MILK QUALITY AND PROFILE OF PRODUCERS FROM A MILK PICK-UP ROUTE

Patrícia Yoshida Faccioli-Martins[1]
Marcela de Pinho Manzi[2]
Glaucea Suman Maiolino[2]
Carlos Roberto Padovani[3]
Benedito Donizete Menozzi[2]
Helio Langoni[2]

ABSTRACT

The aim of this study was to perform a follow-up evaluation of both the milk quality and the profile of 34 dairy milk producers at the central-west region of São Paulo State and one producer at Campinas region, also in São Paulo State, Brazil. Data were collected from farms during three visits at two-month mean intervals, including a questionnaire to verify the herd size and the adopted management. Monthly data of total bacterial count (TBC) and somatic cell count (SCC) provided by the dairy plant were also recorded. The producers had variable characteristics such as: from three to 111 lactating animals; daily production ranging from 10 to 3,632.8 litters. Of the 35 farms, 15.4% and 27.8% had SCC and TBC, respectively above the limits established by the Brazilian Ministry of Agriculture Livestock and Food Supply (MAPA), according the Normative Instruction (IN 51). Only 17.65% farms carried out all hygienic procedures recommended for milking, while 17.65% do not received any type of technical support. The studied farms belong to small to medium-scale farmers with the potential to increase their production and improve milk quality, since they already refrigerated the product and had a certain automation degree. These results indicate the importance of adopting sanitary education activities for the production of more hygienic milk, as well as actions for mastitis control.

Keywords: SCC, TBC, milk quality, dairy farms.

QUALIDADE DO LEITE E PERFIL DOS PRODUTORES DE UMA LINHA DE ENTREGA DE LEITE

RESUMO

O objetivo deste estudo foi realizar uma avaliação sequencial da qualidade do leite e o perfil de 34 produtores de leite da região Centro-Oeste e de um produtor da região de Campinas no estado de São Paulo. Os dados das propriedades foram coletados durante três visitas com intervalo médio de dois meses, incluindo um questionário para verificar o tamanho do rebanho e manejo realizado. Foram anotados ainda os dados mensais de contagem bacteriana total (CBT) e contagem de células somáticas (CCS) fornecidos pelo laticínio. Os produtores da região tinham características diferentes como: de três a 111 animais em lactação, produção diária variável de 10 a 3.632,8 litros. Das 35 propriedades, 15,4% e 27,89% apresentaram em média contagem de células somáticas (CCS) e contagem bacteriana total (CBT), respectivamente, acima dos limites determinados pelo Ministério da Agricultura, Pecuária e

[1]Pesquisadora A – Sanidade Animal. Embrapa Caprinos e Ovinos – Sobral, Ceará, Brasil.
[2] Departamento de Higiene Veterinária e Saúde Pública. FMVZ – UNESP-Botucatu. Contato principal para correspondência: hlangoni@fmvz.unesp.br.
[3] Departamento de Bioestatística. Instituto de Biociências – UNESP-Botucatu.

Abastecimento (MAPA), de acordo com a instrução normativa 51, vigente na época. Apenas 17,65% das propriedades realizavam todos os procedimentos de higiene na ordenha e 17,65% não recebiam nenhum tipo de suporte técnico. Foi possível observar que as propriedades são de produtores de pequeno a médio porte, com potencial para aumentar a produção e melhorar a qualidade do leite, pois já refrigeravam o produto e apresentavam algum grau de tecnificação. Conclui-se ainda pela importância da adoção de atividades de educação sanitária para a obtenção mais higiênica de leite e de ações para controle de mastites.

Palavras-chave: CCS, CBT, qualidade de leite, IN 51, propriedades leiteiras.

CALIDAD DE LA LECHE Y EL PERFIL DE LOS PRODUCTORES DE UNA LINEA DE TRANSPORTE DE LA LECHE

RESUMÉN

El objetivo de este estudio fue una evaluación secuencial de la calidad de la leche y el perfil de 34 productores de leche en la región central y un productor de la región de Campinas en Sao Paulo. Se recogieron los datos de las propiedades durante tres visitas con un intervalo promedio de dos meses, incluyendo un cuestionario para comprobar el tamaño de los rebaños y la gestión realizada. También se registraron los datos mensuales del recuento total de bacterias (TBC) y el recuento de células somáticas (SCC) proporcionada por la industria láctea. Los productores de la región tenían características diferentes como tres a 111 animales lactantes, variables de producción diaria de 10 a 3.632,8 litros. De las 35 propiedades, 15.4% y 27.89% tenían un recuento medio de células somáticas (SCC) y el recuento total de bacterias (TBC), respectivamente, por encima de los límites establecidos por el Ministerio de Agricultura, Ganadería y Abastecimiento (MAPA), la de acuerdo con la instrucción normativa 51, vigente en el momento. Sólo el 17,65% de las propiedades a cabo todos los procedimientos de higiene para el ordeño y el 17,65% no recibió ningún tipo de soporte técnico. Se observó que las propiedades son pequeñas a de tamaño medio, con el potencial para aumentar la producción y mejorar la calidad de la leche, como ya resfriavan el producto y tenía algún grado de tecnificación. De ello se desprende también la importancia de la adopción de actividades de educación sanitaria para la obtención de la leche más higiénica y acciones para controlar la mastitis.

Palabras clave: SCC, TBC, calidad de la leche, granjas lecheras.

INTRODUCTION

Milk is of extreme importance for human diet and its consumption has increased, requiring production with high nutritional quality and safety to the health (1,2). Noticing the delay in the federal sanitary legislation as to milk production, the Brazilian Ministry of Agriculture, Livestock and Food Supply (MAPA) elaborated the Normative Instruction no. 51, 2002 (IN 51), aimed at updating the norms according to the reality of each region of the country for consequent improvement in dairy farming and milk quality (3).

A large number of farmers did not adapt to those requirements and continued producing and transporting milk inadequately before delivering it to the dairy plant; in addition, they faced mastitis as one of the major problems affecting the herd. Thus, IN 62 came into effect in December 2011, which extended the period for producers to adapt to the new quality limits (4). Considering such a reality, milk quality has been affected by the lack of hygiene, and the losses caused by mastitis have led to decreased production, which constitutes a public health

hazard due to the risk of pathogen transmission and dissemination of toxins through the milk to humans (1,5,6).

Normative Instruction no. 51, published in 2002, was gradually implemented in the south, southeast and central-west regions of the country since July 2005. It established quality limits for SCC and TBC. In July 2005, the required limits were 1,000,000 cells/mL and 1,000,000 CFU/mL, respectively. In July 2007, these values were reduced to 750,000 cells/mL and 750,000 CFU/mL. In 2011 (IN 62), these limits were reduced to 600,000 cells/mL and 600,000 CFU/mL for the region where the present study was carried out; for our result analysis, we will consider the SCC and TBC limits in force when this study was conducted.

In spite of the obtained advances, milk quality does not seem to have improved as desired since studies have still shown a high percentage of farms that have not reached the required parameters of SCC and TBC/mL milk. This led MAPA to create IN-62 with a series of recommendations and actions to improve the quality of milk supplied for consumption (4).

Reduced payment for the milk, as a punishment for the farmer who does not reach the established SCC and TBC limits, has not motivated producers to revert this situation to higher quality milk production.

On the other hand, the dairy plants that do not pay for quality do not strive to qualify farmers to produce a greater volume of milk of higher quality. Stimulating the farmers to improve productivity, as well as milk quality, would certainly reduce the cost with shipping and increase the shelf life of products and subproducts, raising the possibility of launching differentiated products with higher value added.

A data survey of the laboratories of the Brazilian Network of Milk Quality Control (RBQL) revealed that, of all assessed items, TBC was the greatest problem and, of the six labs at that time, five had 18.4 to 68.99% samples with TBC values above the limit in force (7).

Considering the importance of milk quality, the present study aimed to assess SCC and TBC, as well as the profile of 35 producers from a milk pick-up route at the central west region of São Paulo State.

MATERIAL AND METHODS

Thirty-five dairy farms at the municipalities of Botucatu, Pardinho, Pratânia, Itatinga, Torre de Pedra, Bofete, Porangaba, Cesário Lange and Quadra, from a milk pick-up route, were visited between 19/06/2008 and 28/02/2009 for three times at two-month mean intervals (except for Farm no. 71, which was visited only twice because the producer was out of the dairy plant pick-up route after the second collection).

During the visits, a questionnaire was applied to producers to verify the characteristics of the herd and the adopted management type. The recorded data included TBC and SCC supplied by the dairy plant, from the milk quality program conducted at the Milk Clinics – Esalq/USP, for the months of visits.

Associations were established by means of Mann-Whitney (Tables 1 and 5) and Kruskal-Wallis non-parametric tests (Tables 2 and 3).

RESULTS AND DISCUSSION

There was great diversity among farms for herd size, production volume and management type. The total number of cows per herd varied from 5 to 170, with mean of 43.9 and median of 35 cows. The number of lactating cows ranged from 3 to 111, with mean of 27.4 and median of 19 animals.

Some farms were not very productive; a few had only three lactating animals and their daily production was 10 litters, slightly higher than 3 litters/cow, while others had 111 lactating cows and daily production of 3,632.8 litters, almost 33 litters/cow. Mean milk production per animal was low (8.42 litters a day), with mean among farms of 303.8 litters and median of 136 litters a day. Mean production of cows per day ranged from 1.88 to 35.99 litters, and the coefficient of variation (CV) was 68.89%. The same profile was reported by Nero et al. (8) for farms in the region of Viçosa – Minas Gerais State, Brazil, assessed in 2007; most of them were small with less than 15 lactating animals and their daily production was inferior to 50 litters.

A great part of farmers at the studied region have remained in the sector as a family tradition, with poor infrastructure, reduced number of animals− most of which without genetics aimed at milk production, little knowledge of good production practices, and lack of financial resources. Several of these characteristics have been reported for different regions of the country (9,10).

This reinforces the importance of a program for stimulating small farmers to update their dairy production, which would improve the supply chain, the quality of the product provided for consumption, and the production and profitability, meeting the demands of the internal and external market. Brito et al. (11) pondered the need of training farmers to adopt a program of good production practices, so that milk contamination with antibiotic residues and pesticides, for example, could be prevented, ensuring the quality of the milk produced in the farm.

As to the quality of milk in immersion tanks or cans, the monthly SCC and TBC values were assessed for the three months of visit. The vast majority of assessed milk samples were from 29 individual cooling tanks (82.86%), 5 immersion tanks (14.29%) and one community tank (2.85%).

SCC ranged from 4,000 to 2,586,000 cells/mL, with mean of 468,228 cells/mL and CV of 78.30%. TBC ranged from 4,000 to 9,999,000 CFU/mL, with mean of 1,099,773 CFU/mL and CV of 174.4%. SCC and TBC values greatly varied, even for one same farm. Such variations many times exceeded the limits established by MAPA, resulting in a public health risk, as well as in losses both to the producers, due to milk disposal, and to the industry. This indicates important failures in the milk supply chain, which must be detected and corrected. Nero et al. (12) assessed raw milk quality based on TBC and detected 21.3% samples with levels above the limit for the region of Viçosa – Minas Gerais State, 56% for the region of Pelotas – Rio Grande do Sul State, 47.6% for the region of Londrina – Paraná State, and 68% for the region of Botucatu – São Paulo State. These results are relevant and evidence the importance of sanitary education actions for milk producers, regardless of the herd type and size, considering that the dairy sector has significantly contributed to the Brazilian agribusiness.

Considering all 35 studied farms, 11 (31.4%) had SCC beyond the limit established by MAPA in some collections, reaching the maximal value of 2,586,000 cells/mL in some situations. SCC did not represent a great problem for most producers, since the herd of these farms is generally composed of crossbred cattle, which show lower production and are more resistant to mastitis. Animals that are more productive are more susceptible to intramammary infections and thus tend to show higher SCC and TBC values, reflecting in the quality of the produced milk.

As to TBC, a rather larger number of farms (57.1%) were not in accordance with the normative instruction in force during the study period (750 CFU/mL), reaching the maximal value of 9,999,000 CFU/mL. The greatest problem for many herds has been the high TBC, which is also related to the inadequate hygiene of facilities, animals and equipment during the

milking process. Pre-milking cleaning is extremely important for hygienic milk production, since this practice eliminates a large quantity of microorganisms contaminating the milk.

Nero et al. (12) studied the quality of raw milk from 210 farms located at four important milk-producing Brazilian states: Minas Gerais (MG), Rio Grande do Sul (RS), Paraná (PR) and São Paulo (SP). In SP, 50 farms at Botucatu municipality were investigated and, at that moment, 68% had aerobic mesophilic count above the limit established for that period (10^6 CFU/mL), a value close to that obtained in the present study (57.1%).

Several factors are important for improving milk quality. The industries in general have concentrated their effort in aspects relative to the product refrigeration and transportation at low temperatures, which mainly interferes in the bacterial growth rate, one of the determinants of the microbiological quality of the product. Actions should still be directed to a second group of factors which are linked to milk initial contamination from the mammary gland, the outer part of the udder, the milking equipment and tools, the cooling tank and, finally, the quality of the water used in the whole process (7).

The community tank that was part of the present study showed SCC of 269,000, 293,000 and 247,000 cells/mL, while TBC values were 586,000 CFU/mL, 793,000 and 3,399,000 CFU/mL in the first, second and third collections, respectively. Low SCC was expected because these farmers have low production herds and their production is not sufficient for installing their own tank. On the other hand, TBC values were not in accordance, indicating a hygiene problem at the farms of origin and in transportation. These counts were superior to those found by Souza et al. (13) who assessed milk from a community tank supplied by nine farms. They obtained values between $2.1x10^5$ and $3.3x10^5$ CFU/mL and suggested that the quality of the product is due to its almost familiar use, as well as to the confidence among each other and common interests.

Results of the correlation between the tank type and the variables daily production of cows, SCC and TBC of the tank are shown in Table 1. There was a significant difference ($p<0.01$) only for milk production at farms with an individual cooling tank, compared to farms with an immersion tank. Farms with an individual cooling tank had milk production median of 7.50 litters, compared to 4.88 litters at farms with an immersion tank. The milk production median (L/cow/day) at farms with an immersion tank was significantly lower compared to that at farms with a cooling tank, which confirms the low production when the immersion system is kept. For producers who have no conditions of obtaining the cooling tank, immersion is a reasonable option, but it is important to gradually replace it since its cleaning is more difficult, there is less temperature control and the refrigeration distribution is irregular. In addition, the can may fall, allowing the entrance of dirty water in the milk, consequently contaminating the product.

Table 1. Descriptive measures of variables according to the type of tank used at the studied farms. Botucatu-SP, 2010.

Variable	Descriptive measure	Type of tank		p value
		Individual cooling	Immersion	
Mean production (L/cow/day)	Minimal value	2.00	1.88	p<0.01
	1st Quartile	5.00	4.00	
	Median	7.50[b]	4.88[a]	
	3rd Quartile	11.47	6.42	
	Maximal value	35.97	7.50	
	Mean	8.94	5.14	
	Standard deviation	6.06	1.65	
SCC (cells/mL)	Minimal value	86000.0	4000.0	p>0.05
	1st Quartile	252250.0	171000.0	
	Median	388000.0	245500.0	
	3rd Quartile	589750.0	741000.0	
	Maximal value	2586000.0	1335000.0	
	Mean	472942.5	438928.6	
	Standard deviation	434991.9	434991.0	
TBC (CFU/mL)	Minimal value	4000.0	8000.0	p>0.05
	1st Quartile	54250.0	220000.0	
	Median	162000.0	499000.0	
	3rd Quartile	722250.0	1709000.0	
	Maximal value	9999000.0	3990000.0	
	Mean	1074105.0	1259286.0	
	Standard deviation	1985404.0	1481939.0	

Median values followed by different letters indicate significant differences between the tank types according to Mann-Whitney non-parametric test.

As regards the milking type, 55.88% farms employed a milking machine; however, the adopted cleaning procedures were not adequate, since only 17.65% performed all necessary procedures for hygienic milking and mastitis control such as washing of teats, pre-dipping, drying of teats, post-dipping, and adoption of dry cow therapy at the end of lactation. This routine, except for dry cow therapy, was practiced by 2.94%. The majority (55.88%) performed only some of these practices, while 23.53% carried out milking without any previous cleaning care. Basic procedures such as washing under running water and drying of teats reduce the number of bacteria on the teats; however, such a reduction is more efficient if associated with antisepsis (14).

Correlation of the variables daily production of cows, SCC and TBC of the tank with the milking type showed a significant difference ($p<0.01$) for the production median in cases of mechanical milking. At farms with mechanical milking, milk production median was 10.00 litters, compared to 5.00 litters at those with manual milking and 4.17 litters in cases of manual and mechanical milking (Table 2).

Table 2. Descriptive measures of variables according to the type of milking used at the studied farms, Botucatu-SP, 2010.

Variable	Descriptive measure	Type of milking			p value
		Manual	Mechanical	Manual and Mechanical	
Mean production (L/cow/day)	Minimal value	2.00	3.13	1.88	p<0.01
	1st Quartile	3.30	7.23	2.45	
	Median	5.00[a]	10.00[b]	4.17[a]	
	3rd Quartile	7.15	13.48	4.48	
	Maximal value	10.00	35.97	4.58	
	Mean	5.29	11.34	3.54	
	Standard deviation	4.78	6.50	1.46	
SCC (cells/mL)	Minimal value	4000.0	86000.0	91000.0	p>0.05
	1st Quartile	201000.0	245750.0	149000.0	
	Median	388000.0	351000.0	323000.0	
	3rd Quartile	590000.0	602500.0	720500.0	
	Maximal value	1335000.0	2586000.0	853000.0	
	Mean	442111.1	493000.0	422333.3	
	Standard deviation	291503.9	423538.4	390591.0	
TBC (CFU/mL)	Minimal value	8000.0	4000.0	220000.0	p>0.05
	1st Quartile	85000.0	33750.0	270000.0	
	Median	271000.0	113000.0	420000.0	
	3rd Quartile	1754750.0	578750.0	2858250.0	
	Maximal value	5783000.0	9999000.0	3671000.0	
	Mean	1221845.0	977039.6	1437000.0	
	Standard deviation	1778501.0	2054403.0	1937284.0	

Median values followed by different letters indicate significant differences among the milking types according to Kruskal-Wallis non-parametric test

The use of mechanical milking by 55.88% farms shows their interest in automation. Production at farms with mechanical milking was higher. Milking automation is positive to the farm management, but the equipment maintenance and cleaning should be respected, following the good production practices (15). Accumulation of dirt, milk residues and bacteria favors the occurrence of mastitis since milking is the major opportunity for microorganism transmission (16), as well as for an increase in TBC and a fall in milk quality (17).

As to technical assistance, 17.65% farms did not receive any type of support, 17.65% received community assistance from "Casa da Lavoura", 55.88% received private assistance and 8.82% concomitantly received community and private assistance. A large number of producers did not search for support and guidance as to sanitary management of the herd and production improvement.

Association between the type of technical assistance and mean milk production, SCC and TBC indicated that farms receiving private or community assistance had higher production and lower SCC. TBC values varied, making the analysis difficult. The highest value (9,999,999 CFU/mL) was reached by a farm without any technical assistance and the lowest value (4,000 CFU/mL) by a farm with private technical assistance. Considering medians, the lowest TBC was obtained by a farm with private technical assistance, followed by farms with community assistance and those without assistance; however, there was no significant difference between the latter, reflecting the importance of technical assistance to control milk quality. The importance of technical assistance and rural extension for small farmers was also remarked by Santos et al. (18). The variables daily production of cows, SCC and TBC of the tank, correlated to the type of technical assistance, are shown in Table 3.

Table 3. Descriptive measures of variables according to the type of technical assistance received at the studied farms. Botucatu-SP, 2010.

Variable	Descriptive measure	Type of technical assistance				p value
		None	Community[C]	Private	Community and Private	
Mean production (L/cow/day)	Minimal value	1.88	2.08	2.59	2.61	p<0.01
	1st Quartile	3.54	4.63	5.06	3.71	
	Median	5.68[a]	5.88[a]	8.21[b]	7.50[ab]	
	3rd Quartile	7.41	7.84	12.94	8.65	
	Maximal value	12.50	14.22	35.97	8.89	
	Mean	5.91	6.60	10.20	6.48	
	Standard deviation	3.13	3.25	6.89	2.71	
SCC (cells/mL)	Minimal value	91000.0	86000.0	4000.0	204000.0	p<0.05
	1st Quartile	260500.0	315250.0	199750.0	378750.0	
	Median	533500.0[ab]	549000.0[b]	297000.0[a]	453000.0[ab]	
	3rd Quartile	832000.0	615000.0	487000.0	479250.0	
	Maximal value	1700000.0	906000.0	2586000.0	770000.0	
	Mean	634350.0	481421.1	405345.5	451857.2	
	Standard deviation	457452.8	217375.4	376822.5	169646.1	
TBC (CFU/mL)	Minimal value	10000.0	21000.0	4000.0	179000.0	p<0.01
	1st Quartile	98000.0	111000.0	27000.0	238500.0	
	Median	371000.0[ab]	271000.0[ab]	77000.0[a]	2047000.0[b]	
	3rd Quartile	1701000.0	2002250.0	529000.0	4116000.0	
	Maximal value	9999000.0	5783000.0	5327000.0	7159000.0	
	Mean	1459400.0	1473947.0	666347.3	2462143.0	
	Standard deviation	2465307.0	2156116.0	1321782.0	2765553.0	

[C] Community technical assistance means assistance by "Casa da Lavoura"
Median values followed by different letters indicate significant differences among the technical assistance types according to Kruskal-Wallis non-parametric test

Farms receiving private assistance had milk production median of 8.21 litters, compared to 5.68 litters for farms without technical assistance and 5.88 litters for those receiving community assistance. Association between private and community technical assistance showed higher milk production, but without significant difference compared to the remaining types.

SCC and TBC were lower for farms receiving private technical assistance, relative to those receiving community assistance.

As shown in Table 4, on average 15.4% farms had SCC values superior to 750,000 cells/mL and 27.8% had TBC values superior to 750,000 CFU/mL, above the limits in force at the moment of this study, suggesting the importance of establishing an educational program aimed at improving milk quality.

Table 4. Distribution of SCC and TBC values for the 35 assessed farms. Botucatu- SP, 2010.

	Collection			Mean
	1st	2nd	3rd	
SCC (cells/mL)				
≤ $4x10^5$ n (%)	21 (60)	20 (57.1)	17 (50)	19 (55.7)
between $4x10^5$ and $7.5x10^5$ n (%)	11 (31.4)	8 (22.9)	11 (32.4)	10 (28.9)
> $7.5\ x10^5$ n (%)	3 (8.6)	7 (20)	6 (17.6)	5 (15.4)
Total n (%)	35 (100)	35 (100)	34 (100)	
TBC (CFU/mL)				
≤ $1x10^5$ n (%)	10 (28.6)	15 (42.9)	14 (41.2)	13 (37.6)
between $1x10^5$ and $7.5x10^5$ n (%)	15 (42.8)	9 (25.7)	12 (35.3)	12 (34.6)
> $7.5x10^5$ n (%)	10 (28.6)	11 (31.4)	8 (23.5)	10 (27.8)
Total n (%)	35 (100)	35 (100)	34 (100)	

Results of the procedures used in the milking management and their influence on SCC are shown in Table 5. There was no significant difference in SCC for farms that performed washing, pre-dipping, cleaning with cloth or paper towel, post-dipping or dry cow therapy, compared to those that did not carry out such procedures. Association between the latter and SCC indicated non-significant difference among farms probably because the animals were more rustic and resistant to intramammary infections. Nevertheless, these procedures are essential to control mastitis, as well as to reduce both SCC and TBC in the milk

Table 5. Descriptive measures of SCC (cells/mL) mean values at the three collections according to the milking management type. Botucatu-SP, 2010.

Type of hygiene/procedure	Is it performed?		p value
	No	Yes	
Washing	465762 ± 261301[A] 462833 (173333; 1057000)[B]	464083 ± 274844 418500 (116000; 1368000)	p>0.05
Pre-dipping	451812 ± 195283 456667 (116000; 800000)	491879 ± 383662 3338333 (143667; 1368000)	p>0.05
Cleaning with cloth/paper towel	382695 ± 169908 368500 (173333; 638667)	509546 ± 299236 429667 (116000; 1368000)	p>0.05
Post-dipping	465768 ± 227351 456667 (116000;1057000)	462697 ± 344336 338333 (173333; 1368000)	p>0.05
Dry cow therapy	431667 ± 226284 429667 (116000; 1057000)	544233 ± 342498 391833 (276667; 1368000)	p>0.05

[A] Mean ± standard deviation
[B] Median (minimal value; maximal value)
There was no significant difference between the management types according to Mann-Whitney non-parametric test

CONCLUSIONS

The data obtained from the studied regions indicated that those small farmers have the potential to increase their production and improve milk quality, since they already refrigerate the product and show a certain automation degree. The implantation of IN 51 seems to have had little influence on the farmers, resulting in minimal improvement in milk quality for some farms, which suggests the need of direct actions to stimulate improvements, such as payment for quality, technical support and constant training of workers.

Consequently, the produced milk will be safe food of high quality both for own consumption, for the industry in the processing and preparation of by products, and especially for the final consumer.

The present results show the reality of the milk supply chain in Brazil, where farms have highly different characteristics and animals have highly variable genetic traits and production, while a large number of farms produce milk below the quality standards desired by MAPA, especially considering SCC and TBC/mL milk. This study evidences the need of establishing an educational program for farmers and stimulating higher quality milk production by granting bonuses to the farmers based on the quality of the milk produced and delivered to the dairy plant.

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REFERENCES

1. Costa EO. Importância econômica da mastite infecciosa bovina. Comun Cient Fac Med Vet Zootec Univ São Paulo. 1991;15(1):21-6.

2. Fagundes H, Oliveira CAF. Infecções intramamárias causadas por *Staphylococcus aureus* e suas implicações em saúde pública. Cienc Rural. 2004;34(4):1315-20.

3. Ministério da Agricultura, Pecuária e Abastecimento (BR). Instrução Normativa nº 51, de 20 de Setembro de 2002. Diário Oficial da União. 2002;Sec 1:13.

4. Ministério da Agricultura, Pecuária e Abastecimento (BR). Instrução Normativa n° 62, de 29 de Dezembro de 2011. Diário Oficial da União. 2011;Sec 1:6.

5. Mota RA, Pinheiro Júnior JW, Silva DR, Silveira NSS, Gomes SM, Silva LBG, et al. Etiologia da mastite subclínica em bovinos da bacia leiteira do estado de Pernambuco. Rev Napgama. 2004;7(1):10-3.

6. Guimarães FF, Nóbrega DB, Richini-Pereira VB, Marson PM, Pantoja JCF, Langoni H. Enterotoxin genes in coagulase-negative and coagulase-positive staphylococci isolated from bovine milk. J Dairy Sci. 2013;96(5):2866-72.

7. Pinto JPAN, Izidoro TB. Qualidade do leite: a Instrução Normativa n° 51/MAPA e os novos paradigmas. Hig Aliment. 2007;21(1):14-6.

8. Nero LA, Viçosa GN, Pereira FEV. Qualidade microbiológica do leite determinada por características de produção. Cienc Tecnol Aliment. 2009;29(2):386-90.

9. Zoccal R. Cem recomendações para o bom desempenho da atividade leiteira. Comun Tec, Juiz de Fora. 2004;39:1-8.

10. Lopes AD, Oliveira MDS, Fonseca MI. Características técnicas das propriedades de baixa escala leiteira observadas na área de abrangência do escritório de desenvolvimento rural de Jaboticabal – SP. Rev Cienc Ext. 2010;6(2):32-45.

11. Brito JRFB, Pinto SM, Souza GN, Arcuri EF, Brito MAVP, Silva MR. Adoção de boas práticas agropecuárias em propriedades leiteiras da Região Sudeste do Brasil como um passo para a produção de leite seguro. Acta Sci Vet. 2004;32(2):125-31.

12. Nero LA, Mattos MR, Beloti V, Barros MAF, Pinto JPAN, Andrade NJ, et al. Leite cru de quatro regiões leiteiras brasileiras: perspectivas de atendimento dos requisitos microbiológicos estabelecidos pela Instrução Normativa 51. Cienc Tecnol Aliment. 2005;25(1):191-5.

13. Souza V, Nader Filho A, Ferreira LM, Cereser ND. Características microbiológicas de amostras de leite de tanque comunitário. Arq Bras Med Vet Zootec. 2009;61(3):758-61.

14. Brito JRF, Brito MAVP, Verneque RS. Contagem bacteriana da superfície de tetas de vacas submetidas a diferentes processos de higienização, incluindo a ordenha manual com participação do bezerro para estimular a descida do leite. Cienc Rural. 2000;30(5):847-50.

15. Santos MV. Boas práticas de produção associadas à higiene de ordenha e qualidade do leite. In: Carvalho MP, Santos MVO. Brasil e a nova era do mercado do leite: compreender para competir. 1a ed. Piracicaba: Agripoint Ltda; 2007. p.135-54. v.1.

16. Smith TH, Fox LK, Middleton JR. Outbreak of mastitis caused by one strain of *Staphylococcus aureus* in closed dairy herd. J Am Vet Med Assoc. 1998;212(4):553-6.

17. Amaral LA, Isa H, Dias LT, Rossi OD, Nader FA. Avaliação da eficiência da desinfecção de teteiras e dos tetos no processo de ordenha mecânica de vacas. Pesqui Vet Bras. 2004;24(4):173-7.

18. Santos NW, Weirich Neto PH, Looddi MM, Rocha CH. Tecnologia desmistificada como base de extensão rural. Rev Conex UEPG. 2009;5(1):70-4.

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