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Physicochemical and Microbiological Characteristics of Milk of a Dairy Industry of Municipality of Juína, MT, Brazil

Características Físico-Químicas e Microbiológicas do Leite de uma Indústria de Laticínios do Município de Juína, MT, Brasil

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Abstract

The quality of raw milk is essential to ensure food safety and to standardize dairy production in Brazil. Normative Instruction 76/2018, issued by the Ministério da Agricultura, Pecuária e Abastecimento (MAPA), establishes standards for milk composition and microbiological counts, serving as a reference for both dairy producers and the industry. This study aimed to evaluate the compliance of milk received by a dairy plant in Juína/MT between 2013 and 2018 with the criteria established by IN 76/2018. Quality control reports of refrigerated raw milk were analyzed, focusing on fat content, Non-fat Dry Extract (NFDE), Somatic Cell Count (SCC), and Standard Plate Count (SPC). Results showed that fat and NFDE levels consistently remained within the normative standards, indicating an adequate nutritional profile of the milk. Regarding SCC and SPC, although monthly averages generally remained within the legal limits, certain months presented values above the established thresholds, highlighting isolated failures in management, hygiene, and refrigeration practices. These deviations did not display a consistent seasonal or temporal pattern, suggesting that nonconformities were primarily related to operational factors rather than environmental conditions. In conclusion, while some milk quality parameters complied with the current legislation, challenges remain in improving overall quality. Enhanced handling, storage, hygiene, and transportation procedures are essential to guarantee that raw milk consistently meets the regulatory standards, ensuring both industrial efficiency and consumer safety.

Keywords: Milk quality. Somatic Cell Count. Standard Plate Count. Milk fat. Milk composition.

Resumo

A qualidade do leite cru é essencial para garantir a segurança alimentar e a padronização da produção leiteira no Brasil. A Instrução Normativa 76/2018, publicada pelo Ministério da Agricultura, Pecuária e Abastecimento (MAPA), estabelece padrões para a composição do leite e contagens microbiológicas, servindo como referência tanto para produtores quanto para a indústria. Este estudo teve como objetivo avaliar a conformidade do leite recebido por uma indústria de laticínios em Juína/MT, entre 2013 e 2018, com os critérios estabelecidos pela IN 76/2018. Foram analisados relatórios de controle de qualidade do leite cru refrigerado, com foco em teor de gordura, Extrato Seco Desengordurado (ESD), Contagem de Células Somáticas (CCS) e Contagem Padrão em Placas (CPP). Os resultados mostraram que os teores de gordura e ESD permaneceram dentro dos padrões normativos, indicando perfil nutricional adequado do leite. Quanto à CCS e CPP, embora as médias mensais tenham ficado usualmente dentro dos limites legais, alguns meses apresentaram valores acima dos limites estabelecidos, evidenciando falhas pontuais no manejo, higiene e refrigeração. Essas variações não apresentaram padrão sazonal ou temporal consistente, sugerindo que as não conformidades estiveram relacionadas principalmente a fatores operacionais, e não a condições ambientais. Conclui-se que, embora alguns parâmetros atendam à legislação vigente, ainda existem desafios para a melhoria da qualidade do leite, sendo necessário aprimorar o manejo, a higiene, o armazenamento e o transporte para garantir a conformidade com as normas e assegurar eficiência industrial e segurança do consumidor.

Palavras-chave: Qualidade do Leite. Contagem de Células Somáticas. Contagem Padrão em Placas. Gordura. Composição do Leite.

1 Introduction

Dairy farming plays a significant role in Brazil’s agricultural sector. It is practiced across nearly the entire country, generating millions of direct and indirect jobs throughout its production chain and contributing billions of reais to the national agribusiness economy (IBGE, 2017).

In the municipality of Juína, located in the northwest region of Mato Grosso state, dairy farming is also a key agricultural activity, particularly among small and medium-sized producers. Predominantly embedded within the framework of family farming, this sector serves as a vital source of income, employment, and socio-economic development for the local community (IBGE, 2023).

Beyond providing a steady year-round revenue, milk production fosters rural population retention and strengthens the local economy, positioning itself as a cornerstone of the region's productive structure.

Despite its social and economic importance, one of the main challenges faced by the dairy industry is ensuring the high quality of raw milk. Milk quality is critical not only to comply with legal and food safety standards but also to maintain the competitiveness of the supply chain and consumer's trust. Multiple interrelated factors affect milk composition and hygiene, which can be broadly classified into nutritional, sanitary, and environmental categories (Ströher; Santos Júnior; Salazar, 2023). When these factors are inadequately managed, they compromise product integrity, elevate public health risks, and result in economic losses for both producers and industry.

Key indicators commonly used to assess milk quality include fat content, non-fat dry extract, somatic cell count, and standard plate count. These parameters not only ensure compliance with legal food safety regulations but also directly impact industrial yields in the manufacturing of cheese, yogurt, and other dairy products. Moreover, producer's remuneration is frequently based on quality payment systems that prioritize these indicators in milk pricing (Botaro *et al.*, 2011).

To establish minimum quality standards for milk production in Brazil, Normative Instruction No. 76/2018 issued by the Ministry of Agriculture, Livestock, and Supply (MAPA) defines essential criteria to guarantee milk quality and safety throughout the production process. These regulations are vital for the dairy industry, ensuring that milk meets consumption standards while promoting continuous improvements in the quality of the national product (Brasil, 2018).

Recognizing the crucial role of milk quality across the entire production chain, this study aims to evaluate the compliance of raw milk received by a dairy processing plant in Juína, Mato Grosso, from 2013 to 2018, with respect to the physicochemical and microbiological parameters mandated by current legislation.

2 Material and Methods

This study utilized a database comprising physicochemical and microbiological analysis records of cow's milk samples from 180 producers associated with a dairy processing plant located in the municipality of Juína, Mato Grosso. The data spanned six years, from January 2013 to December 2018, providing a comprehensive assessment of milk quality parameters over time.

The variables analyzed included fat content, non-fat dry extract (NFDE), somatic cell count (SCC), and standard plate count (SPC). All the physicochemical and microbiological analyses were performed by the Milk Quality Laboratory at the Universidade Federal de Goiás (UFG), a member of the Brazilian Network of Milk Quality Control Laboratories, accredited by the MAPA (Brasil, 2002). Samples were submitted monthly by the dairy plant in accordance with the guidelines of the National Milk Quality Program (PNQL).

Each variable was determined using specific analytical methods and appropriate instrumentation. Fat content was measured by near-infrared spectroscopy (NIR) using the Milkoscan 4000 (Foss Electric A/S, Hillerød, Denmark) and Lactoscope (Delta Instruments, Drachten, Netherlands), following ISO 9622:2013 standards set by the International Organization for Standardization (ISO, 2013). The NFDE was calculated by subtracting the fat content from total solids, using the formula: NFDE = Total Solids – Fat (BEHMER, 1987). The SCC was assessed via flow cytometry using the Bentley Combi System 2300 (Bentley Instruments Incorporated, Chaska, USA), while SPC was also determined by flow cytometry with the BactoCount IBC (Bentley Instruments Incorporated, Chaska, USA).

To facilitate the result interpretation, monthly and annual averages were computed, enabling detailed analysis of temporal trends and seasonal variations. Statistical analyses were conducted using Sisvar 5.6 software, applying analysis of variance (ANOVA) and the Scott-Knott multiple comparison test at a significance level of 0.05.

3 Results and Discussion

To properly interpret the results presented in this study, it is essential to consider both the regulations in effect during the study period (2013 to 2018) and the current regulation, as they define the legal thresholds for the parameters used to assess milk quality.

From January 2012 to November 2018, Brazilian dairy production was governed by Normative Instruction No. 62/2011 (Brasil, 2011), which was replaced by Normative Instruction Nº 76/2018 (Brasil, 2018) in May 2019. Both regulations established the same minimum and maximum limits for the key parameters analyzed in this study: minimum fat content (3.0%), non-fat dry extract (8.4%), somatic cell count below 500,000 cells/mL, and standard plate count below 300,000 CFU/mL. Therefore, despite the regulatory change during the study period, the reference thresholds used for data analysis remained consistent, allowing for direct comparison of the results with current standards.

Table 1 – Fat content (%) in raw bovine milk samples from a dairy plant in Juína, Mato Grosso, from 2013 to 2018

	Years						
Months	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**Mean**
January	3.28	3.45	3.36	3.27	3.35	3.40	3.35^b
February	3.34	3.45	3.40	3.43	3.57	3.35	3.42^a
March	3.32	3.29	3.57	3.57	3.45	*	3.43^a
April	3.30	*	3.44	3.46	3.48	3.58	3.44^a
May	3.33	*	3.31	3.31	*	3.59	3.31^b
June	3.49	3.25	3.30	3.53	*	3.49	3.40^a
July	3.41	3.10	3.71	3.62	3.20	3.31	3.31^b
August	*	3.07	3.31	3.43	3.23	2.95	3.19^c
September	*	3.04	3.03	3.31	3.19	3.04	3.13^d
October	3.19	3.27	3.01	*	3.01	2.99	3.12^d
November	3.28	*	3.11	3.37	3.23	*	3.25^c
December	3.28	*	3.28	3.81	3.18	3.38	3.37^b
Mean	3.32^B	3.24^B	3.30^B	3.46^A	3.28^B	3.31^B	

*Analyses not performed by the dairy plant; Different lowercase letters in the same column indicate significant differences ($p<0.05$) between months; Different uppercase letters in the same row indicate significant differences ($p<0.05$) between years.
Source: research data.

Milk fat is one of the most relevant constituents of milk due to its direct contribution to flavor and yield in the production of dairy products such as butter, cheese, yogurt, and cream cheese. According to Oliveira and Santos (2012), fat is the milk component most susceptible to variations in its concentration, influenced by a range of intrinsic and extrinsic factors, including diet, body condition, breed, health status, ambient temperature, among others.

The fat content of raw bovine milk collected in the municipality of Juína, Mato Grosso, between 2013 and 2018 showed significant variations across months and years (Table 1). According to Normative Instruction No. 76/2018 (Brasil, 2018), the minimum fat content for refrigerated raw milk must be 3.0 g/100g. Overall, the average values observed were within the required standards, except for the months of August (2.95%) and October (2.99%) of 2018, during which individual averages were slightly below the minimum regulated value.

Similar values were reported in a study by Guimarães, Caetano and Rosalem (2016), who evaluated the physicochemical and microbiological quality of refrigerated raw milk received by a dairy plant in the state of Goiás from 2006 to 2015, with average values falling within the legal standards. The authors emphasized that compliance with the minimum fat content established by the legislation is favorable for the dairy industry, as it allows for better yield and quality in the production of dairy products.

Statistical analysis revealed a significant difference ($p < 0.05$) between the months, with the lowest fat contents recorded in September (3.13%) and October (3.12%), which are characteristic months of the dry season in the region. This reduction can be attributed to the decreased availability and quality of pastures typical of the dry season, which compromises the intake of effective fiber—a key component for the production of volatile fatty acids in the rumen, which are directly linked to milk fat synthesis (Coelho *et al.*, 2023).

Another important factor is the strategic use of concentrates in cow diets during the dry season. Although this is a common practice to maintain milk production when forage supply is limited, the literature indicates that a higher proportion of concentrate in the diet tends to reduce milk fat content proportionally, especially when fiber intake is simultaneously reduced (Gonzalez; Campos, 2003; Férrer *et al.*, 2018). This situation may help explain the lower fat levels observed between August and October.

Conversely, the highest fat contents were observed in February (3.42%), March (3.43%), and April (3.44%), which corresponds to the transition from summer to autumn. During this period, there is usually greater availability of pasture with better nutritional quality, which promotes higher dry matter intake and efficient ruminal fermentation—both essential for the synthesis of volatile fatty acids. Thus, it is understood that seasonal variations in milk fat content are strongly associated with nutritional management, particularly the availability and quality of forage throughout the year.

The trend observed in this phase of the study aligns with the findings of Oliveira and Timm (2006), Milani *et al.* (2016), and Barbosa, Costa and Bombonato *et al.* (2021), who also reported similar seasonal fluctuations in milk fat content across different regions. These results support the current understanding that factors such as diet and climate conditions exert a direct influence on this milk component.

When analyzing the annual variation in fat content, 2016 stood out with significantly higher levels compared to the other years evaluated. This indicates that, in addition to seasonal effects, other factors likely contributed to the improved results. It is plausible that nutritional management was more effective during that year, or that climatic conditions were particularly favorable for the development of higher-quality pastures, thereby enhancing nutrient intake and promoting greater milk fat synthesis. The potential impact of genetic improvements within the local herd should also be considered, as advancements in breeding may have increased the animals' productive efficiency. These findings underscore the critical role of the interplay among nutritional strategies, environmental conditions, and genetic progress in determining milk quality.

Table 2 - Non-fat dry extract (%) in raw bovine milk samples from a dairy plant in Juína, Mato Grosso, from 2013 to 2018

	Years						
Months	2013	2014	2015	2016	2017	2018	Mean
January	8.78	8.79	8.90	8.96	8.64	8.82	8.82[a]
February	8.86	8.79	8.88	8.92	8.80	8.77	8.84[a]
March	8.64	8.56	8.78	9.11	8.78	*	8.76[b]
April	8.74	*	8.8	8.84	8.70	8.99	8.81[a]
May	8.72	8.84	8.86	8.68	*	8.87	8.79[a]
June	8.78	8.54	8.85	8.69	*	8.84	8.73[b]
July	8.65	8.62	8.76	8.76	8.73	8.76	8.69[c]
August	*	8.67	8.60	8.52	8.41	8.58	8.57[d]
September	*	8.79	8.55	8.60	8.66	8.43	8.59[d]
October	8.82	8.74	8.77	*	8.76	8.46	8.73[b]
November	8.83	*	8.89	8.87	8.80	*	8.85[a]
December	8.83	*	8.89	8.86	8.86	8.87	8.86[a]
Mean	8.77[A]	8.70[B]	8.80[A]	8.81[A]	8.72[B]	8.74[B]	

*Analyses not performed by the dairy plant; Different lowercase letters in the same column indicate significant differences ($p<0.05$) between months; Different uppercase letters in the same row indicate significant differences ($p<0.05$) between years.
Source: research data.

The non-fat dry extract (NFDE) includes all milk solids excluding water and fat, and is primarily composed of proteins, carbohydrates, minerals, and vitamins. This parameter is highly relevant to the dairy industry, as higher NFDE levels are directly associated with better yields in the production of dairy derivatives (Barbosa; Costa; Bombonato, 2021). Conversely, lower NFDE values may indicate a reduction in key milk solids such as protein and lactose (Oliveira *et al.*, 2024).

In the present study, NFDE levels showed significant monthly variation ($p<0.05$), as shown in Table 2, reflecting seasonal changes in milk composition. Despite such fluctuations, in all the years analyzed the values remained above the minimum threshold of 8.4 g/100g established by Normative Instruction No. 76/2018 (Brasil, 2018) for refrigerated raw milk, indicating that regional production met the required quality standards for this parameter. A similar outcome was reported by Ströher *et al.* (2025), who analyzed the quality of refrigerated raw milk samples from a dairy plant in the state of Rio Grande do Sul, finding NFDE levels ranging from 8.39% to 9.05%, all within the limits defined by the current legislation.

The lowest NFDE values were recorded in August (8.57%) and September (8.59%), coinciding with the driest period of the year in the region. This reduction is likely linked to decreased forage availability and quality, as nutritional deficiencies directly impact the synthesis of milk solids such as protein and lactose—main components of NFDE (Carvalho; Bruhn; Fari, 2024). Notably, this period also saw the lowest fat content values (Table 1), reinforcing the hypothesis that nutritional stress during the dry season broadly affects the milk composition.

Conversely, the highest NFDE levels were recorded between November and February, which marks the beginning and peak of the rainy season, when pastures typically improve in nutritional quality. During this phase, higher dry matter intake and better energy balance are observed, enhancing ruminal metabolism and the synthesis of milk solids (Carvalho; Bruhn; Fari, 2024). This trend was also reflected in fat content values, reinforcing the consistent influence of nutritional and climatic factors on key indicators of milk quality.

Similar findings have been reported in studies by Gonzalez *et al.* (2004), Silva *et al.* (2010), and Neiva Júnior *et al.* (2021) in different regions of Brazil. These authors found that milk produced during the rainy season showed higher quality indices, particularly with respect to increased NFDE levels, compared to those recorded during the dry season.

Annual NFDE averages ranged from 8.70% in 2014 to 8.81% in 2016. Notably, 2016 also recorded the highest average fat content, suggesting that nutritional management conditions may have been more favorable that year. The results could also reflect more favorable climate conditions or even localized genetic improvements in the herd that positively influenced milk production and composition during that period.

The combined behavior of NFDE and fat content across months and years highlights their strong dependence on nutritional management, directly affecting the quality of milk delivered to the dairy plant. Although NFDE excludes fat from its calculation, both parameters are influenced by the same dietary foundation and metabolic performance. Therefore, continuous monitoring of these indicators is essential to identify production bottlenecks and guide seasonal supplementation strategies or management adjustments, ensuring regulatory compliance and consistency of raw material quality.

Table 3 - Somatic Cell Count (x10³ cells/ml) in raw bovine milk samples from a dairy plant in Juína, Mato Grosso, from 2013 to 2018

	Years						
Months	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**Mean**
January	256.99	249.21	236.23	230.30	271.84	241.56	247.01^{a}
February	243.52	249.21	227.25	199.67	265.84	265.66	241.08^{a}
March	280.15	360.23	251.62	296.24	314.27	*	298.48^{b}
April	276.36	*	238.14	195.94	342.48	333.77	271.79^{b}
May	235.02	170.71	209.01	367.66	*	261.94	239.55^{a}
June	237.45	260.68	177.33	293.46	*	365.76	259.16^{a}
July	245.30	265.48	164.62	318.66	217.82	286.53	262.31^{a}
August	*	303.13	350.42	254.12	734.00	329.77	386.69^{c}
September	*	242.86	267.05	341.15	288.55	267.37	284.68^{b}
October	203.95	272.62	280.79	*	266.61	255.06	252.74^{a}
November	263.83	*	257.84	303.03	263.11	*	270.45^{b}
December	263.83	*	264.15	382.88	257.50	222.55	277.41^{b}
Mean	249.91^{A}	263.44^{A}	248.79^{A}	286.78^{B}	320.38^{C}	282.94^{B}	

*Analyses not performed by the dairy plant; Different lowercase letters in the same column indicate significant differences ($p<0.05$) between months; Different uppercase letters in the same row indicate significant differences ($p<0.05$) between years.

Source: research data.

Somatic Cell Count (SCC) is one of the key parameters used to assess milk quality and mammary gland health (Valente; Silva, 2023). According to Normative Instruction No. 76/2018 (Brasil, 2018), the maximum allowable SCC for refrigerated raw milk is 500,000 cells per milliliter. Elevated SCC levels not only reduce milk yield, quality, and industrial processing performance but are also directly associated with mastitis, compromising the animal's welfare and the producer's profitability (Sharun *et al.*, 2021).

Overall, the monthly SCC averages observed during the study period remained within the legal limit, suggesting that the herds maintained adequate sanitary conditions and that good milking practices were implemented in the region. However, August 2017 recorded an exceptionally high SCC value of 734,000 cells/mL, characterizing an atypical non-compliance event. Although the dry climate typical of this period may promote heat stress in animals, weakening the immune system and increasing the incidence of subclinical mastitis (Bueno *et al.*, 2005), the sharp increase observed that month suggests a localized, isolated occurrence. Possible contributing factors include mastitis outbreaks in one or more supplying herds, deficiencies in milking hygiene, milk cooling failures, or even the inclusion of a new supplier producing low-quality milk (Valente; Silva, 2023). This abrupt increase highlights the importance of conducting a more detailed investigation into the management conditions prevailing during that period.

When evaluating overall monthly averages, significant differences were detected ($p<0.05$), with August showing the highest SCC mean (386,690 cells/mL). Although still within the legal threshold, this increase was strongly influenced by the August 2017 spike, demonstrating how isolated events can impact monthly averages and bias the assessment of overall herd health across suppliers.

Higher SCC averages were also observed in March, April, September, November, and December, ranging approximately between 270,000 and 300,000 cells/mL. Most of these months coincide with the rainy season in the region, when environmental conditions pose greater challenges to health. Increased humidity and muddy facilities favor the proliferation of mastitis-causing pathogens, making it difficult to maintain proper hygiene during milking and increasing the animals' exposure to health risks (Martins Júnior *et al.*, 2021). Other contributing factors may include shortcomings in herd health control, lack of early mastitis diagnosis, and overcrowded facilities (Oliveira *et al.*, 2013).

In contrast, January, February, May, June, July, and October recorded the lowest SCC averages, ranging from 239,000 to 262,000 cells/mL. These months are distributed between the dry season and the beginning of the rainy season, suggesting no clear seasonal pattern for the lower concentrations. This temporal distribution indicates that, during these months, herd management and sanitary conditions were likely more effective regardless of the season. Proper hygiene during milking, adequate facility maintenance, and sound animal health management, such as early identification and treatment of mastites, likely contributed to keeping SCC within the recommended levels (Andrade *et al.*, 2014).

Several studies conducted in different regions of Brazil have reported a wide range of SCC results. Vasconcelos *et al.* (1997), for instance, found no differences between SCC levels in milk samples collected during the summer and the winter in São Paulo. Conversely, Simioni *et al.* (2014) observed higher averages in summer months in Santa Catarina, while Noro *et al.* (2006) reported SCC peaks in May in Rio Grande do Sul. These findings highlight the impact of climatic and production diversity across the regions on SCC variability.

Among the years analyzed, 2017 had the highest annual SCC average (320,380 cells/mL), differing statistically from the other years ($p<0.05$). This increase may be linked to various factors that compromised milk quality during that period, including mastitis control failures, challenges in herd health management, or structural changes among supplying farms. It is noteworthy that August 2017 also recorded the highest individual SCC value, which likely contributed significantly to the annual average.

Table 4 - Standard Plate Count (×10² CFU/mL) in raw bovine milk samples from a dairy plant in Juína, Mato Grosso, from 2013 to 2018

	Years						
Months	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**Mean**
January	1277.50	515.10	2224.26	2321.60	10212.86	1725.12	2522.80[a]
February	1532.08	515.10	893.32	739.29	10479.53	5802.88	2863.34[b]
March	1225.34	2333.23	1101.50	1303.59	4646.10	*	1972.38[a]
April	2200.00	*	1404.30	2514.80	1549.43	1231.66	1805.46[a]
May	2230.05	1145.34	2024.28	3540.76	*	1345.96	2011.09[a]
June	813.12	1254.91	935.36	932.64	*	13594.84	3015.19[b]
July	997.75	550.86	313.12	1613.28	2472.19	2525.17	1478.90[a]
August	*	681.93	3727.25	1958.05	3731.56	1508.73	2275.37[a]
September	*	3739.26	6023.87	1869.38	5872.43	3586.51	4371.25[c]
October	5813.03	1566.60	1230.01	*	995.77	3397.69	2803.92[b]
November	1163.01	*	4099.61	4431.71	4411.48	*	3287.85[b]
December	1163.01	*	2875.55	7890.11	4044.85	3683.94	3672.35[c]
Mean	1906.45[B]	1167.11[A]	2331.80[B]	2627.67[B]	4725.01[D]	3856.25[C]	

*Analyses not performed by the dairy plant; Different lowercase letters in the same column indicate significant differences ($p<0.05$) between months; Different uppercase letters in the same row indicate significant differences ($p<0.05$) between years.
Source: research data.

Standard Plate Count (SPC) is a widely used microbiological parameter to assess the hygienic-sanitary quality of milk, reflecting milking practices, utensil hygiene, cooling procedures, and transportation conditions to the processing facility (Coelho *et al.*, 2019). According to IN 76/2018 (Brasil, 2018), the maximum permissible SPC in refrigerated raw milk is 300,000 colony-forming units per milliliter (CFU/mL). Values exceeding this threshold indicate deficiencies in hygiene practices and may compromise both consumer's health and industrial milk yield.

During the evaluated period, January (1,072,000 CFU/mL) and February (1,021,500 CFU/mL) of 2017, as well as June 2018 (1,359,484 CFU/mL), exceeded 1,000,000 CFU/mL, reflecting critical instances of microbiological non-compliance. These peaks are likely associated with operational shortcomings in milk collection and storage, such as insufficient cleaning of utensils and expansion tanks, inadequate refrigeration, or the inclusion of new producers without adequate training in good milking practices (Martins Júnior *et al.*, 2021). Furthermore, lack of strict cold-chain management and handling under adverse environmental conditions, such as elevated temperatures or sudden fluctuations, may have favored bacterial proliferation (Martins; Pieruzzi, 2011). The absence of similar peaks in corresponding months of other years supports the hypothesis that these incidents stem from isolated operational and hygiene failures rather than seasonal effects.

Regarding monthly averages, June, September, November, and December exceeded the legal limit, with values ranging from 301,519 to 437,125 CFU/mL. These results indicate recurrent deficiencies in hygienic-sanitary control, reflecting a lack of standardization, inadequate monitoring of milk quality, and insufficient corrective measures. The occurrence of these months across both the dry and early rainy seasons suggests no consistent seasonal pattern, implying that these spikes are more closely related to operational management deficiencies and the limited technical training of producers than to climate-related factors (Andrade *et al.*, 2014).

Conversely, January, March, April, May, July, and August exhibited the lowest monthly SPC averages, all below 300,000 CFU/mL. Martins and Pieruzzi (2011) suggest that the rainy season can increase SPC by promoting environmental contamination, mud accumulation in facilities, and a higher incidence of dirty teats during milking. In this study, although some of these months fall within the dry season, consistently good results during transitional and rainy periods reinforce the notion that milk microbiological quality depends primarily on the consistent implementation of good management practices, regardless of season (Reche *et al.*, 2015).

Similar findings were reported by Dias *et al.* (2015) in Goiás and by Andrade *et al.* (2014) in Rio Grande do Norte. Both studies found little variation in SPC values across different periods of the year, attributing differences primarily to hygienic management failures and infrastructural limitations. These observations underscore the importance of continuous producer training and systematic production monitoring as effective strategies for ensuring compliance with established quality standards.

On an annual basis, 2017 presented the highest average SPC (472,501 CFU/mL), statistically distinct from other years ($p<0.05$). This outcome is likely influenced by the peaks in January and February, which significantly affected the annual mean and indicate isolated episodes of severe hygienic-sanitary impairment. In contrast, 2014 recorded the lowest average SPC (116,711 CFU/mL), reflecting a period of higher sanitary efficiency and microbiological control throughout the production chain. This improvement may be attributed to greater adherence to milk quality enhancement programs, enhanced technical training for producers, or more effective regulatory oversight by the dairy.

4 Conclusion

The raw milk received by the dairy industry in Juína/MT between 2013 and 2018 showed significant variations in the evaluated physicochemical and microbiological parameters, with some values exceeding the legal limits. Although average levels of fat and solids-not-fat remained within the minimum required standards concerning increases were observed in somatic cell counts (SCC) and total bacterial counts (TBC), indicating occasional deficiencies in milk quality and hygiene.

These variations reflect the multifactorial nature of milk quality, which depends on the interaction among nutritional management, environmental conditions, and hygienic-sanitary practices. This underscores the need for targeted interventions to control product quality and prevent losses across the production chain.

Therefore, although most samples complied with legal standards, the occurrence of values outside the recommended limits highlights the importance of continuous monitoring and the adoption of integrated management and sanitary control strategies to ensure the safety and quality of milk intended for industrial processing.

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