Monitoring the degree of contamination of milk with residual amounts of antibiotics by manufacturers

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Abstract. Over the past 20 years, there has been an increase in demand for organic agriculture products in Russia, which is associated with an increase in the popularity of healthy lifestyle. The general public is showing an increasing interest in their health and healthy nutrition, one of the important components of which is the use of environmentally friendly products. Milk and dairy products are traditionally included in the list of daily foods consumed in a “healthy” diet. The increased use of antibiotics in animal husbandry as therapeutic, prophylactic and growth-stimulating agents and non-observance of the rejection period of milk after treatment of animals are the reasons that certain lots of raw milk contain residual amounts of medicinal preparations in excess of the norm. Periodically published results of inspections by Rospotrebnadzor confirm that such excess occurs in finished dairy products of certain manufacturers. The article presents the results of a study of the safety of milk in the Omsk region, which is supplied for processing using a universal express method, which makes it possible to efficiently detect simultaneously antibiotics of four groups in raw milk in accordance with the requirements of the Technical Regulations. 3.653 samples from farms supplying raw milk from 5 districts of the Omsk region were checked; the share of rejected raw milk samples for 12 months of the study was 0.7% of all analyzed samples, this is more than 2 batches of milk per month, most of the rejected batches of milk (65%) are characterized by a higher content of the antibiotic tetracycline.

1. Introduction

Currently, more and more people are paying attention to the quality of food, their composition and safety [1–10]. There is a lot of writing and talking about clean products or organic products, they are what is called “on everyone's lips”, these concepts are actively used to attract consumer interest by agricultural producers. Ecologically pure or organic products are food products grown or manufactured in an ecologically clean natural area without the use of chemical fertilizers, pesticides, antibiotics, growth hormones, as well as of genetically modified organisms of plants or animals. When grown, manure, humus, compost and other organic preparations are used as fertilizers. These products are also used as
fodder for livestock and poultry in beef and poultry farming to obtain ecologically clean meat and milk [11].

The term “organic food” was first introduced by Lord Northbourne in England in 1940 [12]. And in 1972, the International Federation of Organic Agricultural Movement (IFOAM) was created in Versailles.

It should be noted that the interest in organic food is now high both in the world and in Russia. The population tries to choose healthy and safe samples from the entire list of products on the market. Due to the interest in the development of organic farming and environmentally friendly products in Russia being fairly recent, there is still no law and regulations governing this area. The Russian organic market is just reviving and is at the initial stage of its development [11, 13].

Currently, there are four standards that govern the production of organic products in our country. They define the term “organic agriculture”, present the rules for the production of organic food; storage and transportation rules, procedure for certification of organic products. In 2018, the federal law “On organic products and on amendments to certain legislative acts of the Russian Federation” No. 280-FZ was approved. But until the state level has not developed forms of political and financial support for the production of organic products, as in other developed countries, the rapid development of markets is not expected. Small farms and agroindustrial firms are gradually starting to independently work in the direction of organic farming and produce environmentally friendly products, but mainly for the purpose of exporting them. It turns out that not all agricultural producers are technologically and technically ready for the production of organic products, and there is no interest in producing high-quality and safe products, due to the fact that the domestic market for such products in the country has not yet been formed, since an economic system for the production and sale of ecologically clean products that meets international standards has not been created yet. Milk processing rightfully occupies a leading place among the most important branches of the agro-industrial complex. Milk is the main and valuable food product for the population of many countries of the world. Milk and dairy products are sources of complete proteins, fats, various minerals, valuable vitamins and enzymes for humans. Dairy and fermented milk products in Russia are one of the most popular and are used in the daily diet of food, as well as are recommended by doctors for various diets, as gerodietetic food products and as baby food, for nutrition of socially unprotected groups of the population [11, 18].

One of the important indicators of the quality of milk products is the absence of antibiotics in the raw materials from which various dairy products are made. The presence of even the smallest particles of antibiotics in milk have a negative impact on the immune system and health of a human. When a person consumes products with antibiotics, their body gets used to them, and if they need these medicines during a period of illness, they may not work, because the person may develop antimicrobial resistance and allergies. If there are no traces of medicines in milk, this is an indicator of its quality [14].

For the production of organic milk and dairy products, it is necessary to change the entire system of keeping and feeding a commercial herd; the staple nutrition of the cow should come from pastures, the rest of the food should be grown without the use of chemical fertilizers, pesticides and genetically modified seeds. It is necessary to completely eliminate the use of antibiotics and hormones to stimulate the growth and prevent diseases in cows. But while agricultural producers are only thinking about this direction, ensuring the quality and safety of milk remains one of the most important tasks of producers and processors in the reality in which we live now.

Despite this, every year the problem of milk pollution by residual amounts of antibiotics remains acute and is becoming increasingly important, since the consequences of ingestion of antibiotics in the human body are very dangerous in themselves, and with regular use of products containing drugs, a person develops resistance and immunity to drugs and antibiotic-based products. The antibacterial agents used in agriculture of most classes are common for veterinary medicine and general medicine.

Antibiotics are used to treat mastitis in cows, which is a very common disease; they are injected directly into the affected lobes of the mammary gland, drugs suppress and prevent udder inflammation, and are also used to stimulate the growth of cattle, improve the quality of fodder and their safety [15]. Antibiotics that get into milk are not destroyed during high-temperature processing and, having a toxic
effect, can cause allergic reactions, dysbiosis of the intestines and other body systems, and reduce immunity, especially in children.

Therefore, it is especially important to control the indicator of residual drug in dairy products offered to the public. Residual amounts of antibiotics in milk make the raw material unsuitable for processing into food, as it inhibits the development of lactic acid bacteria [16, 17].

According to the regulations existing in Russia, the milk containing antibiotics is required to be disposed of, which leads to losses for enterprises.

Nevertheless, some batches of milk contaminated with antibiotics end up in processing, making the product dangerous; and they are only found in it during the inspection of finished products by regulatory authorities. Responsibility for violation of product safety is borne by the processor, it is the milk processing enterprise that is responsible for the quality and safety of the final product. Large fines are imposed on the violating enterprise, products are withdrawn from trade, the enterprise suffers losses and loses consumers’ trust.

Studies to determine the residual antibiotics in milk are carried out in accordance with GOST 32219 and GOST 32254. ELISA methods and a microbiological method make it possible to determine the residual amounts of antibiotics at the level stipulated by the requirements of SanRaN 2.3.2.1078-01.

According to the Technical regulations of the Customs Union 033/2013, the collected milk is monitored by the ELISA method once a month or once a quarter for antibiotics of 4 groups: beta-lactam, tetracycline, chloramphenicol, streptomycin [8, 9]. Different industries use different instruments and techniques to identify the residues. But they all target mainly the beta-lactam and tetracycline groups of drugs. For daily batch control of raw milk, many enterprises use express methods that are convenient in work, in the preparation of samples and the interpretation of results.

The purpose of our research was to assess the control of cow’s milk during the acceptance laboratory study for residual amounts of antibiotics using the example of a specific enterprise in Omsk. For this, the monitoring of the presence of antibiotics in milk was carried out in the conditions of the industrial enterprise LLC “VNIMI-Siberia” in Omsk for a period of 12 months using an express method for the simultaneous detection of 4 types of antibiotics.

2. Materials and methods
To control each batch of milk coming from milk producers in the Omsk region to the LLC “VNIMI-Siberia” enterprise at the time of its acceptance, to quickly and accurately determine the residual amounts of antibiotics in milk, we used Sensor BSCT rapid tests (figure 1).

![Figure 1. Rapid tests to determine the residual amount of antibiotics in milk.](image-url)

The instructions for the Sensor BSCT test kit describe the analysis in detail. Working with express tests is very convenient and simple, since there is no need for preliminary preparation of a milk sample; determination of the analysis results is carried out by comparing the brightness of the test line with the control line. The duration of the analysis for all four groups of antibiotics at once is only 5 minutes,
which is very important for the process of accepting raw materials at a dairy enterprise, when the analysis of the incoming raw materials is carried out in a short period of time [19].

In the process of milk research, 3,653 samples from supplier farms were checked, delivering consignments of raw milk from 5 districts of the Omsk region.

3. Results and discussion

During the research, milk samples with an exceeding normal concentration of different groups of antibiotics in all months of the period were identified; seasonal dependence was not established. The share of rejected raw milk samples for the entire research period was 0.7% of all analyzed samples, this is more than 2 batches of milk per month.

The research results showed that most of the rejected milk lots (65%) are characterized by a higher content of the antibiotic tetracycline.

It should be noted that each farm from the milk suppliers was included in the list of offenders during the research period, which indicates the widespread use of antibiotics on livestock farms and the lack of careful control of antibiotic residues in all milk consignments in the field.

The rejected lots of milk were not accepted for processing at the LLC “VNIMI-Siberia” enterprise, and were sent back to the farms. During the research period, the products of the enterprise, in accordance with the production control program according to the approved schedule, were tested for the presence of excess concentrations of antibiotics in an accredited laboratory in Omsk; the results were negative.

The analysis of the work done allows for asserting that the use of the express method helps to timely and effectively carry out production control of dairy raw materials for the presence of all four groups of antibiotics at the same time in the levels established by the legislation of the Customs Union for milk and dairy products at the acceptance stage, which makes it possible to reasonably reject and prevent substandard raw materials from getting into the production process.

Subject to the mandatory use of test kits at all farms and milk collection points for testing freshly milked milk batches for the presence of antibiotics, the risks of medicinal substances getting into dairy products will be minimized, and the costs that arise during the transportation of raw materials to the point of delivery and back and the disposal of low-quality milk will be eliminated.

4. Conclusion

Currently, there is a need to tighten requirements for milk producers, and oblige them to bear responsibility for the safety of products on an equal basis with processors. We believe that at present it is necessary to change the system of payments for milk, the defining indicator of which would be the quality and safety of raw milk, to increase the interest of producers in the production of such products and to create conditions for support and state regulation of the market for safe dairy products.

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