

World Food Prize Youth Institute

Analysis of safety problems of fresh milk storage and transportation

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S F L E G

Abstract

The safety of raw milk storage and transportation is an important part of safety in dairy processing. Protecting the safety of raw milk storage and transportation is an important part of ensuring food safety. Taking Junlebao Company as an example, this paper analyzes the possible safety problems in the process of storage and transportation of raw milk and their solutions.

Key words: Raw milk; Storage and transportation; Food safety

With the development of economy, the production and export volume of dairy products in China have been greatly increased, but the self-sufficiency rate of milk source in China is insufficient, and the waste of raw milk still exists. For the safety of Chinese dairy products, the quality problem of raw milk should be paid more attention to, especially the storage and transportation of raw milk. In order to avoid spoilage and waste of raw milk, we should be aware of the high requirements of storage and transportation, and establish appropriate methods and strict standards to control them.

1. Research background

Before the reform and opening up, China's dairy breeding industry grew slowly. After the reform and opening up, the government began to encourage private raising of dairy cows, and the dairy industry implemented the policy of "state enterprise, collective and individual developing together", and the industry entered the initial stage of development. Since 1997, China's dairy cattle breeding industry has gradually become larger in scale, more intensive and more standardized. At the same time, due to the improvement of consumption capacity and the introduction of ultra-high temperature sterilized milk, the demand for raw milk in China has increased rapidly during this period. In recent years, affected by the epidemic, China's raw milk production growth began to slow down. However, China's domestic demand for raw milk is still growing steadily, the quality of China's dairy industry is also constantly improving, the quality and safety of raw milk has been further guaranteed, and the modern dairy industry pattern has initially taken shape.

On September 6, 2022, the "China Dairy Industry Quality Report (2022)" was officially released. The report shows that in 2021, the country's milk export is 37.78 million tons, with an increase of 7.0 percent year-on-year. In general, the situation of China's dairy industry and its industrial quality are steadily improving, and the quality of dairy products continues to maintain a high level. However, at present, the value of milk production in China has been fluctuating at a low level, and the self-sufficiency rate of milk source has been declining year after year, less than 70% for now; There are still imbalances in raw milk production and consumption, and the problem of periodic excess and shortage of milk sources has always existed. These phenomena will bring some problems to the safety of milk source in our country. In order to maintain and strengthen the safety of fresh milk, this paper takes Junlebao as an example to discuss the possible safety problems and corresponding solutions in the process of fresh milk storage and transportation, so as to help this topic gets more

attention.

The research object of this paper is Junlebao Company, which has high dairy safety quality. Junlebao is now the largest dairy processing enterprise in Hebei Province, and has built more than 20 production factories in Hebei, Henan, Jiangsu, Jilin and other provinces, with the advanced level of technology and production lines in the leading level in the country. Junlebao has created two models: firstly, the whole industry chain model, that is, a production and management model that integrates grass planting, dairy farming, production and processing to ensure product safety; secondly, the "four world-class" model, with world-class advanced farms, world-class leading factories, world-class partners and world-class video safety management system, to ensure that the raw milk's protein, somatic cells and other key factors are better than the EU standard, and make products' quality ranks in the international leading level. Figure 1 and Figure 2 are the qualified test results of Junlebao by Swiss General Surveyor (SGS) and the qualified test results of Junlebao by Intertek in EU standards.

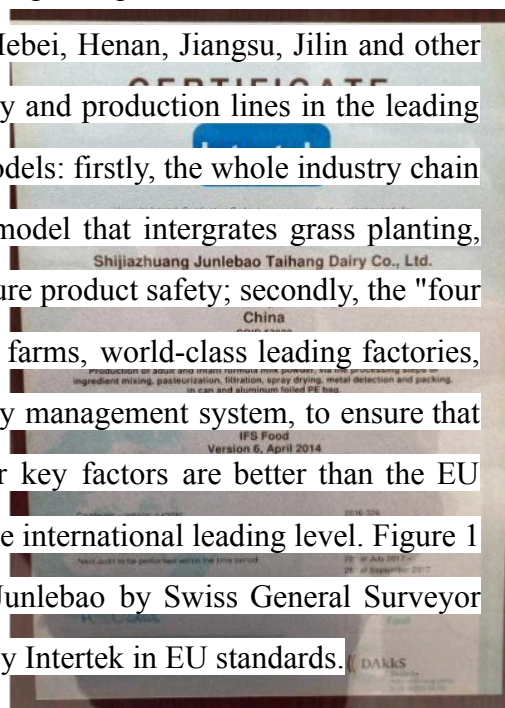


Figure 2 Certificate given by Intertek



Figure 1 Certificate given by SGS

Lastly, the phrases "raw milk" and "fresh milk" in this paper refer to the unprocessed milk that leaves the cow body within 24 hours, rather than the processed milk. Storage

and transportation safety refers to the safety of food(raw milk) in storage and transportation. The storage links concerned in this paper include the collection and storage process of raw materials (raw milk) in upstream institutions such as social farms, enterprise farms and factories; The transport link refers to the process of all social farms and enterprise farms conveying raw milk to the factory; Safety problems include quantity waste and quality of fresh milk.

2. Safety problems that may occur during the storage and transportation of fresh milk

2.1 Equipment problems

In the process of raw milk storage and transportation, good transportation and storage equipment are needed. At present, the main method of milk source transportation in China is milk tanker transportation. No matter what kind of transportation, the temperature requirements are high. Raw milk contains rich nutrients, but also contains a large number of microorganisms. The temperature of raw milk from the cow body is about 36 degrees Celsius, which is suitable for microbial reproduction, and if it is not cooled in time, it is easy to spoil and deteriorate^[1]. Good transportation equipment should ensure that raw milk does not freeze in winter or spoil in summer.

2.2 Process problems

An efficient storage and transportation process is very important. In order to ensure the freshness of raw milk and prevent the breeding of microorganisms, the time between cow milking and the process should be shortened as much as possible. The number of temporary deposits should also be minimized. This has high requirements for the arranging of enterprises, the site selection of ranch and factories, and the selection of transportation modes.

2.3 Milk source quality problems

The collection process of milk sources for enterprise farms (or even individuals) needs to gather raw milk. If there is a quality problem in one of the milk sources, the

raw milk of the entire transport point will be wasted. To solve such problems, enterprises need to shorten the storage and transportation process, and strengthen the control and detection of raw milk quality, so that the freshness of raw milk and safety standards will be both improved.

3. The solution

3.1 Set up efficient and rigorous storage and transportation processes

The milk source of Junlebao is mainly obtained from two ways: enterprise farms and social farms. The former is to build farms next to the factory to facilitate the direct transport of milk sources; the latter is to cooperate with the farms in the society and it has formed its own cooperation access mechanism. The main process of these two ways of storing and transporting raw milk is the cycle of "transportation - detection - temporary storage". There are two specific modes of transport: milk tanker and pipeline. The flow chart is shown in Figure 3. The details are as follows:

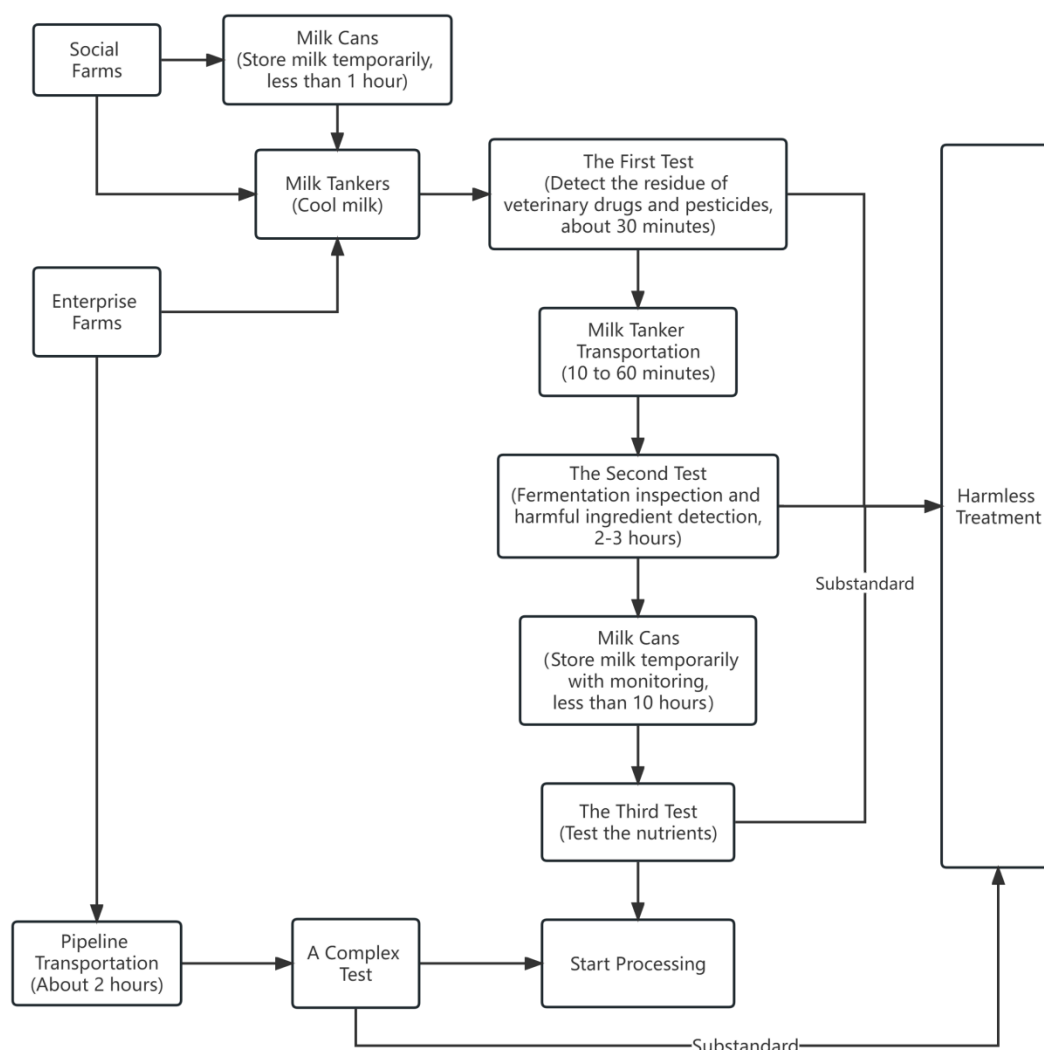


Figure 3 The flow chart of the transportation process

3.1.1 Milk tanker transport (See Figure 5)

For social farms, some qualified farms can temporarily store raw milk in milk cans for about an hour; while others quickly transfer milk sources to milk tankers for cooling. Enterprise farms transfer milk directly to milk tankers. The milk source will be sampled for the first time in the farm, mainly to check the residue of veterinary drugs and pesticides. The test takes about half an hour. After passing the test, the milk can be transported to the factory. The process can be as short as 10 minutes to as long as about an hour, depending on the length of the journey and traffic conditions. After entering the factory, the milk tanker will meet a second sampling test, which is mainly divided into two parts: fermentation inspection and harmful ingredient detection.

Apart from veterinary drugs and pesticides, the detection of harmful ingredients will also detect heavy metals, melamine, aflatoxins and other ingredients. This inspection process takes about 2-3 hours. After passing the second inspection, the raw milk in the milk tanker will be transferred to the factory milk tank for temporary storage. (See Figure 4) Here, the staff in the general control room will monitor the temperature of the milk tank in real time, the number of microorganisms and other data, and at the same time conduct the third sampling quality inspection. This time, the quality inspection mainly tests the nutrients in raw milk, such as whether the protein content meets the requirements. Raw milk is stored in the milk tank for a maximum of 8-10 hours, and after passing the third test, raw milk is officially put into processing.



Figure 4 Milk cans



Figure 5 Milk tanker

3.1.2 Pipeline transportation

This mode of transportation is generally used in enterprise farms which are close to the factory, and can greatly reduce transportation time. On piped ranches, raw milk takes about two hours from leaving the cow to being processed. However, this mode of transportation eliminates the first two quality inspections of milk tanker transportation, and puts all the inspection items before processing. This may have a certain bad impact on the quality control of milk sources, so raw milk transported in this way will undergo more complex tests during processing.

It is worth noting that apart from the three times of quality inspection in the

transportation of raw milk, in the milk processing process, Junlebao also has at least one quality inspection of semi-finished products, and there is also a quality inspection of processed milk. Once there is a milk source or milk product that fails the test, the relevant person in charge of the factory or ranch will contact the professional department to remove the unqualified raw milk or product for harmless treatment. The factory neither discharges themselves, nor secretly uses unqualified raw milk as raw materials for processing.

3.2 Advanced storage and transportation technology

3.2.1 Efficient and environmentally friendly refrigeration equipment

In the early years, the cooling equipment used by Junlebao is fluorine cooling equipment. This equipment is inefficient. According to statistics and experiments, the raw milk in the medium milk tanker takes about two hours to cool from 36 degrees Celsius to 0 to 2 degrees Celsius, which cannot effectively inhibit microbial growth. Fluorine cooling equipment is also environmentally unfriendly and is easy to cause environmental pollution. Now, Junlebao adopts international advanced direct cooling equipment, which can cool the raw milk to 0 to 2 degrees Celsius in less than one second, greatly reducing the safety problem of raw milk caused by microorganisms.

3.2.2 Safe and high quality materials for tanks and other equipment

The metal materials in the milk tanker and milk pipeline are all made of food-grade 304 stainless steel or above this standard. Besides, there is a thermal insulation film between the two layers of metal materials to reduce the possibility of temperature change of raw milk. According to the results of factories' experiments, in summer, when the milk tanker is filled with ice water and is exposed to the sun for more than ten hours, the average temperature of the ice water is only about 0.5 degrees Celsius higher.

3.2.3 Effective monitoring equipment and scheduling software

There is real-time temperature monitoring equipment in Junlebao milk tank truck, milk tank and pipeline to ensure the control of raw milk's temperature. In addition,

Junlebao has developed communication software that can contact the farm, the factory and the driver. Its use can improve the transportation efficiency and reduce the cost of storage and transportation time.

3.3 Strict management system

The driver of the milk tanker needs a professional transport permit, and the ranch with Junlebao also has strict management and access system, including the distance from the factory, hardware and software equipment and other aspects. Junlebao and the ranch are synchronized with information on a monthly basis, stabilizing supply and demand, and greatly reducing the waste of raw milk.

4. suggestions on improving the safety of raw milk

Many milk enterprises, represented by Junlebao, have their own relatively mature raw milk storage and transportation process, advanced storage and transportation technology and detailed raw milk safety detection mechanism. In addition, the enactment, implementation and supervision of national standards are also of great significance to solve the problem of raw milk storage and transportation safety. At present, there is still room for further improvement of China's national standards for raw milk safety. It is very important to enact a more unified, standardized, scientific national standard system, and strengthen national supervision of fresh milk storage and transportation, as well as improve the standardization and supervision mechanism of cold chain transportation of raw milk and dairy products^[2]. In terms of transportation mode, it is necessary to strengthen the construction of pipeline transportation to shorten the transportation time of raw milk and ensure its freshness. The high efficiency of pipeline transportation is obvious to all, and it has great potential to be developed. The software used in storage and transportation should be upgraded, and the GPS function should be utilized by combining the concept of “the Internet of Things”. This helps to improve the efficiency of the storage and transportation process. Finally, it is necessary to accelerate the involvement of third-party logistics enterprises. Third-party logistics enterprises have more advanced storage and transportation technology, so it is a good idea to leave the professional

things to professional people to do. It is very important to strengthen the cooperation between milk enterprises and third-party enterprises and improve the transportation quality and scale of third-party logistics providers of dairy products^[3].

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