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Influence of the seasons on the quality and composition of milk from dairy farms in the northern region of Rio Grande do Sul, Brazil

Influência das estações do ano sobre a qualidade microbiológica do leite de fazendas leiteiras da região norte do Rio Grande do Sul, Brasil

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Abstract
This study aimed to verify the relationship between parameters of physicochemical composition, microbiological quality, and volume of milk delivered to a dairy in the northern region of Rio Grande do Sul, in 2020, at four different times of the year. For this, the parameters evaluated were volume, protein, fat, lactose, total solids, somatic cell count (SCC), and standard plate count (SPC). Data were collected in January, April, July, and October in 1,634 dairy farms located in the northern region of Rio Grande do Sul. Data were evaluated using Pearson's correlation, and the means were compared using the Tukey test, both at 5% significance. Milk fat and protein contents were higher during autumn (4.02 and 3.35%) and winter (3.90 and 3.36%, respectively), contributing to the higher solid's concentration in the same period. The microbiological quality of milk, especially the SCC, is compromised during the warmer months due to the thermal stress suffered by the animals, challenging the immune system and increasing susceptibility to diseases. The highest milk CPP in the winter period (247.12 x 10^3 CFU/mL) refers to the transfer of contamination from the teat to the tank due to the inefficiency of pre-milking procedures. Therefore, the microbiological quality of the milk was variable between the periods studied, and the fat and protein contents suffered reductions during the summer, reflecting in lower remuneration for quality, given the high CCS in the same season.
Keywords: Dairy cattle; Casein; Climatology; Standard plate count; Lactose.

Resumo
O objetivo desse estudo foi verificar a relação entre parâmetros da composição físico-química, qualidade microbiológica e volume de leite entregue a um laticínio na região Norte do Rio Grande do Sul, no ano de 2020, em quatro diferentes épocas do ano. Para isso, foram avaliados os parâmetros volume, proteína, gordura, lactose, sólidos totais, contagem de células somáticas (CCS) e contagem padrão em placas (CPP). Os dados foram coletados nos meses de janeiro, abril, julho e outubro, em 1.634 propriedades leiteiras localizadas na região Norte do Rio Grande do Sul. Os dados foram avaliados por meio da correlação de Pearson e as médias foram comparadas pelo teste de Tukey, ambos a 5% de significância. Os teores de gordura e proteína do leite foram maiores durante o outono (4,02 e 3,35%) e o inverno (3,90 e 3,36%, respectivamente), contribuindo para a maior concentração de sólidos no mesmo período. A qualidade microbiológica do leite, principalmente a CCS, é comprometida durante os meses mais quentes, em virtude do estresse térmico sofrido pelos animais, desafiando o sistema imune e aumentando a susceptibilidade a enfermidades. A maior CPP do leite no período de inverno (247,12 x 10^3 UFC/mL) remete à transferência de sujidades do teto para o tanque, em virtude da ineficiência dos procedimentos pré-ordenha. Portanto, a qualidade microbiológica do leite foi variável entre os períodos estudados, sendo que os teores de gordura e proteína sofreram reduções durante o verão, refletindo em menores remunerações por qualidade, visto a alta CCS na mesma estação.
Palavras-chave: Bovinocultura de leite; Caseína; Climatologia; Contagem padrão em placas; Lactose.

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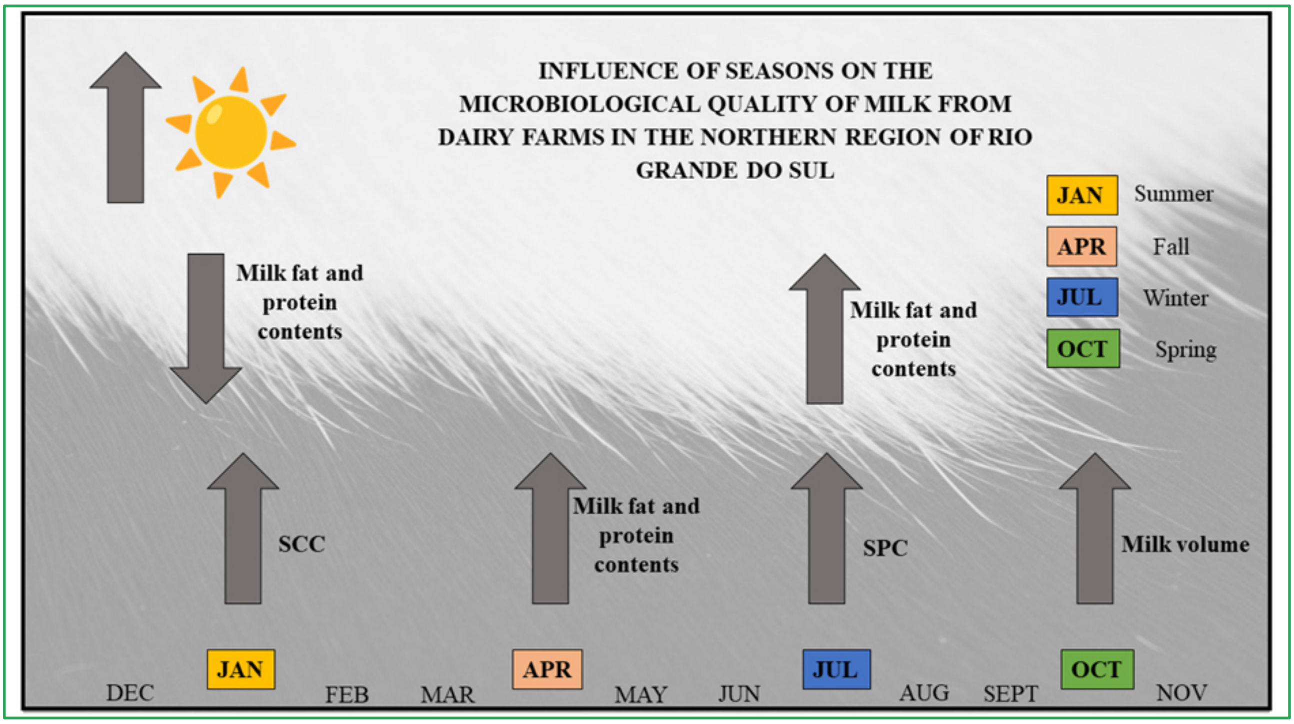

Graphical abstract: Influence of seasons on the microbiological quality of milk from dairy farms in the northern region of Rio Grande do Sul, Brazil.

Introduction

Dairy cattle farming in the South of Brazil is characterized by the presence of highly specialized herds and the adoption of appropriate management for this potential of the herd [1]. The activity stands out in the economic and social scenario due to its importance in the generation of jobs and income distribution, being one of the essential activities of Brazilian agriculture[2].

Knowing milk composition is essential to assess its potential as a raw material for industrialization. On average, cow's milk is composed of 87% water and 13% solid components, which are divided into about 4 to 5% carbohydrates, 3% protein, 3 to 4% lipids (mostly saturated), 0.8% minerals, and 0.1% vitamins[3]. Abreu et al.[4] used principal component analysis and identified that the variables total solids, lactose, and milk fat were those that most contributed to the differentiation between Holstein dairy herds. Thus, it shows the importance of these parameters for selecting animals to improve the milk quality of herds.

In this context, market globalization due to the large and varied supply of imported dairy products has induced Brazilian consumers to become more demanding in terms of product quality. As a result, the industry has modernized and demanded better quality milk from the producer in an attempt to become more competitive[5]. Considering that milk quality is one of the most discussed issues in dairy production, good production practices are essential to obtain milk within the minimum requirements required by current legislation (IN 76/2018). Therefore, quality bonus processes have become a decisive stimulus for the adoption of good production practices.

The seasons of the year, hygienic and sanitary management in the dairy farms, animal stress, lactation phase, and adequate productive and reproductive management can change milk quantity and quality[6]. Seasonal differences in milk production can be caused by periodic alterations in temperature and humidity throughout the year, which have a direct effect by reducing dry matter intake and an indirect effect by fluctuating food quantity and quality[7]. Another parameter affected by climate seasonality is milk composition, possibly because of the different compositions of the available feeds provided to cows in different seasons associated with the effect of ambient temperature[8].

In this context, this study aimed to verify the relationship between parameters of physicochemical composition, microbiological quality, and volume of milk delivered to a dairy in the northern region of Rio Grande do Sul, Brazil, at four different times in 2020.

Material and methods

This research is characterized as a descriptive quantitative study, as it brings information regarding a database of a dairy company located in the northern region of Rio Grande do Sul, Brazil. The soil of the region is classified as a Red Latosol (Oxisol), with a humid subtropical climate (Cfa), according to the Köppen classification, and an average temperature of around 18 °C throughout the year.

Dairy farms were configured as small-and medium-sized properties, which exclusively used family labor. The semi-confined production system, characterized by supplementation of concentrate and forages preserved in the trough, mainly corn (*Zea mays* L.) silage, was predominant. The main forage species used in the grazing system during the winter were oat (*Avena sativa*), ryegrass (*Lolium multiflorum*), and the dual-purpose wheat BRS Tarumã (in about 10% of the farms that adopt the integrated crop-livestock system). The diets during the summer were based on silage, as the arable areas were occupied by corn and soybean. However, Tifton 85 (*Cynodon* spp.) and millet (*Pennisetum glaucum*) were mostly used. The farms had natural and artificial drinking troughs to supply the herd with water in pasture areas and close to the management center, respectively.

The herds were composed mainly of Holstein cows, specialized in milk production. Animal milking was performed twice a day (07:00 and 16:30) by means of mechanical milking. Pre-and post-milking procedures were performed on all farms, according to technical guidelines for management and health education from the company responsible for milk collection. The milking system was different among farms, ranging between bucket and herringbone.

Information regarding sanitary, productive, and reproductive management of the herds, the lactation phase of cows, and cases of heat stress could not be collected. Information regarding fat, protein, lactose, total solids, somatic cell count (SCC), and standard plate count (SPC) was collected from 1,634 dairy farms in January, April, July, and October 2020. The data on microbiological quality of milk were collected from the company that collects the in natura raw material on the farms. The information was collected monthly, but not all the information for 2020 could be used due to bureaucratic issues at the company. Only data from January, April, July, and October 2020 were used, totaling 6,403 observations. Table 1 shows the number of milk samples analyzed according to the months of the year.

The samples were analyzed by the Laboratory of Services for Dairy Herds (SARLE) of the University of Passo Fundo (UPF), which is accredited by the Ministry of Agriculture, Livestock and Food Supply (MAPA). Fat, protein, lactose, and total solids (TS) were determined by a Bentley® 2000 infrared spectrometer (Bentley Instruments, Chaska, MN, USA), whereas somatic cell count (SCC) and standard plate count (SPC) by flow cytometry using Bactocount® IBC (Bentley Instruments, Chaska, MN, USA) and Somacount® 300 equipment (Bentley Instruments, Chaska, MN, USA), respectively.

Table 1. Number of observations according to the seasons.

Month	Season	Number of observations[1]
January	Summer	1,634
April	Fall	1,604
July	Winter	1,559
October	Spring	1,606
Total		**6,403**

[1]Number of analyzed milk samples.

The data were subjected to analysis of variance at a 5% probability, and the season effect in terms of physicochemical composition, microbiological quality, and produced volume was evaluated. The means were compared by Tukey's test (P<0.05). The variables milk composition, quality, and volume, as well as the direction of the linear relationship between the variables during all seasons and each one of them separately, were analyzed using Pearson's correlation.

Results

Table 2 shows the variations between milk volume and constituents, as well as quality parameters (SCC and SPC).

No significant difference in total milk production (volume) was found between the spring (11,417 liters), winter (10,911 liters), and summer (10,247 liters of milk) seasons. However, a decrease was observed during the fall (8,847 liters, P<0.05). Regarding milk constituents, fat and protein were higher during the fall, with values of 4.02 and 3.35%, respectively (P<0.05). No statistical difference in milk protein content was observed during fall and winter (3.35 and 3.36%, respectively). Consequently, milk total solids (TS) were also higher during these periods (12.72 and 12.71%, respectively). Milk fat and protein contents and TS were lower (3.66, 3.20, and 12.17%, respectively) during the summer. The highest mean of lactose contents was found during the winter (4.47%, P<0.05).

The indicators of microbiological quality of milk showed higher SCC values among the studied farms during summer (750,430 cells/mL) and winter (730,800 cells/mL). In contrast, milk SPC showed no statistical difference between summer, fall, and spring, being higher during winter (247,120 CFU/mL, P<0.05). Pearson's correlation (Table 3) shows the behavior of the variables in 2020.

Table 2. Mean and standard deviation of the parameters composition (fat, protein, lactose, and total solids), quality (SCC and SPC) and volume of milk delivered to a dairy in the northern region of Rio Grande do Sul, Brazil, at different times of the year

Item	F %	P %	LAC %	ST %	SCC x1000 cells/mL	SPC x1000 CFU/mL	VOL L
Summer	3.66 D	3.20 C	4.36 C	12.17 C	750.43 A	120.43 B	10.247.26 A
SD	± 0.35	± 0.17	± 0.12	± 0.50	± 463.16	± 231.45	± 13.928.21
Fall	4.02 A	3.35 A	4.33 D	12.72 A	703.59 B	126.69 B	8.847.11 B
SD	± 0.43	± 0.21	± 0.16	± 0.57	± 397.34	±227.91	± 12.788.64
Winter	3.90 B	3.36 A	4.47 A	12.71 A	730.80 AB	247.12 A	10.911.32 A
SD	± 0.39	± 0.20	± 0.13	± 0.53	± 475.78	± 610.30	± 14.159.94
Spring	3.76 C	3.23 B	4.40 B	12.39 B	599.31 C	131.82 B	11.417.77 A
SD	± 0.35	± 0.18	± 0.13	± 0.50	± 386.44	± 347.80	± 16.632.63
pr>f*	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
CV	10.06	5.91	3.26	4.22	62.11	246.83	139.54

*Analysis of variance at 5%. Uppercase letters in the column differ from each other by Tukey's test at a 5% significance. VOL: volume; F: fat; P: protein; LAC: lactose, TS: total solids; SCC: somatic cell count; SPC: standard plate count.

Table 3. Pearson's correlation coefficient values between composition (fat, protein, lactose, and total solids), quality (SCC and SPC), and volume of milk received by a dairy in the northern region of Rio Grande do Sul, Brazil, in 2020

Item	F	P	LAC	TS	SCC	SPC	VOL
F	1	0.541	−0.154	0.903	0.036	0.044	−0.202
		(<0.0001)	(<0.0001)	(<0.0001)	−0.0034	−0.0004	(<0.0001)
P		1	0.058	0.776	0.075	0.042	−0.03
			(<0.0001)	(<0.0001)	(<0.0001)	−0.0006	−0.013
LAC			1	0.145	−0.349	−0.042	0.338
				(<0.0001)	(<0.0001)	−0.0007	(<0.0001)
TS				1	−0.029	0.042	−0.078
					−0.016	−0.0007	(<0.0001)
SCC					1	0.235	−0.053
						(<0.0001)	(<0.0001)
SPC						1	−0.046
							−0.0002
VOL							1

*Values in parentheses correspond to P<0.0001.

VOL: volume; F: fat; P: protein; LAC: lactose, TS: total solids; SCC: somatic cell count; SPC: standard plate count.

TS showed a high correlation with fat (0.90) and protein (0.78) and a weak correlation with lactose (0.14). SCC presented a moderate to low negative correlation with lactose content (−0.35). The analyzed SPC data showed a low-intensity positive correlation with milk SCC (0.23). Milk volume showed a moderate and negative correlation with fat content (−0.20) and a moderate positive correlation with lactose content (0.34). The correlations between milk fat and protein had moderate associations (r= 0.48; r= 0.55; r= 0.45 and r= 0.47) for January, April, July, and October, respectively. TS showed a strong correlation with the components fat (r=0.89 and r=0.90) and protein (r=0.72 to r=0.78) and very weak correlation with lactose (r=0 .04 to r=0.19) (Tables 4, 5, 6, and 7).

Negative and weak correlations were found among the variables SCC and lactose, ranging from r=−0.39 to r=−0.37 in the evaluated months. Positive but weak correlations were also observed during the period collected for SPC and SCC (r=0.23 to r=0.27) and milk volume and lactose content (r=0.32 to r=0.39) (Tables 4, 5, 6, and 7). Negative and weak correlations were found between milk volume and fat content, with values ranging from −0.22 to −0.31 (Tables 4 and 5) in January and April. However, these correlations became very weak in July and October, ranging from −0.17 to −0.11 (Tables 6 and 7).

Table 4. Pearson's correlation coefficient values between composition (fat, protein, lactose, and total solids), quality (SCC and SPC), and volume of milk received by a dairy in the northern region of Rio Grande do Sul, Brazil, in January 2020

Item	F	P	LAC	TS	SCC	SPC	VOL
F	1	0.485	−0.138	0.889	0.026	0.046	−0.223
		(<0.0001)	(<0.0001)	(<0.0001)	−0.277	−0.06	(<0.0001)
P		1	0.172	0.752	0.058	0.038	0.065
			(<0.0001)	(<0.0001)	−0.018	−0.121	−0.007
LAC			1	0.191	−0.367	−0.124	0.33
				(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)
TS				1	−0.036	0.029	−0.054
					−0.136	−0.24	−0.026
SCC					1	0.225	−0.02
						(<0.0001)	−0.396
SPC						1	−0.036
							−0.142
VOL							1

*Values in parentheses correspond to P<0.0001.
VOL: volume; F: fat; P: protein; LAC: lactose, TS: total solids; SCC: somatic cell count; SPC: standard plate count.

Table 5. Pearson's correlation coefficient values between composition (fat, protein, lactose, and total solids), quality (SCC and SPC), and volume of milk received by a dairy in the northern region of Rio Grande do Sul, Brazil, in April 2020

Item	F	P	LAC	TS	SCC	SPC	VOL
F	1	0.546	−0.261	0.904	0.034	0.044	−0.313
		(<0.0001)	(<0.0001)	(<0.0001)	−0.163	−0.075	(<0.0001)
P		1	−0.053	0.779	0.105	0.028	−0.028
			−0.034	(<0.0001)	(<0.0001)	−0.259	−0.26
LAC			1	0.043	−0.388	−0.109	0.388
				−0.08	(<0.0001)	(<0.0001)	(<0.0001)
TS				1	−0.035	0.019	−0.147
					−0.161	−0.439	(<0.00010)
SCC					1	0.232	−0.072
						(<0.0001)	−0.0038
SPC						1	−0.064
							−0.01
VOL							1

*Values in parentheses correspond to P<0.0001.
VOL: volume; F: fat; P: protein; LAC: lactose, TS: total solids; SCC: somatic cell count; SPC: standard plate count.

Table 6. Pearson's correlation coefficient values between composition (fat, protein, lactose, and total solids), quality (SCC and SPC), and volume of milk received by a dairy in the northern region of Rio Grande do Sul, Brazil, in July 2020

Item	F	P	LAC	TS	SCC	SPC	VOL
F	1	0.451	−0.116	0.903	0.025	0.02	−0.173
		(<0.0001)	(<0.0001)	(<0.0001)	−0.318	−0.422	(<0.0001)
P		1	−0.03	0.717	0.052	0.022	−0.117
			−0.232	(<0.0001)	−0.038	−0.367	(<0.0001)
LAC			1	0.129	−0.394	−0.103	0.318
				(<0.0001)	(<0.0001)	(<0.0001)	(<0.0001)
TS				1	−0.049	0.0079	−0.102
					−0.0501	−0.754	(<0.0001)
SCC					1	0.271	−0.059
						(<0.0001)	−0.018
SPC						1	−0.066
							−0.008
VOL							1

*Values in parentheses correspond to P<0.0001.

VOL: volume; F: fat; P: protein; LAC: lactose, TS: total solids; SCC: somatic cell count; SPC: standard plate count.

Table 7. Pearson's correlation coefficient values between composition (fat, protein, lactose, and total solids), quality (SCC and SPC), and volume of milk received by a dairy in the northern region of Rio Grande do Sul, Brazil, in October 2020

Item	F	P	LAC	TS	SCC	SPC	VOL
F	1	0.474	−0.098	0.897	0.075	0.055	−0.114
		(<0.0001)	(<0.0001)	(<0.0001)	−0.0026	−0.025	(<0.0001)
P		1	0.073	0.726	0.069	−0.017	−0.007
			−0.0031	(<0.0001)	−0.0051	−0.492	−0.756
LAC			1	0.185	−0.376	−0.082	0.351
				(<0.0001)	(<0.0001)	−0.001	(<0.0001)
TS				1	−0.0119	0.012	−0.0112
					−0.632	−0.62	−0.651
SCC					1	0.25	−0.054
						(<0.0001)	−0.028
SPC						1	−0.044
							−0.075
VOL							1

*Values in parentheses correspond to P<0.0001.

VOL: volume; F: fat; P: protein; LAC: lactose, TS: total solids; SCC: somatic cell count; SPC: standard plate count.

Discussion

The relationship between climate seasonality and milk quantity and composition is a subject that has been studied and discussed by different researchers in dairy cattle in recent years[5,9,10]. The main reason for this interest is due to the assessment of the viability of the dairy activity carried out through the collection of data on milk productivity and quality, which can be affected by seasons[6].

The reduction in the average volume of milk delivered to the dairy in April compared to the other months is explained by the autumnal forage void during this period, possibly resulting in the seasonality of forage production for animal feed and, consequently, the reduction in milk production[11]. Moreover, the higher average volume delivered by the producer during the spring reflects the ease of feed production in the spring, especially in integrated crop-livestock systems in the South of Brazil. Similarly, Martins et al.[9] verified variation in milk production, with the highest values in the spring months (average of 11.45 liters/cow/day) and a lower total volume in the summer, fall, and winter months.

The reduction in milk fat and protein contents in summer months compared to fall may be justified by the thermal stress suffered by animals subjected to high temperatures, without access to shade, ventilation and sprinkler systems in the waiting room, and water in quantity and quality. Some of the farms of the present study had only natural drinking troughs, such as weirs, located in areas of difficult access for animals. Continuous exposure to these conditions leads to a reduction in certain physiological factors such as dry matter intake, nutrient use efficiency, and production and percentage of fat in the milk, as well as increased respiratory and heart rate[12]. Therefore, the use of natural or artificial shade, ventilation, and mist is recommended for grazing cows[13] in the waiting room to improve thermal comfort, as intake decreases when the temperature is above 25 °C[14].

Milk protein is a component that presents smaller variations when compared to fat contents. However, it is negatively affected by heat stress since the proportion of casein tends to decrease, reflecting the increase in the contents of chlorine and whey proteins[15]. Solids content is highly influenced by milk fat content[16,17], which explains the high correlation (0.90) found in our study. In addition, large milk volumes have a dilution of fat and protein contents, whereas the concentration of these solids occurs at low production[18]. It explains the negative and low-impact correlations found during winter and spring between milk volume and fat content.

The average value of lactose found in the winter (4.47%), which is higher than the other evaluated seasons, can be explained by the higher milk production during this period. Lactose is considered an osmotic regulator[19], contributing to the arrival of water in the mammary gland and, consequently, in the produced milk volume. This fact corroborates the findings of the present study by the correlation between milk production and lactose (0.34) throughout 2020 and in different seasons.

Another interesting fact that is worth mentioning is that lactose in milk has low variation[19]. Fagan et al.[20] observed that the lactose content of milk was not influenced by climate conditions but by nutritional issues (% fiber, % crude protein, and % total digestible nutrients). In our study, the composition of diets fed to the animals was not evaluated but we can infer that there was interference from nutrition, as, on average, 172 changes were observed per month in the fat-to-protein ratio of milk, which is characterized by being an evaluation tool of diets of dairy herds. Despite this, milk lactose has a negative correlation with milk SCC and parity of animals, with a reduction in lactose contents and, consequently, lower milk production with an increase in SCC[21].

Silva and Antunes[22] found a negative correlation (−0.42) between SCC and lactose and stated that this parameter is the component that suffers the most reductions due to the increase in SCC. In the present study, this correlation was also found between the variables, but with a weaker magnitude (r=−0.39 to r=−0.37). This reduction may result from disorders of the mammary gland, such as increased permeability of the membrane that separates milk from blood, causing lactose loss into the bloodstream[23].

Heat stress, which affects reproductive characteristics and milk composition and production, is also a gateway to new diseases given its contribution to the decrease in animal immunity[24,25]. Several authors found higher SCC values in the summer[9,26,27], as pointed out in this study (750,430 cells/mL), probably due to the higher incidence of clinical mastitis during the warmer months, which is harmful to the health of the mammary gland.

High SCC concentrations indicate an inflammatory action in the mammary gland[28]. Most leukocytes migrate from the blood to the breast tissue in response to physical, chemical, or infectious aggression[29]. Intramammary infections are considered the main factor of increase in SCC, but other factors can influence the variation of this indicator, such as the susceptibility of the animal compared to the rest of the herd, the order of parturition, lactation period, and season[26,30].

Milk SCC in the analyzed samples was higher than the maximum limit established by the current Normative Instruction (76/2018) regardless of the season, which is 500,000 cells/mL for the individual tank of producers[31]. The higher the SCC concentrations in the milk, the lower the industrial yield, the shelf life of derivatives, and their quality[15], in addition to a lower bonus and remuneration for the producer. Thus, Normative Instruction 77, also from 2018, instituted the Milk Supplier Qualification Plan (PQFL), a dairy tool to help and qualify producers in terms of activity management, good agricultural practices, and technical assistance aiming at higher productivity, quality, and yield of dairy products, with higher competitiveness in the sector. However, sanitary control of the mammary gland is still a great challenge for milk producers.

The highest average for SPC of milk during the winter (247,120 CFU/mL) occurred because the winter in the South of Brazil is more intense, humid, and with the presence of rainy periods, which makes the animals kept on pasture arrive dirtier at the milking parlor. Good practice procedures before milking, such as pre-dipping, should be performed to avoid contamination of the tank. This method aims at higher cleaning and disinfection of the teats, helping to reduce the number of microorganisms that pass into the milk at the time of milking[32]. Importantly, SPC is a parameter that can lead to the suspension of milk collection on the farm if the quarterly geometric mean exceeds 300,000 cells/mL. In these cases, the dairy must investigate the reason why the milk is out of the standard (e.g., lack of hygiene, pre-dipping failure, dirty milk piping, and inefficient refrigeration) and then implement corrective measures. The producer needs to have a sample within the established standard for the collection to be resumed, being analyzed by the Brazilian Milk Quality Network (RBQL). Frequently, the producer would look to switch to a smaller dairy when the dairy requirement was high. However, the collection suspended by MAPA becomes valid for all dairy companies that receive the inspection, according to the new normative instruction, preventing the producer from marketing the milk until it meets the required standards.

A moderate positive correlation was observed between teat SPC and somatic cell count (r=0.40; p=0.03), as verified by Albino et al.[33] Thus, agents present in the teat skin can be risk factors for the occurrence of inflammation and infections in the mammary gland when hygiene procedures are not performed effectively. These data possibly explain the low-intensity correlation (0.23) found between SPC and SCC of milk in the present study.

Lactose content reduces when milk hygiene is compromised, reflecting high SPC and SCC values, as both variables have an inverse behavior[34]. Hygiene in the production process should be the main focus to ensure higher milk production and microbiological quality. Jamas et al.[35] analyzed the situation of family producers in the state of São Paulo and described a significant reduction in SCC in production systems that received guidelines for proper production management, reinforcing the importance of sanitary education, especially for family farming milk producers, usually with lower financial conditions. This information evidences the importance and necessity of adopting hygiene and milking procedures, as milk quality is also influenced by climate conditions, such as temperature, relative humidity, and rainfall[36].

Conclusion

The seasons of the year influenced the microbiological quality of milk from dairy farms located in the northern region of Rio Grande do Sul, mainly during winter and summer. However, spring was the season that most favored milk production in volume. The results show that the behavior of milk composition and quality variables is well-marked during the different seasons. These observations can help the producer to implement measures (thermal stress control and forage planning) within the farm to maintain the contents of milk components within the standard required by Brazilian legislation. Importantly, the highest difficulty in using a database for research is that other information is scarce, especially relative to the environment, management, and nutrition of herds, factors that can also influence the evaluated parameters. Therefore, the influencing factors cannot be isolated as in an experiment. However, the use of a database helps us to characterize a condition, given the large number of reliable observations obtained.

Declaration of conflict of interest

The authors have no conflicts of interest to declare.

Author contributions

Conceptualization: T.R.Marcon. *Data curation:* T.R.Marcon. *Formal analysis:* E.Gopinger. *Visualization:* M.Zopollatto. *Investigation:* T.R.Marcon. *Project management*: E.C.Debortoli. *Supervision:* E.C.Debortoli. *Writing (original draft):* K.F.Nogara. *Writing (review and editing):* G.C.B.Kaelle and Q.G.Tavares

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