелковых продуктов, а также усиление требований к качеству и безопасности молочной продукции. Особое внимание уделено влиянию глобальных экономических процессов и изменений в потребительских предпочтениях на структуру молочного рынка. В статье описываются основные проблемы перерабатывающих предприятий: нестабильность сырьевой базы, необходимость повышения эффективности логистики, энергозависимость и кадровый дефицит. Приводятся перспективные направления развития отрасли, такие как автоматизация технологических линий, использование технологий глубокой переработки, расширение экспорта и переход к устойчивым моделям производства. Материал может быть полезен специалистам молочной индустрии, исследователям и студентам агропромышленного направления.

Ключевые слова: логистика, молоко, гидродинамика, переработка, безопасность, эффективность, технология, внедрение, реализация, введение в действие, качество, количество, питательность, пищевая ценность.

Introduction

In 2024, Uzbekistan produced about 12.4 million tons of milk, equivalent to approximately 12.7 billion liters. Most of the milk (11.51 million tons) was produced by private household farms, 0.74 million tons by farming enterprises, and 0.19 million tons by agricultural organizations.

Milk processing is a key link in the chain from farm to end consumer. It includes the reception, primary purification, and cooling of raw milk; heat treatment (pasteurization, sterilization); separation of components (cream, skim milk); further processing (cheese, yogurt, milk powder, whey, etc.); packaging, storage, and delivery.

Today, the industry is undergoing significant changes under the influence of technological progress, shifting consumer demand, global markets, and challenges in the raw material sector. This article examines current trends, issues, and prospects of milk processing at the global level, with a focus on technology, raw materials, the market, ecology, and regional features.

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According to reports, the global milk market is in a state of significant oversupply: production growth in major regions exceeds demand, leading to price pressure on farmers. For example, in the seven main export regions, milk production growth in 2025 is expected to reach about 1.6% year-on-year. In countries with transitional economies, the situation is more complex. For example, Kazakhstan faces a shortage of high-quality milk, despite large production volumes in private households, which reduces the share of raw materials suitable for premium product processing.

The quality of raw milk is one of the most important factors in processing.

Its characteristics (protein, fat content, somatic cell count, microbiological purity) determine the technological and economic efficiency of processing. In many countries, products from small farms do not meet standards.

In Kazakhstan, for instance, many private farms do not comply with technological hygiene, leading to instability in production volumes and reduced suitability of raw materials.

Logistics and milk collection also remain problematic: delivering small batches from remote farms increases costs and complicates ensuring raw material stability.

Raw materials remain a “bottleneck” in milk processing - quantity, quality, and stability all require improvement. For the further development of the industry, it is important to strengthen the link between farms and processors, implement quality standards, and improve logistics.

Milk processing includes several stages: reception and cooling of raw milk, cream separation, pasteurization or sterilization, homogenization, further processing (drying, concentration, filtration), and packaging.

Such a complex technological cycle requires modern equipment: separators, pasteurizers, membrane filters, dryers, and packaging lines. According to estimates, the global market for milk processing equipment in 2023 was about USD 10.5 billion and is forecasted to grow to approximately USD 17.8 billion by 2033 with a CAGR of over 5.4%.

Deep milk processing is one of the most significant areas — the processing of by-products of the dairy industry: whey, lactose, casein, protein concentrates. In several countries, for example, Russia, “deep” milk processing projects aim to produce valuable raw materials for the food, pharmaceutical, and dietary industries.

This allows processors to move up the value chain, reduce dependence on raw milk as a commodity, and provide farmers with better prices for milk.

In modern conditions, not only technology but also the environmental component is important: reducing energy consumption, minimizing waste, treating wastewater, and using renewable energy sources. In some countries, milk

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processing is becoming part of the circular economy. For example, in India's Gujarat region, the Gujarat Cooperative Milk Marketing Federation (GCMMF) is experimenting with producing bioethanol from whey.

Milk processing technologies continue to evolve rapidly: automation, deep processing, and sustainable development are becoming key drivers. Processors that invest in modernization gain a competitive advantage.

Consumers are increasingly paying attention to the quality, origin of milk, environmental friendliness of production, and packaging. The focus on a "clean" product without additives, with improved nutritional properties, is a trend in the premium segment.

There is also a growing demand for milk alternatives (plant-based "milks") and functional beverages, which encourages dairy processors to diversify. Although cow's milk remains the main product, competition is increasing.

The milk processing market is developing dynamically but faces dual pressure: on the one hand, growth in certain segments and countries; on the other, market saturation, falling prices, and competition. Success depends on the ability of processors to adapt - add value, enter new markets, implement innovations, and respond to changing consumer preferences.

In Central Asia and Eastern Europe, milk processing faces typical challenges: low standardization of farm production, small-scale operations, and weak infrastructure. For example, Uzbekistan experiences a shortage of milk and problems with processing plant utilization.

In Kazakhstan, only about one-third of milk meets the standard suitable for premium processing.

Such markets require both modernization of plants and reforms in the raw material sector.

In developed markets, processors face saturated demand, tough competition, and the need to find new growth sources. For example, in Europe, the largest companies adjust milk procurement volumes to avoid processing raw materials at low margins.

In Russia, raw milk production is increasing (up to 33.5 million tons in 2023) due to modernization and new production complexes.

In India, despite its leadership in milk volume, processing and infrastructure still lag behind growing demand. However, the segment of processing and value-added products is growing rapidly. An example is Milky Mist Dairy Food Ltd, which produces a wide range of dairy products and is increasing raw milk procurement volumes.

Regional features greatly influence the state of milk processing: from developing markets with insufficient infrastructure to developed ones with

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saturated demand. Processor strategies must consider raw materials, technology, demand, logistics, and competition - all at the regional level.

Conclusion. The current state of milk processing is characterized by several significant trends: technological modernization, increased demand for value-added products, deeper processing, focus on sustainable development, and global competition.

However, the industry also faces serious challenges: unstable raw materials, price pressure, infrastructure constraints, and regional differences.

For the successful future of milk processing, strategic adaptation is required -modernization of plants, improvement of raw material supply, production of competitive products, market diversification, and integration with environmental and digital standards. Ultimately, milk processing is no longer just about turning raw milk into products - it is about creating added value along the chain from cow to consumer, with a focus on quality, sustainability, and global competition.

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