

Selling and pricing practices in the direct sales of producer's raw cow's milk

1. Summary

Among our objectives were the presentation of the most well-known sales channels of raw milk, sales practices and also the technological level used, as well as the examination of the issues related to the pricing, critical points and challenges of the direct sales of raw cow's milk. Our observations and samplings were performed at 21 direct sales locations of eight Budapest districts over 13 months, from June 2013 through June 2014.

Based on the results, it can be stated that, in the area studied, the sale of raw milk is realized through three main sales channels: markets (market halls), self-service systems (milk vending machines, refrigerated store containers) and different forms of mobile sales (tankers, regional home delivery system of producers). Further marketing practices can be distinguished within the different sales channels, where one can find the most primitive practice, the one without cooling, the traditional one and one that can be considered modern even when compared to Western European practice. The theoretical possibility to sell high quality raw milk was available for all sales channels, but the level of sales – especially from hygienic and technological viewpoints – ranged widely.

Based on changes in the sales price of raw milk, and its correlation with wholesale buying prices and pasteurized milk prices, it can be assumed that market prices and supply and demand are closely followed by shareholders of the market. Analyzing the mutually influencing effect of the prices of sellers located close to each other (e.g., in the same market), it could be concluded that the majority of them used a follower pricing strategy. Results of the price/quality ratio indicate a disordered state and arbitrary pricing.

The application of proper milk procurement, management and sales approaches would improve, in itself, processes that take place at the critical locations, described under the headings human factors, work organization, operation, maintenance and repair, quality aspects, packaging and labeling.

2. Introduction

A new situation was created in the sector by the structural problems affecting the Hungarian dairy industry, the limited competitiveness of businesses, the influx of cheap imported products often having the same quality as domestic ones, changes in buying habits

and the wholesale buying price of producer's raw milk that often does not exceed cost price. It became clear to producers that the commercial practice that had been in place for decades, in which the profit generated during the sales of the product mainly pocketed by commercial chains or other players of the marketing chain, cannot be maintained indefi-

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nitely in the future. So players in the sector pay more and more attention to operating short food supply chains, one of which can include direct sales of milk. Within the dairy sector, the concept of direct sales is interpreted comprehensively by Sebesy et al.: “A product that is sold directly enables the consumer, on the one hand, to buy a complete, fresh – only hours old – milk of natural composition, free of treatments and additives. And it opens up a new perspective for the producer by shortening the marketing chain, because the processing and retail levels are eliminated from the market. The extra revenue thus generated ensures a higher profit for the producer [12].”

In Hungary, selling from home or in the market, as well as the sales of often “udder-warm” or refrigerated raw milk directly from the farm after milking are long known and well operating practices. However, in direct sales, a more and more increasing role is played by solutions that are used by producers to serve the consumer as well as possible, creating a stable consumer base to successfully maintain their businesses. Technological development made it possible, and efforts to reach a wider consumer audience enforced the appearance of new, previously not used commercial practices and technological solutions, changing buying habits and increasing consumption. As a result, in addition to those mentioned above, in Hungary one can now buy producer’s raw milk through mobile sales from tankers, through home delivery systems, from grocery stores, from milk vending machines and at other delivery points as well.

Knowledge of existing sales practices is important, in addition to other reasons, because the quality parameters of the raw milk sold this way are directly affected by the proper operation of the technological background used for it, and its hygienic conditions. In our earlier works [4], [5], [6] we demonstrated that the physical-chemical and microbiological-hygienic quality parameters of directly sold raw cow’s milk were worse than those of raw milk bought by wholesale producers during the same period, for all parameters that were analyzed and could be compared. In this connection, the effect of the technological background used and of the different sales practices on quality were highlighted. In addition, the need arises to gain knowledge about the evolution of prices, and the relationship between the price and certain quality parameters.

3. Literature overview

3.1. Practical aspects of direct sales

Sales practice is a complex concept that can be interpreted as the union of the technological background employed and the human factor. The human factor includes the personality of the seller, product handling experience, as well as logistics. From the point of view of the quality and quantity of the prod-

ucts that can be sold, all of the factors are extremely important, but while the assessment of the technological background can be performed according to objective criteria – and there are literature resources available typically for this topic – , certain elements of the human factor are often hard to be evaluated, and only in a subjective way [4].

Since it is impossible to harmonize milk production with market demand completely, a surplus may form at the producers. In the case of milk producers who typically sell their products to wholesale buyers, direct sales could be an effective method for reducing surpluses. A less typical but also existing practice is flexible buyer behavior, where milk quantities remaining after direct sales are taken over without quantity restrictions. So direct sales mean an increased market risk for producers, who then go beyond the safety of guaranteed acceptance and price, provided by a buyer’s contract, in hope of liberal pricing and a higher income. Another important argument is the establishing of a direct, trusting relationship with consumers, and also the realization of immediate income, as opposed to the often 30 to 40 days’ payment deadline of producers’ contracts.

All domestic sales practices are known and supported by domestic and EU grants. Through these grants, support can be requested mainly for the development and operation of farmers’ markets, and for the purchase of milk vending machines and vehicles suitable for selling milk. Based on research conducted on the subject, at least 200 to 300 liters of milk per day should be sold from such a vehicle, in order to be able to cover the cost of operation (fuel, depreciation, wages, etc.). To ensure a profit, 500 to 600 liter per day should be sold. In personal interviews, the above statement was confirmed by the producers studied, who said that, in their opinion, a daily turnover of at least 200 liters is necessary for economical operation, in the case of milk vending machines [8]. In the case of selling in the market, or from home or the farm, determination of the daily quantity of milk to be sold to ensure economical operation is a complex task: it is influenced by the number of animals, daily yields of milk, and also by the direct and indirect costs incurred.

Looking at the technical-technological background of direct sales, it can be stated that there are several businesses present on the domestic market that deal with the manufacturing of vending machines suitable for dispensing raw milk, with the preparation of vehicle bodywork suitable for selling milk, and also with the production of the tools and equipment of producer’s location and market sales (refrigerated storage and milk handling). According to the report of Juhász, a significant portion of producers questions the success of milk vending machines in Hungary, the main reasons being their improper placement and the inadequate turnover of the selling place [8]. In the case of vending machines placed in public places, van-

dalism poses an increased risk. And in the case of vending machines placed in the sales area of grocery stores and supermarkets, objections may be raised regarding rental fees, or the nutritional values or the microbiological properties of the products.

Farmers' markets have been present in the direct sales of raw milk as a domestic practice for a long time. Raw milk is sold in the markets with or without refrigeration, at very different technological and hygienic levels.

Self-service systems have been gaining ground in Hungary mainly since 2008. The main reason for this was that there was an opportunity for the high volume procurement of milk selling vending machines, using grant sources. However, not only vending machines are meant by self-service systems, but also steel containers placed in, for example, grocery stores, in showcase refrigerators, that can also operate in a self-service mode. The technological level of domestic self-service systems varies widely, their common characteristic is refrigerated storage and the possibility of regulating the dispensing rate.

The first wide range of attempts at mobile sales were realized after joining the EU, between 2005 and 2006, using milk selling vehicles. These were either bought ready-to-use, or were transformed from closed cargo space trucks according to customer demands, which were greatly influenced by the range of products to be sold (if they wanted to sell other dairy products, in addition to milk, then the design of the refrigeration-storage space had to be different). Home delivery can also be classified into the practice of mobile sales. During this service, which is practical from the point of view of consumers, the order is placed through a phone call, an SMS or in an electronic way (e-mail, or filling out an online order form). Bottling is performed at the milk producing farm, which is more favorable from a hygienic point of view than the conditions of market sales. Orders of less than a liter cannot be submitted, and the volume can vary, depending on the needs of the customer (2, 5, 10, 20 liters). Shipping companies relate to new orders in different ways: some businesses will serve the customer even if it is outside the established and accepted shipping area. This way of thinking is based on the importance of the "first impression", according to which a bad experience (in this case, rejection of the new customer) is highly unlikely to be followed by further inquiries, which can be an obstacle to expanding the customer base in the long run. In addition, there is a practice in logistics that delivery is only undertaken in certain districts along fixed routes, while others set an order value threshold, where the charge increases in tiers, proportionally to the distance. If the order is taken in the morning, it is delivered the same day, while orders submitted before 2 p.m. are filled no later than the following day. Similarly to other sales methods, proper storage temperatures and cold chain continuity are of the utmost importance. It is a further ad-

vantage of home delivery that it can be done with a simply converted vehicle with a refrigerated cargo space, representing significant cost savings, compared to the purchase price of a milk selling vehicle that can exceed 10 million HUF.

Transfer or collection points also fall into the category of mobile sales. In this case, the location and time of the transfer of the product ordered is coordinated by the customer and the producer. In terms of technological solutions and practice, this sales form is similar to the mobile sales channels described above, so it is not discussed separately.

3.2. Technological background of direct sales

Technological backgrounds of different levels and designs are assumed by the channels and practices of the direct sales of raw milk. According to the sales channels examined, the most common technological solutions of market sales, self-service and mobile sales are described below.

3.2.1. Market sales

According to paragraph II/3 of Annex IV of FVM decree 52/2010, in the case of raw milk, the *sales practice without refrigeration* can only be applied if the milk is sold within 2 hours after milking [3]. Here, one cannot talk about serious technological background or technical equipment, milk is often sold in plastic mineral water bottles. According to another practice of sales without refrigeration, milk is measured from a 50-liter plastic drum, or a 15-liter plastic pail. In the case of insufficient stirring, it is always the fat layer collected at the top that is given out first, so if milk is undisturbed for a long time and the storage temperature is relatively high, then batches containing significantly more fat than the average can be sold in the beginning. Accordingly, the fat content of the residual quantities, sold last, will be proportionally lower. For the filling of the bottles and adjustment of the final volume, a 1-liter measuring container and a plastic funnel are used.

There are several practices of *refrigerated storage* known that are used during market sales. One of the simpler, practical solutions is the procedure where the milk is bottled at the production site, and then sold at the sales location. By performing production site bottling and refrigeration in accordance with good dairy management practice, milk handling operations performed at the sales location and related risk factors can be kept to a minimum. The sale of raw milk bottled at the production site can be performed from a glass-walled milk cooling counter, from a wall-mounted milk cooler with a shelf design or, in the case of smaller amounts, from a showcase refrigerator. Equipment operated at markets typically work with an integrated generator and ventilation cooling. Newer types can be programmed electronically, and their operating temperature range can typi-

cally be regulated between 1 and 10 °C. The principle of operation of the refrigerators listed is the same, the only difference is in the design of the product offering layout. Their use depends on the available space and the layout of the sales area. Under market conditions, wall-mounted milk coolers usually do not operate in a self-service system, customers are generally served by the seller.

In the practice of market sales, vertical orientation tank refrigerators equipped with a stirrer are used most often. Szakály presents refrigeration-storage tanks as double-walled, 200 to 5000-liter, insulated equipment made of stainless steel and equipped with a stirrer, in which milk is cooled to a safe storage temperature, and then stored until the sale. The purpose of the stirring device is, in addition to the homogenization of raw milk, to improve heat transfer [13]. In his work reviewing the construction of dairy industry equipment, Ambrus writes that, from a refrigeration technology point of view, systems operating according to the direct refrigeration principle are the most common [2]. Here, the evaporator coils of the refrigeration unit are in direct contact with the bottom or the wall of the refrigeration tank, and so heat is drawn away directly from the milk in the tank. The compressor is usually a separate unit, located under or next to the tank. Earlier models were equipped with a traditional thermometer and a calibrated measuring stick, the latter for monitoring quantities. In the case of newer models, temperature and stirring regulation can be programmed, and the important parameters (e.g., temperature) can be seen on a liquid crystal display, usually situated in the controller box. Milk can be dispensed easily through the drain valve of the tank.

Another well-known practice of refrigerated sales of raw milk is the application of a raw milk dispensing counter. Development of the apparatus was justified by practical aspects: while in the case of refrigeration-storage tanks, bottles are usually filled by sellers through the drain valve at the bottom in a crouching position, with the help of the dispensing counter, this operation can be performed comfortably, in a standing position. By placing the bottle simply under the dispenser nozzle, the operator keeps pushing the control button of the milk pump until the desired volume is reached. The storage space with ventilation cooling is in the insulated case made of stainless steel and, depending on the design, it can hold one or two plastic tanks of usually 50-liter volume. In the case of several domestic constructions, stirring of the raw milk in the tanks has not been solved, the equipment only keeps the milk at the desired temperature (4-6 °C). Milk is forwarded into the milk pipeline by the suction pump, and then into the container through the dispenser nozzle. A problem with this type of solution can be that, with no possibility of homogenization, first the bottom layer poorer in fat is pumped out through the milk pipeline that reaches to the bottom of the unstirred tank, and the fat con-

tent of the remaining quantities, sold later, will be extremely high. Other challenges can be posed by the refrigeration deficiencies of the entire length of the pipelines, and by dripping, often encountered at the dispenser nozzle [4].

3.2.2. Self-service sales

Self-service sales of raw milk can be done from vending machines, or from stainless steel tanks placed in showcase refrigerators and equipped with taps. In the latter case, cooling of the milk is performed in an indirect way, and the tank does not have a stirring device.

Since vending machines are the most widely used self-service systems, in our paper only their technical features are described. The advantage of vending machines lies in their unattended operation, in that they do not require personal vendor presence except during filling and regular maintenance. Their design depends on whether they are integrated into buildings (e.g., built into walls), placed outdoors, in a unique stand-alone pavilion, or in the bodywork of vehicles. The latter solution represents a transition between self-service sales in the classical sense and mobile sales, but this practice is not yet typical in Hungary. Currently operating milk dispensing vending machines are similar in their principle of operation, the difference between them is in the way milk is stored: it can be done in stainless steel tanks, or in polyethylene pouches. Vending machines are solidly built, "vandal-proof" construction is a basic principle of manufacturers already in the design phase. The operating principle is the same in all cases: after inserting the amount of money corresponding to the desired volume of milk, the customer can obtain the raw milk by simply pushing a button. The insulated casing, which is made of stainless steel both inside and outside, not only ensures the protection of the device, but also the operating temperature (approx. 4 °C) of the refrigerated internal storage space. In the case of vending machines located outdoors, temperature regulation of the storage space means not only a cooling, but also a heating function. Cooling is usually performed according to the ventilation principle, and it can be supplemented by the cooling of the bottoms of milk tanks. Since there is unhomogenized raw milk in the tanks – similarly to other practices –, homogenization is performed by an automated integrated mixing device. Protection of the filling space is ensured by a lockable plexiglass door. After each filling, an automatic washing-rinsing cycle is launched by the machine, in order to remove milk residues from the pipeline system and the filling space, preventing harmful microbiological processes caused by stagnant milk. To loosen deposits found in the pipeline system, water with a temperature of 35 °C is used by the machine, and the cleaning efficiency can be improved by the addition of a detergent. The mixture of used wash water, milk residues and detergent is stored in a separate wastewater tank.

Because of cleaner operation and the more favorable microbiological characteristics of the raw milk dispensed, the application of drip-free and cooled dispenser nozzles, as well as of one-way valves is now common. For vending machines, the use of pipelines that are easy to replace and are as short as possible is expected, as is the installation of a flow system that is cooled along its entire length.

Almost all of the functions of the machine (e.g., temperature control, switching tanks, washing-rinsing, the currency recognition module, filling volume regulation, remaining milk volume monitoring, data storage, etc.) are electronically controlled. Most of the machines already communicate with its operator with the help of a built-in GSM module about the most important operating parameters (e.g., temperature above the critical level, the necessity of refilling). The smooth operation of the vending machines is ensured by refrigeration space doors with safety locks and by door sensors.

In the absence of the customers' own bottles, a useful packaging option could be the installation of PET bottle and/or cup dispensers and, in the case of machines placed in shops, the installation of a PET bottle holding shelf system next to the milk vending machines [4].

3.2.3. Mobile sales

Like other forms of sales, the practice of mobile sales can also be classified along various criteria. These include the packaging of milk (bottled in advance or measured on site) or the application of refrigeration.

Vehicles that transport milk refrigerated and in a tank usually have a bodywork either specifically developed for this purpose, or converted subsequently. Their common feature is the sales area for serving customers, the refrigeration unit, the cooled (stirred) milk container, the milk pump and the dispenser unit. Of the structural components listed, the construction of the cooled milk container has already been described in detail, so only the milk dispensing unit is depicted here. They are fixed in a way that is independent of the container, practically on the wall of the vehicle. The volume of the milk to be dispensed can be selected freely, and the volume is set with the help of three hotkeys or of the keyboard. Some versions have built-in dispenser pumps and also control the stirring of the container. Data of the quantities sold are stored by the machine, and these can be queried regarding a certain period. There are milk dispensing units already in the product range of domestic manufacturers, and they can be ordered with various technical specifications. Milk dispensers which are equipped with a pump usually have an expansion option, so they can be fitted with a currency recognition (coin reception) module, making automatic operation possible.

Transportation and storage of milk bottled at the production site is done in refrigerated vans or small trucks. Their typical features include an insulated cargo space, shelves to facilitate product organization (optional), a refrigeration unit and the evaporation-ventilation unit [4].

Our objective was the presentation and evaluation of direct sales channels, sales practices, and the level of the technological environment used, and also the analysis and evaluation of the sales price, from a milk market and quality point of view.

4. Materials and methods

4.1. General analytical principles

Our observations and analyses were performed over 13 months, from June 2013 through June 2014. In our work, we refrained from divulging any information (e.g., a more precisely defined area of operation) from which the exact source of the samples could be deduced. However, for the evaluation of the study results, knowledge of the sampling locations points is relevant, and these are given, in accordance with the above considerations, on a "capital district" level. A total of 21 sampling locations in eight Budapest districts were involved in the samplings.

4.2. Selection and presentation of the study region

Certain forms of direct sales are spreading in rural towns, but their penetration in smaller villages varies, and in many places is still limited. For our research topic, a sampling area had to be found where the number of considerable sampling locations is high and, in addition, the different modes of direct sales are present in the area in the greatest possible diversity. The criteria regarding the number and nature of the sampling locations were only met in Budapest, therefore, our observations and samplings were performed there. In this city, the most well-known sources of producers' raw milk are farmers' markets, market halls, milk vending machines, mobile sales systems and pick-up points, of which the first two are the most common. Since raw milk falls into the category of perishable products, it is not sold at wholesale markets. In our study, with the exception of pick-up points, all of the sources described above are examined.

4.3. The method of analysis of sales practices and prices

Sales practices and prices were recorded using descriptive observations. Raw milk wholesale purchase prices and packaged milk prices for the period in question were obtained from the Market Price Information System of the Research Institute of Agricultural Economics [1].

4.4. Mathematical-statistical analysis of the study results

Evolution of the analytical results of the 21 sales locations participating in our study, and also the corresponding average, standard deviation and extreme values are summarized in tables. The closeness of the relationship suggested by the analytical results was evaluated by correlation analysis. In the case of a correlation coefficient value (r) of 0.90-1.00, the relationship between the variables examined was classified as extremely close, in the 0.75-0.90 range it was classified as close, in the 0.50-0.75 range as appreciable, in the range of 0.25-0.50 as loose, and in the case of values below 0.25, as uninterpretable. For the processing of the analytical results, statistical rank analysis was also performed.

4.5. Examination of other factors

Our non-quantifiable observations regarding the human factor and work organization, operation, maintenance, troubleshooting, dairy management and sales practices, certain questions of the quality aspects, packaging and labeling, as well as information and communication were recorded in a descriptive way, and were all evaluated from a consumer point of view.

5. Results

5.1. The practice of direct sales

Sales practices characteristic of the study area were discussed in detail in section 4.2. Accordingly, sales practices most well-known on the local level were among the selected sampling locations. They were divided into three major sales channels, which were the different forms of markets (market halls), self-service systems and mobile sales. Based on our field experience, those sales practices were distinguished which may be similar in nature, but their technological background and/or practical operations differ from each other in one or more aspects. Due to the characteristics of the study area, the familiarity with and popularity of traditional forms of sale, and also because of the current position of direct sales, markets and market halls are overrepresented, compared to other forms of sale. The sales channels and practices studied are summarized in **Table 1** [4].

5.2. Description of the sales channels examined

When classifying according to sales channel, of primary concern was the identification of criteria, based on which the individual sales practices can be placed in common categories (**Table 1**). The study also included farmers who reached the customers with their products through several sales channels at the same time. Accordingly, different sales practices were present simultaneously, so they were able to serve their customers at multiple locations, from multiple sources, often leaving the customer with a possibility to

choose [4]. At several sales locations, the use of the available technological background, the sales practice was not uniform, it could change on successive purchasing occasions.

5.2.1. Market sales

Market sales mainly refers to the location of the transaction, to which typical sales practices can be linked. Although in common language, the concepts of consumer and farmers' markets are often used interchangeably, relevant professional organizations usually refer to wholesale markets by farmers' markets. The closest to the traditional concept of the market are consumer markets, where producers can sell their products directly to the customers. In market halls, customers either buy directly from the producer, or through direct sales from the dealer playing an intermediary role.

Within the market sales channel, three sales practices are distinguished, which are broken down further, based on the technical background and the operations used. Based on the experience gained at the sales locations, we concluded that raw milk had been stored before sale without refrigeration and/or with refrigeration, but the combination of the two practices also occurred.

The most common way of market sales is when empty mineral water bottles are filled with raw milk by the producer at the farm, and then it is sold at the booth, without refrigeration, together with the other products, regardless of the actual ambient temperature. Although production site bottling could be advantageous from a hygiene point of view, storage without refrigeration makes any effort at producing low-germ milk meaningless. In connection with this, collection of PET bottles brought by customers was a practice that could be observed at several sales locations. Beverage or mineral water residues occasionally observed at the bottoms of the bottles, in addition to concerns regarding microbiology-hygiene, raise questions about even elementary level knowledge of good hygienic practices.

A known practice is the market sale of milk from plastic barrels. Barrels can be closed by a threaded lid and, for a better seal, a plastic film is placed under the lid. In these cases, we usually encountered "udder-warm" milk from same day milking, but sometimes refrigerated milk could be bought from identical barrels. From the barrels, milk was filled into bottles using a 1-liter measuring container, sometimes with the help of a plastic funnel. The lid was not always put back on the barrel, in this case selling the milk is continued from an open container. It also happened, that there was residual milk from the previous filling in the 1-liter measuring container hanging on the side of the plastic barrel, and so this residue was first poured into the bottle of the customer, then the missing amount was added, if necessary.

Refrigeration of raw milk was typical in market sales: of the 15 market sales locations, in only two cases did we buy non-refrigerated milk. During the most common refrigerated sales practice, milk was stored in a vertical orientation cooler tank equipped with a stirrer, and it was dispensed through the drain valve at the bottom of the tank into the capped PET bottle brought by the customer or purchased on-site. At sales locations with a higher turnover and having an established customer base, new, empty PET bottles were also sold, which were filled on-site in advance, thus shortening service time. The filled bottles were stored in milk cooling counters.

According to a modified version of the above-mentioned practice, a rubber hose was attached to the drain valve of the refrigerated tank, and filling of the bottles was facilitated by a dispenser gun at the end of the hose. The modification could be justified by practical reasons, since milk can be dispensed more comfortably this way, in an upright position, eliminating frequent bending down and crouching (*application of a rubber hose for food industrial purposes is generally a cause for concern from a microbiological point of view – ed.*).

According to a practice similar to those described for refrigerated tank storage, but including further operational steps, milk is drained from the refrigerated tank into a 15-liter plastic bucket, and then the content of the bucket is transferred into a 25-liter aluminum milk churn equipped with a drain tap. Finally, bottles are filled through the drain tap of the milk churn, and the top of the churn is covered with a textile cloth to prevent contamination (*application of the textile cloth for food industrial purposes is also a cause for concern from a microbiological point of view – ed.*).

According to another multi-step process, a 15-liter plastic bucket was filled through the drain valve of the milk tank, and milk was transferred into the bottle of the customer or into a PET bottle provided by the seller with the help of a 1-liter plastic measuring container and a funnel.

A counter for dispensing refrigerated milk and operated by the sales staff is also an established market sales practice. Plastic milk storage containers are located in the refrigerated storage space of the equipment, and stirring of the milk is not solved here. As a result, milk with a significantly higher fat content can be served to customers before the tanks are emptied. According to the simplest way of serving the customers, milk was poured directly into the bottle through the dispenser nozzle. During another observed dispensing mode, milk was first drained into a 1-liter plastic measuring container, and bottles were filled from this with the help of a funnel, or bottles were filled from the machine, and the residual milk found in the measuring container was only used to adjust the final volume. The plastic measuring container was also used, in addition to the things men-

tioned above, to collect milk dripping from the dispenser nozzle. On several occasions and at several locations a sales practice was observed, wherein the 1-liter plastic measuring container was filled by the sellers in advance, and the residual, non-refrigerated amount thus prepared was also sold.

Sales location milk handling operations are simplified by the custom, during which new 1.5-liter PET bottles are filled by the producer at the farm. This way, their market sale is performed from a showcase refrigerator with a glass door and side walls. In this case, partial amounts could not be requested, bottles were not opened. Sales were done from the milk cooler, containing other dairy products as well.

In the case of the other PET bottle sales practice, a 1.5-liter mineral water bottle is filled by the seller at the farm or from the refrigerated tank on-site. Bottles were stored in the refrigerated counter in this case. Filled bottles were opened, if requested, and the required amount was transferred into the container brought by the customer, or partial amounts were sold in the “original” mineral water bottles. Accordingly, it happened several times, that customers who arrived late could only be served residual quantities, sometimes meaning the sale of 0.3 to 0.5 liter of milk in a 1.5-liter PET bottle.

5.2.2. Self-service sales

Self-service sales refers to the nature of sales, usually at permanent locations. The sale of milk in a self-service system had become known in Hungary under the name of “milk machine” in the first years of the 2000s, although it is a broader category both in terms of content and practice.

In addition to vending machines, there is also a sales method where a stainless steel tank is placed in a glass-walled refrigerator in the sales area of the grocery store, and customers can fill their bottles through its drain valve. This way, refrigerated storage is achieved, however, stirring of the milk is not solved in the case of this practice either. Empty mineral water bottles were available next to the refrigerator, which can be filled in the absence of the customer's own bottle. This method of sales is a good example of the interoperability of different forms of operation, because the showcase milk refrigerator that was operating in a self-service mode at the beginning of the study, was moved behind the counter after the end of the study period, and from there customers were served by the sales staff.

The only difference between milk vending machines in the study area was in the mode of operation, so two different operating practices could be discerned within the self-service system sales channel.

In the first case, the milk vending machine was installed at a busy public area location, next to the

entrance to a block of flats, built into the wall. Next to the vending machine, for personal hygiene and to keep the machine clean, a paper towel dispenser and a waste collection bin was also installed by the operator. There was no opportunity to buy bottles on-site, it had to be taken care of by the customer. In all of the vending machines examined by us, the milk was stored in a prismatic stainless steel tank. The machine only accepted HUF coins, did not return change, and banknotes or credit cards could not be used. The information provided by the liquid crystal display alternated between the per liter price of milk, its temperature and the actual amount of milk stored in the machine. After dispensing the amount purchased, customers were alerted by a message also on the liquid crystal display to remove their bottles from the filling space, before the start of the washing-rinsing operation. Information was also provided on the display, proportionally to the coins inserted, about the volume of milk purchased. Operating the device is simple: after inserting the number of coins corresponding to the volume of milk to be purchased, the door of the filling space was opened, and after placing the bottle under the dispenser nozzle, filling could be regulated by a button, and it could be interrupted as needed (e.g., changing the bottle, suspension of filling because of foaming).

In the other case, vending machines were installed in the sales area of bakeries, grocery stores or supermarkets. Such busy locations are usually selected by the operators of the milk vending machines in order to maximize turnover, and it also reduces the exposure of the device, and the permanent presence of the sales staff and the customers provides protection against vandalism. In addition, the operators of the vending machines have more opportunities to place signs attracting attention and decorative elements [4]. According to Juhász, it can be considered a disadvantage that, in such cases, the profit of the operator has to be shared with the owner of the store. In addition, to generate a sufficiently high revenue, a busy store (mostly a supermarket or a hypermarket) is necessary, where the rental fee is extremely high, and the milk varieties offered by the store and the raw milk present a competition for each other [8].

The operating practice of vending machines placed in grocery stores cannot be considered uniform either. From the vending machine located in the bakery, milk could only be purchased into our own bottle, after inserting the coins. In the case of the vending machine located in the supermarket, a bottle holding shelf can be mentioned as a positive example of sales culture. From the multi-level shelf system next to the vending machine, polyethylene bottles of different volumes (0.5 to 2.0 liters) equipped with a cap could be purchased, so it was the customer's choice whether to fill the milk into their own bottle or into one purchased on-site. If the customer brought his own bottle, first it had to be presented at the cash register. After weighing the bottle, it could be filled

at the vending machine in the way described above. After filling, the bottle was weighed again, and the purchase price was calculated from the net weight obtained as the difference. The volumes of the PET bottles that could be bought on-site were known to the cashiers, so purchase prices could be determined without weighing in these cases. Since the price of milk has to be paid at the cash register, there was no possibility to insert coins in the case of this vending machine. This sales practice contradicts the report of Juhász, according to which, in the case of buying milk from a vending machine, the bottle always has to be brought by the customer [8].

Based on the experience gained at the sales locations, we concluded that only refrigerated raw milk was sold in self-service systems. The opinion of the operators was uniform that, for this method of sales, the most difficult tasks were presented by the on-site cleaning, filling and maintenance of the vending machines, but most of all, by maintaining an appropriate level of hygienic conditions.

Before the end of the study period, the vending machines operated in the bakery and the supermarket were removed, and operators explained this by the insufficient turnover.

5.2.3. Mobile sales

Moving sales, also known as mobile sales of raw milk refers mainly to the method of sale, which is also the most intense form of sale from the producer's point of view. The mobile sales method is linked to locations through regularly scheduled sales sites, on the one hand, and through the addresses of the customers, on the other. The application of a variety of sales practices and technical solutions is typical. Raw milk was sold both with and without refrigeration by the producers examined by us.

According to the semi-intensive method of mobile sales, raw milk is not home-delivered, the sale was performed in a public area from the milk dispensing vehicle. Customers were served according to a pre-determined schedule, at permanent sales locations. All the milk selling vehicles sold refrigerated milk. New PET bottles, which were stored in plastic bags in the cargo space of the vehicle, were also sold by the operators. Bottles were filled easily and quickly via the large diameter filling pipe of the dispenser unit. In order to avoid spilling, the filling pipe was usually introduced into the bottle, which is objectionable from a hygiene point of view. To collect the milk dripping after filling a bottle, a plastic bucket placed under the filling pipe was used.

In the case of the other, more intense method of sales, milk was delivered in a bottled form, either with or without refrigeration, to the address given by the customer. With businesses operating at a higher level of organization, orders could be submitted via

a customer service phone number, after talking with an administrator, and also via SMS. The delivery addresses given then could be inserted into next day's delivery schedule. Bottling of the milk was performed at the producing farm, into different volume PET bottles, according to the needs of the customers. In order to ensure a continuous cold chain, delivery was carried out by vans with ventilation-cooled cargo spaces. During the study period, packaging materials of various colors and shapes were used by the business.

According to the other practice of home delivery systems, milk was also bottled at the farm by the producer, in this case, into empty PET bottles. Delivery was always carried out after the afternoon milking, in the evening hours (between 7 p.m. and 9 p.m.). Similarly to the previous case, orders could be submitted via phone. Delivery was carried out in the passenger compartment or the trunk of a standard vehicle without cooling, and the milk was often handed over to the customer in an "udder-warm" state.

5.3. Analysis of sales prices

Sales prices were recorded on all sampling occasions, and these were processed on the basis of several criteria. By the analysis of prices at a sales location level, pricing trends were followed over the study period. Monthly average prices of direct sales were compared to wholesale prices of the same period and to pasteurized milk prices, using correlation analysis. The closeness of the relationship was used to assess the effect of milk market tendencies on the pricing of direct sellers. In view of the results of the quality parameters analyzed and of sales prices, a trend analysis was performed to characterize the price-quality ratio. Finally, at the level of the individual sales locations, the pricing practice was analyzed, looking for an influencing effect of sellers located close to each other (e.g., at the same market).

5.3.1. Sales price trends

In the case of all sales locations, the average price, the corresponding standard deviation, the difference between the prices recorded during the first and last (26th) sampling of the study period, and also the percentage difference between the extreme values of the given sales location were given. Results are shown in **Table 2** [4].

The results in **Table 2** show that the average prices of the different sales locations varied widely (167-252 HUF/liter). The average price of 11 sales locations (52%) exceeded the 200 HUF/liter level. A total of six (29%) sales locations were recorded where the price difference between the first and last samplings and the difference between the extreme values were both 0%. At these locations, there was no decreasing or increasing trend over the 26 samplings of the 13 months, prices remained the same all along. A

price decrease of 10% was observed in the case of a single seller, accompanied by a 26% price volatility, in terms of the extreme values. Periodic fluctuation of the sales prices is indicated by the pricing practices of those three sellers (14%) where the difference between the first and the last price was 0%, but a change in price during the period was indicated by the extreme values (10.00-18.75%). In the case of the remaining 11 sellers (52%), the price difference recorded between the first and the last sampling was the same as the difference between the extreme values, indicating one or more successive price increases during the study period.

5.3.2. Pricing practice in the direct sales of raw milk

5.3.2.1. Impact assessment of dairy market processes

Sales prices of all the sellers investigated were averaged on a monthly basis, these main averages were organized into a timeline, and were compared to the data published by the Hungarian Central Statistical Office for the same period, broken down by month [10]. From the correlations, possible effects of dairy market trends on direct sellers, and the flexibility (inflexibility) of direct sales prices were analyzed. The analyses were performed for the average prices of wholesale raw milk and 2.8% fat content pasteurized milk (**Table 3**). Closeness of the correlations between the different data sets were evaluated using correlation analysis. The trend of the data set for directly sold raw milk showed an appreciable, close correlation ($r = 0.75$; $P < 0.05$) with wholesale prices of the same period, while the correlation with the average monthly price of 2.8% fat content pasteurized milk was extremely close ($r = 0.93$; $P < 0.05$) [4].

Different results were obtained when correlations were analyzed at a selling location level. Here, averages calculated from sales prices recorded twice a month were compared to the average prices of wholesale milk and 2.8% fat content pasteurized consumer milk over the same period. In the case of seven of the 21 sales locations (33%), there was no detectable connection with the average monthly price of wholesale milk, in three cases (14%) the connection was tenuous, in five cases (24%) appreciable, for four sellers (19%) it was close, and in two cases (10%) extremely close. Subtracting sellers with a negative correlation from the results obtained, it can be stated that there was an appreciable ($r > 0.5$) positive connection between the sales prices and wholesale milk prices in the case of a total of 10 sellers (48%).

Correlation analysis was also carried out in the case of the 2.8% fat content consumer milk prices as well, analyzing on the different sales location levels the closeness of the relationship between the two variables. In the case of six sales locations (29%), there was no correlation at all between the results and prod-

uct milk prices, in two cases (10%) the correlation was tenuous, in three cases (14%) it was appreciable. The sales prices of nine sellers (43%) presented a close correlation, while those of one seller (5%) showed an extremely close correlation. Subtracting sellers with a negative correlation from the results obtained, it can be stated that there was an appreciable ($r>0.5$) positive connection between the sales prices and 2.8% fat content product milk prices of the same period in the case of a total of 11 sellers (52%).

5.3.2.2. Analysis of follow-the-leader pricing

Retail pricing practice is described by Kartali et al. as a “pricing mechanism based on monitoring each other” [9], so this hypothesis was also examined in the case of sales locations operating close to each other. During the sampling rounds, the 21 samples were taken at 12 locations, five of which were locations where more than one sample could be bought. This meant 14 sellers (67%), where comparison of the sales prices was possible. To do so, average prices of the producers involved were examined, related to the main averages of the given sales locations (Table 4).

Completely identical prices were only recorded at a single location (A), and in this case, follow-the-leader pricing could be proved unambiguously. A similar result was obtained at location D, where price deviation from the average was very small, not exceeding 5%. For sellers of location B, there was also only a small difference between average prices: it was slightly more than 5%. At location C, there was a difference exceeding 10% in the case of one seller (6.), in all other cases it was around 5%. The largest difference between average prices in this group was 33.08 HUF/l, between sellers 6. and 7. In group E, there was no appreciable difference between the average prices of two sellers (14., 15.), however, the price level of seller 16. was closest to the group average. The milk price of seller 21. differed from the group average by 11.73% (approx. 26 HUF/l), but by almost 40 HUF/l from the lowest average of the group [4].

5.3.3. Presenting price-quality ratio

5.3.3.1. Prices and nutritional values

Physico-chemical quality was evaluated in our case, based on nutritional parameters of major importance to consumers, i.e., fat and protein content. To do so, the different sellers were ranked, based on the fat and protein content of the milk sold, and the final ranking was determined by averaging of the rankings of the two parameters. Accordingly, sellers of milk containing more fat and protein were awarded lower rank numbers, indicating a better nutritional value. To each seller, the arithmetic mean of the sales prices recorded in the study period was assigned, and no statistical test was applied in order to eliminate outliers [4].

When looking for a linear relationship in the case of the result points, an increasing trend was obtained (Figure 1), indicating that samples of higher quality were cheaper, and prices increased with decreasing quality. However, a weak relationship between the quality rank and the price was indicated by the coefficient of determination ($R^2=0.260$).

5.3.3.2. Prices and microbiological-hygienic characteristics

Characterization of microbiological quality was based on parameters which best reflect the udder health condition of the dairy herd, and also the hygiene conditions of milking and dairy management. Therefore, total viable count, somatic cell count and coliform count were selected, following the procedure described above for nutritional values, when establishing the ranking [4].

The straight line fitted to the result points indicated a decreasing trend (Figure 2). It can be stated then that the price of milk decreased with decreasing quality, although – similarly to what was found in the case of nutritional values – the correlation between the price and the quality was tenuous ($R^2=0.283$) here as well. The weakness of the correlation between the quality and the price indicates the absence of systematic and regular quality control, and also the application of an unregulated, free pricing practice in this segment of the milk market [4]. Both in the case of the nutritional value and the microbiological price-quality ratio analysis, it was observed on several occasions that sales points that were far apart in the quality ranking, sold their milk at similar prices, or the price of the lower quality milk was even higher (Figures 1 and 2) (the correlation values published – <0.300 – indicate very little correlation between the variables compared – ed.).

5.4. Critical points and challenges in the direct sales of raw milk

Examining the direct sales channels and practices of raw cow’s milk, its technical background, and also the quality parameters of the samples taken, the aspects could be determined which proved to be critical for the safe and sustainably successful sale of raw milk. Their significance can be evaluated individually, but their simultaneous existence greatly hinders efforts to improve quality and to increase turnover [4]. It seemed practical to group our observations around the following topics: the human factor and work organization; operation, maintenance, trouble-shooting; milk handling and sales practice; quality aspects; packaging and labeling.

5.4.1. The human factor and work organization

The human factor is of great importance in all forms of sales, but it is particularly significant in market and mobile sales, because here a personal contact is es-

tablished between the customer and the seller, who becomes the “face” of the business, and influences the quality of raw milk by his behavior, dressing and personal hygiene both directly and indirectly, and also has an effect on developing consumer loyalty. The importance of the realization of the “right person for the right place” principle along the entire production and sales process is emphasized by Juhász et al., because the human factor has an effect on the quality and quantity of the product sold [8]. In their work, the authors also pointed out that finding the right personnel is especially hard in the capital region, and the staff turnover rate is high. This finding was only partially proved by our examinations, since there was a change in the sales staff at only two of the 16 market sales locations examined – changes were made twice in both cases. Regarding the development of customer preferences, Juhász describes in detail the stimulating effects characteristic of people regularly going to the market. These include the significance of good human relationships, which is largely supported by the stability of the sales staff [7].

In addition to external appearance and professional competence, other important and expected employee characteristics are punctuality and reliability. This way cases can be avoided where the milk ordered for a certain day is delivered several hours later than the pre-arranged time, or not delivered at all by the business performing mobile sales. Communication well below the expected level and tone can also have a detrimental effect on the orders. If the market sales points are closed due to vacations, or health or any other reasons, this can also have a negative effect on customers. Another factor that hindered purchases was milk shortage, which occurred mainly in the morning hours. Morning (before 8 a.m.) milk shortage was mainly experienced in market sales, in addition to vending machines [4].

5.4.2. Operation, maintenance, trouble-shooting

Proper operation, maintenance performed regularly and professionally, as well as quick and efficient trouble-shooting are basic conditions of selling good quality raw material in the case of all of the sales channels and practices described. The only outdoor vending machine examined by us was regularly damaged. Paper towels were stolen, and the garbage can was filled with household waste. Over time, the paper towel dispenser was stolen, and the waste disposal basket was smashed. The plexiglass cover of the door of the filling space was broken, and often there was newspaper or milk residue on the ledge in front of the filling space. Similar phenomena were reported by several authors [8], [11]. The milk residue left behind is detrimental not only from an aesthetic point of view, but can also attract stock pests (ants, cockroaches) and flies, which is very objectionable from a hygiene point of view.

In terms of the quality of the raw milk sold from the

vending machine, regular cleaning and maintenance, and also the proper practice of filling the vending machines are of paramount importance. In the uniform opinion of operators, cleaning and disinfection of the chemicals used for handling, achieving the desired level of cleanliness and collection of the wastewater and the residual milk present difficulties. During the cleaning operation, carried out when replacing the tank, it was observed that the collection/drip tray under the tanks and the bottle holder plate of the filling space were washed using the same sponge and cleaning fluid, as the stirring paddles extending into the milk tank (the milk). Such a practice is extremely problematic from a microbiological point of view, and makes all the efforts to produce and sell low-germ milk useless.

Proper cleaning of the equipment is a hard task, because it has to be performed in a public area or in a sales area. In the case of dispensing counters, the cleanliness of the milk storage tank is of paramount importance, because the wall of the plastic tank is wetted well the milk. And in the fat phase of the residual milk, biofilms consisting of microorganisms can develop. In the case of sales area placement, the operation has to be performed without disturbing other commercial activities. Faulty devices were also often encountered. In this case, customers were informed by the operator on a printed sheet of paper about the malfunction, but the expected time of fixing the problem was not indicated.

In the case of mobile sales, we found several times that milk cars broke down, or worked in a replacement system for some other reason. Therefore, locations and times accustomed to by customers were changed, acting against maintaining a stable customer base. During each sampling performed from milk cars, the driver of the car was asked about the temperature of the milk in the cooling tank, and this was compared to the actual temperature of the milk sample taken by us. In several cases, the thermometer of the car did not work, or not accurately, which made precise control and regulation of the proper cooling parameters for the operator questionable. It has to be emphasized that – based on the high temperature values (11-20 °C) measured after delivery – more attention than what has been observed by us has to be paid to the continuity of the cold chain in the case of home delivery systems [4].

5.4.3. Milk handling and sales practice

In our study, several series of movement and operations were observed, which are incompatible with the proper hygienic, milk handling and sales practice. The reasons for this include milk adulteration, the lack of traceability, negligence and a lack of material knowledge. Microbiological non-conformities were frequent, and the volume of the milk dispensed was not always sufficiently accurate. In most of the cases, a positive volume deviation was observed. Less than

the nominal volume was only rarely dispensed by the sellers. Such irregularities were observed only in the case of pre-filled bottles sold in markets, and of milk dispensing counters.

In the case of market sales, tanks, barrel and containers used for milk storage were often left without lid, and funnels, measuring containers and buckets used for dispensing the milk were waiting for the next customer without rinsing, often with milk residue from the previous transaction. This way, during sales, milk was not protected from flying insects or other sources of contamination. Similar deficiencies were observed in the case of refrigerated milk dispensing counters, where the plastic measuring container was used, in addition to filling the bottles, to catch the milk dripping from the dispenser nozzle. The small amount of milk found in the measuring container quickly warms to ambient temperature. Warm milk then provides an excellent medium – especially in the summer months – for the rapid growth of microorganisms.

Non-refrigerated forms of sale can only be used within the legal boundaries, observing the 2-hour time limit from the completion of milking, although this in itself is not a guarantee of quality. In the summer, especially around noon, non-refrigerated sale of raw milk at market stalls – either from PET bottles or from plastic buckets – is irregular, both in terms of legal requirements, as well as basic food safety aspects.

In the case of self-service systems, if the raw material is of high quality, the actual quality of the raw milk dispensed is influenced by the cooling of the milk tanks and the entire pipeline system, proper stirring of the milk, efficient operation of the cleaning/rinsing programs, a drip-free dispenser nozzle, and the thoroughness of the cleaning operations performed when filling up the vending machines. In order to ensure a steady supply and to increase the amount sold, increased attention has to be paid to the timely refilling of the vending machines. In the case of mobile sales, deviation from the prescribed temperature of the milk dispensed was occasionally experienced. From a microbiological point of view, it is an objectionable practice if the filling hose is inserted deeply into the bottle to be filled. It is so, because during filling, the milk residue found on the outer wall of the hose, rich in bacteria, can be rinsed into the bottle [4].

5.4.4. Quality aspects

Looking at the quality parameters of directly sold raw milk, nutritional value, microbiological and organoleptic objections were frequent. In our previous works discussing the results of physico-chemical and microbiological tests [4], [5], [6], objectionable analytical results and their causes were described in detail, so they will not be covered here.

At the same time, physical purity as a quality parameter has to be definitely mentioned, to the importance

of which our attention was drawn during samplings. In our original test plan, the analysis of purity was not included, because the fraction of wholesale raw milk classified into category II because of its physical purity has become irrelevant by today, barely reaching 0.01% in 2002. This is the reason why the testing of physical purity during milk qualification was abolished by the legislature.

After sampling, physical contamination of different frequencies was recorded for a total of eight sales points (38%), the physical form of which was sediment at the bottom of the bottle. The contamination was sometimes fine, sand-like, while at other times it was coarse and grainy, which could be the result of careless milking and/or milk handling. With soil, mud and manure in the milk, or through milk handling and bottling operations performed with contaminated hands, millions of saprophytic and pathogenic bacteria can enter the milk. Therefore, removal of physical contaminants by filtration is one of the most important technological steps. Filtration of the milk has to be performed in time, preferably once. It should be noted that filtration of the milk is referred to by Szakály as a “necessary evil” operation from a professional point of view. Necessary, because contaminants have to be removed, preferably before they dissolve. And evil, because the mechanical effect of filtration (especially multiple filtration) may fragment a portion of the contaminants, which can result in an increased microbial count of milk [13].

Overall, it can be stated that with a change of approach, with adhering to the proper practice of milking and milk handling, as well as to basic (personal) hygiene rules, microbiological/hygienic and organoleptic properties of directly sold raw milk could be improved substantially [4].

5.4.5. Packaging and labeling

Although the seller is responsible only for the quality and labeling of the packaging material provided by him, he has other labeling/information obligations as well. Labeling obligations of small producers in the case of products sold at the site of production, markets, fairs, events, authorized temporary sales locations or by home delivery are regulated by section (4) of paragraph 6 of FVM decree 52/2010. (IV. 30.): “*in the case of the sale of unpackaged food in such ways, the name and address of the small producer, or the address of the farm, and the name of the product has to appear in front of the product displayed*” [3]. The legal obligation to provide information was fulfilled by all sellers, but sometimes only in a form that was barely visible or legible to customers. According to section II of FVM decree 52/2010. (IV. 30.), “*raw milk can only be packaged into clean containers suitable for sterilized packaging. When using recycled containers, they have to be cleaned and sterilized before and after use, they have to be rinsed with drinking water, and have to be stored in a clean, dry place,*

protected from contamination" [3]. Empty mineral water bottles were used for packaging at markets, in mobile sales, and even in grocery stores.

At direct sales points, bottles provided by both the producer and the customer were encountered. Of packaging materials provided by the producer, empty mineral water PET bottles were the most common. The physico-chemical and microbiological purity of these cannot be guaranteed. The type, shape, form, color and the degree of usage of bottles waiting to be filled varied widely, irrespective of the form of sales. Next to vending machines placed in the sales area of stores, a forward-looking solution was the providing of technically sterile bottles on bottle holder shelves. This practice is still rare in Hungary. In mobile sales, bottles were stored in bags without caps in the cargo hold of the vehicle. Previously unused (new) PET bottles were mainly encountered at mobile sales locations and markets.

Rules of the sale of raw milk in packaged form are also regulated by FVM decree 52/2010. (IV. 30.). According to section (4) of paragraph 6, the name and address of the small producer, or the address of the farm, the name of the product, the weight of the product (except when the packaged product is weighed by the small producer in the presence of the customer), the use-by date or the expiry date – in the case of foods with a use-by duration – , and the storage temperature have to be displayed [3]. It should be noted that, during our survey, not a single packaging material, provided by the producer, was encountered, on which any of the labeling elements prescribed by law could be found [4].

6. Conclusions

The possibility to sell good quality milk is given in the case of all sales channels. However, sales were made under various hygienic and technological conditions. The sales practice had a significant effect on the homogeneity of milk, and its physico-chemical and microbiological-hygienic parameters. In the area studied, market sales locations, requiring minimal investment were in the majority. These sales locations are known and loved most by customers. Of the sales locations studied by us, only three closed during the study period. The reasons for closing are likely to include improper selection of the sales location, or the proper sales channel and sales practice.

It is assumed that up-to-date market knowledge and following market prices and the demand-supply conditions are behind the changes in the sales price of raw milk, and the correlation with wholesale and pasteurized milk prices. It should be noted that only half of the operators of sales locations involved in this study paid any attention to market conditions.

Analyzing the effect of proximity on milk prices of sellers located close to one another (e.g., in the same

market), it was concluded that the sales prices of other sales locations influenced their pricing to varying degrees. Results of the analysis of the price/quality ratio indicated a disordered state, arbitrary pricing, which could be made more uniform by introducing the reward and sanction effects of the price system used for wholesale raw milk, by forcing price consistency. Further investigation is needed to determine the causes behind statistically significant correlations.

Our personal experience and the survey results draw attention to fundamental shortcomings regarding the distribution of raw milk. The importance of training and causal relationships should be emphasized, in order to teach basic physico-chemical and microbiological-hygienic processes. In order to improve the level of customer management, and to eliminate objectionable seller behavior, a change of attitude, a customer-focused commercial practice is required.

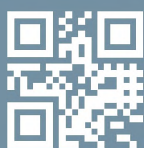
Efforts should be made to maintain permanent work order and to solve substitutions, because in the case of repeated occurrences of closed shops or milk shortages consumers may take up new customer habits in a short time, they might try alternative products, and may become committed to another seller (sales location). Removal of contaminations (e.g., spilled milk) as soon as possible is an essential requirement. In the case of vending machines, the cleaning operation is more complex, compared to manually controlled equipment. Special attention has to be paid to the maintenance and cleaning of machines located in the sales area of stores. To prevent vandalism to vending machines located in public areas, development of the consumer culture, learning general norms of behavior, improving public safety and the installation of compact, "vandal-proof" equipment might be the solution. Improper milk handling and sales practices could be fought by organized education and targeted inspections. Of particular importance are the minimization of milk contact surfaces, elimination of unnecessary operational steps, as well as uncovered and non-refrigerated storage habits, adherence to technological specifications, and to proper filling and cleaning discipline. The frequency and level of occurrence of physical contamination could be reduced by adhering to the proper practice of milking and milk handling.

Sterilization of commonly used PET bottles by heat treatment is not feasible. In the absence of this, sufficient level of chemical cleaning and rinsing of the bottles could only be achieved by applying inordinate amounts of economic and technological efforts, and so this is not done by most of the sellers. So this kind of packaging material has to be considered a potential source of contamination. In the case of all forms of sale, displaying mandatory labeling elements and informational texts is recommended, as well as proper information of customers.

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