



TECHNICAL AND LEGISLATIVE ISSUES REGARDING THE TRANSPORT AND STORAGE OF MILK AND MILK PRODUCTS

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Abstract: Milk is a food used by people of all ages, both directly and as a very wide range of dairy products. Being highly perishable and exposed to infestation from many pathogens, legislation concerning the production, distribution and marketing of milk is very rich. The most representative aspects of the legislation are presented further. Also, the equipment for the transport of milk from producer to processor are under severe hygienic and sanitary restrictions, so that their construction, maintenance and cleaning should meet several requirements. The same situation is also for the storage of milk, this paper treating as well this issue.

Keywords: equipment for transport, legislation, milk, storage

1. INTRODUCTION

The milk is a product consumed by people of all ages, both in liquid form and in the form of dairy products, without which the human diet, especially children's and the elderly's would be poor. Compared to the many advantages the milk and the milk products presents as food, they have one big disadvantage generated by the high perishability that exhibit at high temperature or if they are produced, transported or stored in unsuitable conditions. Through the Romania accession at the EU, and therefore because of the existence of the European single market and the free movement of goods, Romanian producers of milk and dairy products must meet very strict European legislation, which was entirely taken in Romanian law. This paper presents a part of this legislation, namely the one for transport and storage of milk and milk products, including the way how these requirements are implemented in the construction, maintenance and cleaning the equipment for transport and storage of those products.

2. GENERAL RULES REGARDING THE HYGIENE OF THE EQUIPMENT USED FOR FOOD TRANSPORT

Norm of 24 October 2002 on the hygiene of foodstuffs, published in Official Monitor 866 of 2 December 2002 makes a number of clarifications, which will be presented below.

- the transport of foods is performed depending of the perishability of the products, using only hygienic and health authorized equipment, which could lead to the preservation of nutritional, organoleptic, physico-chemical and microbiological characteristics during the transport, as well as the protection against dust, insects, rodents and other pollution, degradation and contamination agents for both transported products and packages;
- the equipment used for the transport of foods must be designed and equipped depending on the nature of the product, and the exterior walls will be filled in with the name of those products (meat, bread, milk, etc.). The exterior walls and the platform will be made using resistant, waterproof and easy to clean materials;
- the perishable foods will be transported by refrigerated transport equipment provided with cooling and ventilation systems, including temperature monitoring and recording devices. For the transportation in the same locality or with a duration less than 4 hours can be used insulated transport equipment;
- the equipment for foods transport, and the packaging must be kept in a perfect technical condition and cleanliness; they will be washed and disinfected after each transport;

- the personnel that ensures the transport and handling of perishable foods and bread will wear health protective equipment (stored in vehicle) during all operations where they come in direct contact with foods, and will have health card;
- the containers from vehicles and / or containers used for foodstuffs transporting must be kept clean and in good condition in order to avoid the food contamination;
- in order to eliminate any possibility of food contamination, containers referred to in the preceding paragraph should be designed and built, where appropriate, to permit cleaning and / or a fair and efficient disinfection, and will be used only for food transport;
- where containers are also used for the transportation of other goods, an effective separation of products must be carried out in order to avoid the risk of cross contamination;
- where containers from vehicles were used for the transportation of different foods they must be thoroughly cleaned between two transport operations;
- food from containers should be placed and protected so as to prevent cross contamination;
- containers from vehicles used for foodstuffs transportation must be provided, where appropriate, with the necessary facilities which lead to maintain them at the recommended temperatures specified on the label or / and the food accompanying documentation. Also they need to have temperature monitoring systems;
- the chilled foods must be transported on vehicles which are capable of maintaining food at a temperature between 0°C...+4°C. The interior vehicle temperature, monitored throughout the journey must ranged between 0°C...+8°C, following the terms of laws and under appropriate accompanying documents.

3. THE SPECIFIC LEGISLATION FOR THE PRODUCTION, TRANSPORT, STORAGE AND MARKETING OF MILK AND MILK PRODUCTS

The most important legislation following transport and storage of milk and milk products are conducted is presented below [3].

- **EO no. 97/2001** on regulating the production, distribution and marketing of food, approved with amendments and completions by *Law no. 57/2002*, republished;
 - **Order No. 721 of 18 November 2009** on the approval of *Measures to improve the quality of raw cow's milk*, published in Official Monitor no. 813 of 27 November 2009;
 - **Regulation (EC) No 852/ 2004 of the European Parliament and of the Council of 29 April 2004** on the hygiene of foodstuffs;
 - **Regulation (EC) No 853/2004 of the European Parliament and of the Council of 29 April 2004** laying down specific hygiene rules on the hygiene of foodstuffs;
 - **Regulation (EC) No 178/2002 of the European parliament and of the Council of 28 January 2002** laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety;
 - **Council Regulation (EC) No 1234/2007 of 22 October 2007** establishing a common organisation of agricultural markets and on specific provisions for certain agricultural products (Single CMO Regulation)
 - **Council Regulation (EC) No 1153/2007 of 26 September 2007** amending Regulation (EC) No 2597/97 laying down additional rules on the common organisation of the market in milk and milk products for drinking milk [4].
- The obligations of food business operators responsible for the transport of raw cow milk (Order no 721 of 18 November 2009** concerning the approval of measures to improve the quality of raw cow's milk, published in Official Monitor no 813 of November 27, 2009) are presented below.

Food business operators responsible with the transport of raw cow's milk, have these **obligations**:

- transporting the raw milk only in veterinary authorized vehicles for such activities;
- transporting the raw milk only in isothermal vehicles of transport, ensuring the maintenance of the cold chain during transport, so that the raw cow's milk temperature does not exceeding 10°C upon the arrival at the destination processing milk,
- transporting the raw milk only in vehicles built and equipped so as to minimise the risk of milk contamination, having written the mention 'milk';
- developing and implementing procedures for carriers, regarding the raw cow's milk control, checking the temperature, smell, colour, identifying the presence of foreign bodies, before transferring the milk from cooling tank to the vehicle of transport;
- holding throughout the journey the reception documents of the raw milk per each supplier, producer, and / or on each raw cow's milk collection centre;
- holding insulation equipment for the preservation during transport of the taken raw cow's milk samples for carrying out laboratory tests,

- providing training for carriers regarding the reception and transport of raw cow's milk to the processing units, sampling and transport of samples of raw cow's milk to the laboratory unit under the delegated tasks and responsibilities;

- after each journey, or after a series of transport, when the period of time between unloading and the following loading is very short, but in all cases at least once a day, the containers and tanks used for the transport of raw cow's milk must be cleaned and disinfected properly before reuse [2].

The vehicle of transport must be approved by the Veterinary Department and meet the technical legal requirements for obtaining the permit. As minimal amenities, it is specified the *isothermal transport*, supplying with the *condensing unit*, and the use of the *food approved materials* in the internal transport area. The vehicle of transport should be authorized based on a specific file submitted to the Veterinary Department.

4. THE TRANSPORT AND STORAGE OF MILK AND MILK PRODUCTS

The vehicle of transport and handling of milk and milk products must comply with the law regarding the construction, the materials used, the way the milk is handled, the personnel etc. [8].

The tanks used to transport the milk (Figure 1) may have capacities between 1000...30000 l, the optimum option being chosen based on economic considerations [4]. Also, the tanks for the collection and the transport of milk may have one or more compartments. The latter option enables doing simultaneous transport of more than one quality of milk maybe resulting from several species of animals [6], [7].



Figure 1: Tank for the transport of the milk [www.scania.ro]

The crucial issue which must be solved by the milk carrier is about ensuring the hygiene of transport premises under veterinary rules, which are extremely severe in this case. Cleaning and disinfection should be done after every transport or even once a day, otherwise, there is a risk that a good quality milk at the time of collection to suffer characteristics depreciations during the transport.

The cleaning materials used for the sanitizing of spaces in which the milk is transported are from those agreed and indicated by the veterinary authorities.

The cold chain is vital as well in the case of milk and milk products, given the higher risk of perishability of these products. Thus, each step of the process that requires cold must be taken in consideration.

In the case of production of the milk, the cold occurs in the steps shown in Table 1. The storage is excluded from the table.

The maximum cooling durations and different end temperatures are explained through the cooling methods which are applied.

In any case, the best equipment for cooling milk at farms or at the collection centres are cooling valves (providing indirect cooling with cold water or the use of an intermediary agent or providing direct cooling when it is used a refrigerant) which must be provided with a high speed stirrer at 5 rev / min.

The cooling of milk in the factory is done in plate heat exchangers (pasteurizers are also equipped with heat recovery section and cooling section itself).

Before and after pasteurization the cold milk is stored in insulated tanks equipped with stirrers. These tanks are such isolated that at an ambient temperature of 25°C, increasing the temperature of the milk is of 3°C / 24 hours. Insulated tanks have different capacities depending on the processing capability of the plant in question (over 2500 to 100000 l).

The pasteurized and cooled milk, intended for consumption, is packaged in bottles, polyethylene bags (Poly-Pack system) or laminated cartons with polyethylene in interior and waxed at the exterior (Tetra-Pack system).

Until delivery, the packaged milk is stored in the factory at 0...4°C, the outlet temperature of the milk being at a maximum value of 6°C.

Cream. It may be preserved by refrigeration up to 0...6°C and stored for a few days at 0...6°C (fresh and fermented sour cream). The cream preservation by freezing is used where a subsequent manufacture process is done for producing ice cream or for bringing the dairy products at a certain standardized fat content.

In the first case, the 50% fat cream is mixed with 10% sugar which leads in protection of the emulsion and the flavour of the cream during storage, after which it is rapidly frozen. In the second case, the cream with a fat content less than 50% is frozen, rapidly as well, using rapid freezing tunnels or scraped surface freezer apparatus.

The maximum storage life of the cream at $t_{air} = -30^{\circ}C$ is 18 months, at $t_{air} = -25^{\circ}C$ is 12 months and 6 months at $t_{air} = -18^{\circ}C$.

Table 1: The stages of cold application on the processing of milk

Product	The place of cooling applying	The stating moment of cooling	The maximal duration of cooling, <i>h</i>	The final temperature of the cooled milk, °C	The maximal duration at the final temperature
Raw milk	Farm or collection center	Immediately after milking or collection	4	10...12	4...5 hours
Raw milk	Farm or collection center	Immediately after milking or collection	3	4...5	1...2 days
Raw milk	Farm or collection center	Immediately after milking or collection	3	0	6...7 days
Pasteurized milk	Factory	Immediately after pasteurization	2...3	1-0	7...8 days

Butter. Resulted from pasteurized cream butter can be type extra (83% fat), superior type (80% fat) and mass type (74% fat), and from the quality point of view, of class I and II.

The cold interferes in the technological process, but also in the preservation, storage and transportation.

Butter can be delivered in the following retail packages:

- printed metallised paper packages (for extra and superior butter);
- packages of parchment paper and aluminium foil (for small portions, in tourism and aviation units purposes);
- packages of vegetable parchment printed paper (for mass butter);
- blocks of butter in the vegetable parchment paper and placed in boxes of cardboard or plywood.

The refrigeration of the butter after packing is done in tunnels for refrigeration up to 0...5°C.

For the storing of the butter in the factory the temperature is at $t_{air} = 4^{\circ}C$ for up to 5 days for prepackaged butter, and 10 days for butter in block.

The storage life (including that at the retail units), is, however, much higher: 4...8 weeks at 0...2°C; 2...3 weeks at 4°C (the relative humidity of the air should be 70...80%).

The freezing of the packing butter is done in tunnels for freezing with forced air circulation, and in freezers with plates, the freezing time being 24...48 hours, and the consumption of cold being 45 kcal/kg butter in the first case, and 30...33 kcal/kg butter in the second case.

The storing frozen in the factory of the prepackaged butter is done at $t_{air} = -15...-20^{\circ}C$ for up to 10 months. The maximum permissible durations for the storage of the frozen butter (including also the storage in sales unit) are higher: 15 months at -30°C; 12 months at -25°C; 8 months at -18°C and 3 months at -10°C.

Table 2: The storage conditions for dairy products

Product	The storage temperature in the factory, °C	The storage duration in the factory, <i>h</i>	Warranty term (from the delivery date) at the maximum storage temperature, <i>h</i>
Yogurt, sour cream for consumption, kefir, buttermilk, fruit flavored yogurt	2...8	24	24

The acidic dairy products. The cooling may occur in the manufacturing technology, but also for the storage of the finished products. Regarding the storage conditions in the factory and retail units, there are information presented in Table 2.

Cheeses. The cold interferes in different phases of technological process (milk cooling, drain and pressing of the curd, salting, cheese fermenting etc.), but also at their refrigeration and storage.

The cheese refrigeration occurs at the air temperature equal to the air temperature from deposits, i.e. 0...8°C for soft cheeses and 4...12°C for semihard and hard cheeses. The relative humidity of the air should be 70...90%, depending on the type of cheese and the air temperature [1].

The vehicles for the transport of the dairy products must be equipped so that when travelling to avoid any negative impact on the dairy products. The interior space of the vehicle will be lined with aluminium or stainless steel sheet.

5. CONCLUSIONS

1. The milk is a perishable product, so to avoid its degradation was necessary to develop a precise legislation that could ensure the maintenance of its basic characteristics through the way between producers and processors.
2. The equipment for the transport of raw milk must meet certain minimal requirements like isothermal transport area, supplying with the refrigerating unit, and the use of the food approved materials in the internal transport zone.
3. The main problem that needs to be solved by the carrier of milk is about ensuring the hygiene of the transport premises under veterinary rules, which are extremely severe in this case.
4. The dairy products, such as cream, butter, cheeses have specific regulations concerning the storage conditions. Also, the vehicles for the transport of the dairy products must be equipped so that when travelling to avoid any negative impact on the dairy products. The interior area of the vehicle will be lined with aluminium or stainless steel sheet.

REFERENCES

- [1] Amarfi F. R. . a., Athermal and thermal processing in food industry, Alma Publishing House, Galati, 1996.
- [2] Br tucu Gh., P unescu C. C., P unescu C. G., C p î n I., Transportation systems in the food industry, Transilvania University Publishing House, Bra ov, 2013.
- [3] *** www.ansvsa.ro.
- [4] *** <http://europa.eu>
- [5] *** www.scania.ro.
- [6] *** www.mercedes.ro.
- [7] *** www.renault.com.
- [8] *** www.legestart.ro.