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Management tools applied to milk quality in cattle farming in the Western Amazon

Ferramentas de gestão aplicadas à qualidade do leite na bovinocultura na Amazônia Ocidental

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Highlights

Propriedades leiteiras em regime familiar, não aplicam boas práticas de ordenha.
Ferramentas de gestão podem gerar resultados significativos na qualidade do leite.
Implantação das práticas de ordenha obteve redução média de 31,4% CCS e 63% CBT.
Ferramentas de gestão auxiliam na identificação de pontos fracos no sistema de ordenha.

Abstract

This study aimed to analyze the applicability of management tools such as SWOT matrix, GUT matrix, Brainstorming, PDCA, Ishikawa diagram, and 5W2H in improving milk quality in rural properties for family labor. The survey was conducted in 18 properties in the municipality of Senador Guiomard, State of Acre, Brazil, during the period from January to December 2019. The properties were divided into two groups (treatment group-TG and control group-CG) and the data obtained through a form with 255 questions for diagnosis and analysis (LQL-GO) for somatic cell count (SCC) and total bacterial count (TBC) were tabulated

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in spreadsheets (Excel®) and subjected to statistical analysis by the Wilcoxon test. Nineteen weaknesses were obtained through the GUT matrix. The implementation of milking practices using tools obtained an average reduction of 31.4% for SCC and 63% for TBC in TG and a reduction of 39.3% for SCC and an increase of 33.7% for TBC in CG. Thus, the management tools applied to milk quality are capable of generating positive results ($p < 0.05$) in microbiological control, facilitating quick decision-making, aiming at the correction of weaknesses, and, consequently, an increase in profitability.
Key words: Good milking practices. Management. Quality indicators. Planning.

Resumo

Objetivou-se analisar a aplicabilidade de algumas ferramentas de gestão como: matriz SWOT, matriz GUT, Brainstorming, PDCA, diagrama de Ishikawa e 5W2H na melhoria da qualidade do leite em 18 propriedades rurais em regime de economia familiar, localizadas no município de Senador Guiomard, Acre, durante o período de janeiro a dezembro de 2019. As propriedades foram divididas em dois grupos (grupo tratamento-GT e controle-GC), e os dados foram obtidos utilizando-se um formulário com 255 questões para o diagnóstico, e por meio de análises (LQL-GO) para contagem de células somáticas (CCS) e contagem bacteriana total (CBT); posteriormente tabulados em planilhas (Excel®) e submetidos à análise estatística pelo teste de Wilcoxon. Obteve-se, por meio da Matriz GUT, 19 pontos fracos. A implantação das práticas de ordenha por meio das ferramentas obteve redução média de 31,4% para CCS e 63% para CBT no GT, enquanto o GC obteve redução de 39,3% para CCS e aumento de 33,7% para CBT. Conclui-se que as ferramentas de gestão aplicadas à qualidade do leite são capazes de gerar resultados positivos ($p < 0,05$) no controle microbiológico, facilitando a tomada rápida de decisões visando à correção de pontos falhos e, consequentemente, o aumento da rentabilidade.
Palavras-chave: Boas práticas de ordenha. Gestão. Indicadores de qualidades. Planejamento.

Introduction

The milk production chain has great importance to the Brazilian agribusiness, both in economic development, with generation of jobs and income (Siqueira, Carneiro, Almeida, & Souza, 2010), and in a social aspect, reducing rural exodus (Passetti, Eiras, Gomes, Santos, & Prado, 2016).

Dairy herd in Acre State is characterized by low productivity about 23,000 farms. Of these, 83% is composed of smallholder livestock producers, with herds of up to 100 heads. In 2019, state production totaled 42.47 million liters of milk (Instituto Brasileiro de Geografia e Estatística [IBGE], 2019; Reis et al., 2019).

Dairy product demand has increased considerably around the world and, consequently, consumers have become increasingly demanding in terms of quality (Empresa Brasileira de Pesquisa Agropecuária [EMBRAPA], 2019).

According to Soares and Gaglietti (2015), farms with worse performance regarding quality undergo typical management problems: lack of planning, clarity regarding business health, disengaged employees, and financial difficulties. Good management allows identifying possible administrative obstacles and failures, providing support for decision-making (Fassio, Reis, & Geraldo, 2006).

Management tools are essentially technical for use in the company to solve administrative problems usually related to the poor performance of processes, being predominantly used to identify, observe, and analyze problems, and used as preventive, corrective, and team commitment measures for their success (Meireles, 2001).

However, few studies are related to livestock, especially regarding milk quality. In the State of Acre, Reis et al. (2019) analyzed 100 dairy farming properties using management tools and observed good results in minimizing failures and increasing profitability.

Given the importance of the subject and the scarcity of studies, this research was carried out to analyze the applicability of management tools such as SWOT matrix (Passetti et al., 2016), brainstorming (Werkema, 1995), GUT matrix (Meireles, 2001), Ishikawa diagram (Lins, 1993), PDCA cycle (Vieira, 2007), and 5W2H (Werkema, 1995) to find and solve, or at least minimize, problems related to milk quality on rural properties under family labor in the municipality of Senador Guiomard, State of Acre, Brazil.

Material and Methods

This study was approved by the Ethics Committee on Animal Use of the Federal University of Acre (CEUA-UFAC) and registered under the No. 23107.020486/ 2018-47 and protocol number 50/2018.

The study was carried out in 18 rural milk-producing properties in a family economy regime in the municipality of Senador Guiomard, State of Acre, Brazil, from January to December 2019. These producers were selected using non-probabilistic sampling by judgment through the registration at the State Secretariat of Production and Agribusiness of Acre (SEPA).

The evaluated properties were under under extensive tropical grazing conditions, with occasional concentrate supply during forage shortage periods. Predominant breeds were Girolando and mongrel animals, which have average yields of 24,982 liters milk per year, 68 liters per day, and 4.0 liters per cow/ day.

The farms are characterized by family-based management. On some farms, cows are milked by hand with calf at the foot. Only one farmer (6%) milks twice a day. In more than half of properties (56%) milking is mechanical. In 13 properties (72%), milk is not stored and is transported to dairies and/or consumers on the same day. Only two properties have expansion tanks (11%), three (17%) store milk in domestic freezers, and five sell it informally.

The evaluated properties have adopted a traditional production system, with little or no technology and good milking practices, which leaves them out of the standards established by the IN 77.

A diagnosis of the properties was carried out on the first visits using a semi-structured form containing 255 questions divided into the register of the producer (52 questions) and the property (12 questions), characterization of the herd and milk production, with a higher emphasis on quality and milking management (191 questions).

Milk analyses (SCC and TBC) were carried out monthly (July to December 2019) to attest to the effectiveness of the use of management tools in improving milk quality, as these results are used worldwide as indicators of milk quality (Pantoja, Reinemann, & Ruegg, 2011).

Milk samples were collected individually in the properties directly from the expansion tank (n=2) and cans (n=16), following the collection rules according to article 40 of IN 77/2018 and Official Letter No. 113/2009 DIPOA/MAPA, in sterile 40-mL bottles, one of them containing a Bronopol® tablet (Silveira, Fonseca, Lago, & Veiga, 2005), and the other with Azidiol® (Sampaio et al., 2015), packed in isothermal boxes (4 to 8 °C), and transported by air to the Laboratory of Milk Quality of Goiânia (LQL-GO).

The sample population was divided into two groups, according to the producers' interest in carrying out measures of good milking practices:

a) Treatment group (TG): nine properties, in which producers carried out one or more measures for the management of good milking practices.

b) Control group (CG): nine properties, in which producers have not carried out any measures for the management of good milking practices, providing only the data for the research.

The following good milking practices were suggested: 1) disregard the first jets of milk; 2) black-bottomed mug test; 3) pre-dipping: immersion of teats with chlorinated water at 750 ppm; 4) drying with paper towels; 5) California mastitis test (CMT); 6) post-dipping: disinfectant solution; 7) vigorous washing of the milking utensils with suitable products; 8) inversion of buckets/cans; 9) sanitization of pre-milking utensils; 10) washing of milking machine and milk claws as recommended by the manufacturer; 11) milking machine hygiene; 12) cleaning of facilities; 13) training and qualifications (Vallin et al., 2009; Matsubara et al., 2011; Bozo et al., 2013).

The SWOT matrix tool was used (Passetti et al., 2016). To obtain the strengths and weaknesses, opportunities and threats found in properties. The weaknesses were listed as weak points and scored using the GUT matrix, in which each researcher assessed individually and scored from zero to five the items considered more serious, more urgent, and more likely to worsen, according to Lopes, Reis and Ferrazza (2016a) and Lopes et al. (2018). Subsequently, the Brainstorming tool (Werkema, 1995) allowed indicating the management tools Ishikawa diagram, 5W2H, and PDCA (Longaray, Laurino, Tondolo, & Munhoz, 2017) to correct or, at least, minimize the diagnosed problems, following the methodology proposed by Lopes et al. (2016b).

This analysis enabled the generation of an action plan with the guidance of those responsible and actions to be taken, in addition to suggesting a deadline, verification of its applicability, and compliance within the described period.

The results of the six months of milk analysis were registered in Excel® spreadsheets, with the geometric means, as established by Souza et al. (2017), defined as the n-th root (where n is the number of terms) of the multiplication of terms, according to the equation:

$$\left(\prod_{i=1}^{n} a_i\right)^{1/n} = \sqrt[n]{a_1 a_2 \cdots}$$

Subsequently, the data were submitted to statistical analysis by the Wilcoxon-Mann-Whitney statistical test (wilcox.test) using the software R 3.6.1 to evaluate the significance of the differences in the results of SCC and TBC observed in the samples before, during, and after applying the management tools, and the statistical difference between groups, considering a 95% confidence (α = 0.05).

Results and Discussions

Nineteen weaknesses were found in the properties, being listed in the GUT matrix in decreasing order by the average of the assigned score (Table 1). According to Reis et al. (2019), higher scores indicate the weaknesses that should be prioritized in an attempt to equate or minimize them.

Table 1
Scores assigned, through the GUT matrix, to each weakness related to milk quality found in the 18 dairy farms in a family economy regime located in the municipality of Senador Guiomard, Acre, Western Amazon, 2019

Weakness	Score assigned by the researchers*								
	1	2	3	4	5	6	7	Mean**	SD
Non-disposal of milk unfit for consumption	125	125	125	125	125	125	125	125.00	0.00
Incorrect hygiene of equipment and utensils	125	125	125	125	125	125	125	125.00	0.00
Lack of knowledge about good milking practices	125	125	125	125	125	125	125	125.00	0.00
High incidence of mastitis	125	125	125	125	125	125	125	125.00	0.00
Lack of control of brucellosis and tuberculosis	125	125	100	125	125	125	125	121.43	8.75
Incorrect handling in drying animals	125	100	125	125	125	125	125	121.43	8.75
Use of collective cloth for teats hygiene	125	125	125	125	125	64	125	116.29	21.35
Positive Alizarol (°GL) analysis	125	100	125	125	125	64	125	112.71	21.68
Incorrect handling of the milking machine/ claws	80	100	75	125	80	80	60	85.71	19.35
Improper milk storage	64	125	75	125	45	125	24	83.29	38.99
Incorrect teat hygiene before and after milking	125	24	80	32	125	27	125	76.86	45.13
Inadequate cleaning products for milking	60	100	64	80	64	80	64	73.14	13.30
Lack of goals for milk quality	60	80	64	80	64	27	64	62.71	16.41
Failure to perform water treatment	100	80	8	16	100	125	3	61.71	47.35
Incorrect facilities	45	30	45	45	30	60	50	43.57	9.90
Facilities of difficult cleaning	45	30	45	45	30	1	50	35.14	15.72
Milking with calf at foot	16	6	3	9	6	8	6	7.71	3.81

*Multiplication of scores from zero to five for the requirements severity (S), urgency (U), and trend (T); **Simple arithmetic mean; SD: standard deviation.

This article discusses the points that received the highest score in the GUT matrix, namely: the non-disposal of milk unfit for consumption; incorrect hygiene of facilities, equipment, and utensils; lack of knowledge about good milking practices; and high incidence of mastitis.

First weakness: non-disposal of milk unfit for consumption

The disposal of milk unfit for consumption was not carried out in 12 properties (67%). According to RIISPOA, milk unfit for human consumption is out of physical and chemical standards, such as high acidity, foreign substances, drug and pesticide residues, mastitic milk, and presence of colostrum (Ministério da Agricultura, Pecuária e Abastecimento [MAPA], 2017).

All the analyzed properties did not respect the grace period for antibiotics and pesticides. Nascimento, Junqueira, Carneiro, Ramos, Abdallah and Fracalossi (2015) found a similar result in Alegre, ES, where 64% of the analyzed properties did not respect the grace period. Estevão, Garino, Santos, Silva and Matos (2015) pointed out that the occurrence of antibiotic and pesticide residues in milk constitutes a risk to public health and losses to the industry.

Management tool proposed to solve the first weakness: 5W2H

The 5W2H tool is a reference to support decisions, allowing the monitoring or development of a given project (Werkema, 1995). Veiga, Polacinski, Silva, Tauchen and Pires (2013) described this tool as an action plan for any pre-established activity, answering seven questions (Table 2)

Table 2
Application of the 5W2H management tool to solve the weakness: Non-disposal of milk unfit for consumption

	QUESTION	ACTION
5W2H	What?	Disposal of milk unfit for consumption
	Why?	Fitting into legislation and impact on public health
	Where?	Milking parlor
	Who?	Producer
	When?	Whenever there is it
	How?	Do not send to the dairy company, nor for family consumption, but can be supplied to calves
	How much?	Accounting by liters; it influences the activity profitability, reducing revenue

Second weakness: incorrect hygiene of milking equipment and utensils

All 18 properties (100%) cleaned incorrectly the equipment and utensils using soda soap, washing powder, or neutral detergent, without any type of water treatment. According to Reinemann, Wolters, Billon, Lind and Rasmussen (2003), the effectiveness of cleaning milking equipment and tools is related to factors such as time, temperature, volume, concentration of detergent and turbulence of cleaning solutions, and adequate drainage (Oliveira et al., 2015).

Rangel et al. (2014) assessed dairy properties in the Agreste region of the State of Rio Grande do Norte and observed that properties that performed the correct cleaning of the milking equipment had low TBC.

Management tool proposed to solve the second weakness: PDCA cycle

The PDCA cycle was proposed due to the continuous nature of the problem since this tool is a managerial decision-making method that guarantees the achievement of the goals necessary for the survival of an organization (Longaray et al., 2017). The PDCA cycle was presented as follows:

Plan - establishing a routine for cleaning milking equipment and utensils after milking.

Do - cleaning with alkaline-chlorinated detergent and water at the initial temperature of 70 °C and the final temperature of 45 °C, for 10 minutes. Acid detergent with an inlet temperature from 35 to 45 °C for 10 minutes. Buckets, cans, and mugs must be washed with alkaline detergent and warm water, using appropriate brushes or sponges, which must be rinsed immediately after milking.

Check - through visual, tactile, and microbiological analysis.

Action - correct possible failures and validate assertive actions and make them routine in the property.

Third weakness: lack of knowledge about good milking practices

According to Dereti, Gonçalves, & Zanela (2019), the lack of adoption of good milking practices by the milking personnel can be justified by the absence or deficiency of knowledge regarding the importance of each procedure. Battaglini, Fagnan, Dungaa and Beloti (2013) detected a rapid and significant improvement in milk quality after training producers on the importance of milk quality and procedures to achieve it.

Management tool proposed to solve the third weakness: 5W2H

A three-day training course for transferring information was developed and the producers involved in the research were invited to attend it (Table 3).

Fourth weakness: high incidence of mastitis

The high incidence of mastitis found in eight properties (44%) was of a clinical nature, diagnosed through the black background mug test, since only one producer (6%) carried out the control of subclinical mastitis using the indirect method California mastitis test (CMT).

Table 3
5W2H method used to solve the weakness lack of knowledge about good milking practices

	TOOL	ACTION
5W2H	What?	Training course
	Why?	Dissemination of knowledge about the quality of milk produced in the properties
	Where?	Colônia Três de Junho
	Who?	Producers
	When?	June 19, 20, and 21, 2019
	How?	Through lectures and demonstrative practices
	How much?	Course offered free of charge by SENAC/AC

Failure in the diagnosis of clinical and subclinical mastitis is an important factor for the uncontrolled disease in the herd (Santos & Fonseca, 2019). Lopes et al. (2012) emphasized that mastitis is considered the most relevant disease in dairy cattle, causing direct and indirect economic losses, which may represent 15 to 24% of gross income (Vissio, Agüero, Raspanti, Odiernob, & Larriestra, 2015).

Management tool proposed to solve the fourth weakness: ishikawa diagram

Considering the multifocal factor of the disease, the proposed management tool was the Ishikawa diagram (Figure 1), which allows the cause and effects to be demonstrated through a composition in which the main axis indicates the problem, and the sub-axes indicate the causes, resembling a fishbone (Lins, 1993).

The tools were implemented to join the Good Agricultural Practices (GAPs) program in milking management in the studied properties. Nine producers (50%) showed no interest in carrying out practices to improve milk quality, thus being the control group. Soares, Duarte, Carrijo and Costa (2019) also encountered resistance on the part of producers, mainly on the cleaning and hygiene of utensils, as obtained in this study.

All five farmers (28%) selling milk informally were interested in introducing good milking practice measures, concerning about final consumers given their close contact with them. A different result was found by Dutra, Castagnara, Hoch, Tadielo and Dinarte (2020) in Uruguaiana (RS), where farmers selling informally showed no interest in receiving training to improve hygiene practices in milking.

Few practices used to be performed at the beginning of this study, often due to lack of knowledge. Picoli et al. (2015) reported a negative correlation between family farming and producer education, milk quality, management, and productivity.

No practices were added in the management of CG properties during the research period. The practices implemented by all TG producers (100%) were the filtering of milk to eliminate physical contaminants, inversion of buckets/cans to eliminate residual water, and hygiene of facilities, as they are simple and easy.

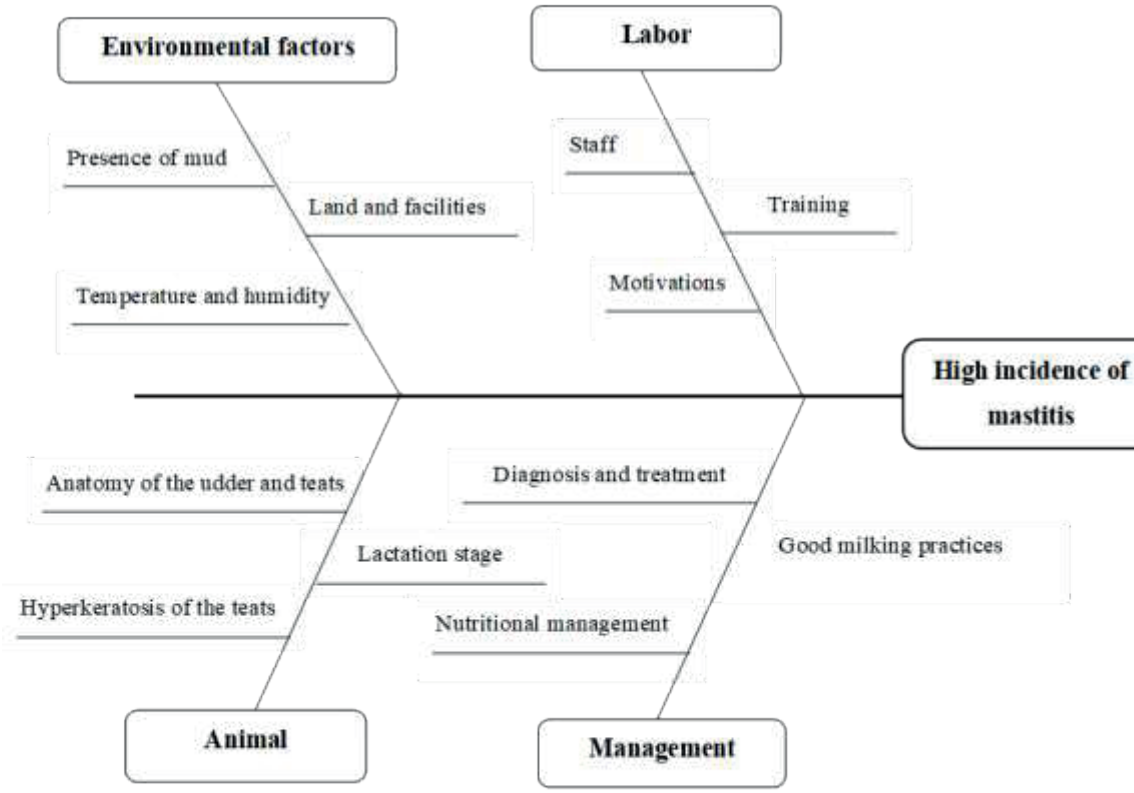

Figure 1. Ishikawa diagram as a proposal for the resolution of the weakness high incidence of mastitis.

Constantino et al. (2019) demonstrated that the main critical points of contamination by microorganisms are utensils (buckets/cans) and teats of animals, with residual water being the main source of contamination. Matsubara et al. (2011) found significant results when applying good practices to reduce microorganisms from milk claws and teats (99.6%), cans (80.0%), buckets (99.9%), and elimination of residual water from cans (100%).

The selective dry cow therapy was also accepted by all TG producers (100%), as they understood the importance of mastitis control (Langoni et al., 2017).

However, only two properties implemented post-dipping, which showed a high incidence of subclinical mastitis in the herd, over 60% of lactating cows. A similar result was found by Nascimento et al. (2015) on family farms in the city of Alegre - ES, where only 6% of the evaluated farms performed post-dipping.

Four geometric means were obtained from the result of the six milk analyses (Table 4), as established in the Technical Regulation of chilled raw milk (Normative Instruction No. 76/2018). TBC showed a reduction ($p<0.05$) in milk from the TG properties and an increase was observed in CG. SCC showed no statistical difference ($p>0.05$) between groups. The variation in the indicators SCC and TBC between the studied properties considering the legislation standards (IN 76 and 77) ranged from low to very high (SCC = 2361 ± 65×1000 SC/mL; CBT = 1314 ± 15×1000 CFU/mL), probably due to factors such as management, herd, and breeds, which differed between the studied properties.

Table 4
Values obtained for the total bacterial count (×1000 CFU/mL) and somatic cell count (×1000 SC/mL) of dairy farms in the municipality of Senador Guiomard, AC, Brazil, before and after the implementation of management tools

	TREATMENT					
	SCC[NS]			TBC*		
	Before	After	Difference (%)	Before (b)	After (a)	Difference (%)
P1	69	107	34.82	369	168	-54
P2	1643	816	-50.32	799	365	-54
P3	65	74	12.14	140	50	-64
P4	144	130	-10.00	58	10	-81
P5	96	123	22.01	44	33	-25
P6	406	234	-42.29	25	21	-14
P7	498	232	-53.33	1163	247	-79
P8	432	566	23.71	1270	463	-63
P9	109	90	-17.31	172	131	-23
Mean	385	264	- 31.42	449	165	- 63.02
	CONTROL					
	SCC[NS]			TBC[NS]		
	Before	After	Difference (%)	Before (b)	After (a)	Difference (%)
P1	186	130	-30	15	18	20
P2	190	277	45	134	506	275
P3	202	161	-20	1286	574	-55
P4	2361	1013	-56	815	1119	37
P5	195	260	-33	1314	1571	19
P6	523	301	-42	1039	2241	115
P7	154	124	-19	68	93	35
P8	254	184	-27	221	241	8
P9	294	192	-34	223	478	114
Mean	484	294	-39.35	568	760	+33.70

P: analyzed properties. *Significant divergence between groups. NSNot significant between groups ($P \leq 0.05$).

The average SCC and TBC of the nine TG properties before the introduction of the tools was 385×1000 SC/mL and 449×1000 CFU/mL, respectively. On the other hand, 264×1000 SC/mL and 166×1000 CFU/mL were obtained after the implementation of the tools. Average reductions of 31.42 and 63% were observed for SCC and TBC, respectively.

The initial average values for CG were 485×1000 SC/mL and 569×1000 CFU/mL, reaching 294×1000 SC/mL and 761×1000 CFU/mL after the six months of collection, with an average reduction of 39.32% and an increase of 33% for SCC and TBC, respectively.

Vallin et al. (2009) observed an average reduction of 87.9% for TBC in manual milking and 86.9% in mechanized milking. Bozo et al. (2013) compared the average of dairy farms in the city of Pitangueiras, Paraná, and also found an average reduction of 93.4% for TBC.

The lower values found in this research (63%) were probably due to the non-implementation of all GAPs in the studied properties. The adequacy of cleaning the utensils and milking equipment using suitable products presented the highest resistance on the part of producers (83%). This fact is related to the non-existence of these products in the market in the State of Acre and the complexity of execution reported by producers. Similarly, Soares et al. (2019) reported a difficult standardization of disinfectant dilutions and failure to execute the correct action time.

The average values of SCC decreased (31.4%), but no statistically significant difference ($p<0.05$) was observed when the results were compared before and after the use of the management tools (Figure 2). Similar results were found by Soares et al. (2019), which were different from those observed by Bozo et al. (2013), who obtained reduction averages of 74.3% for CCS.

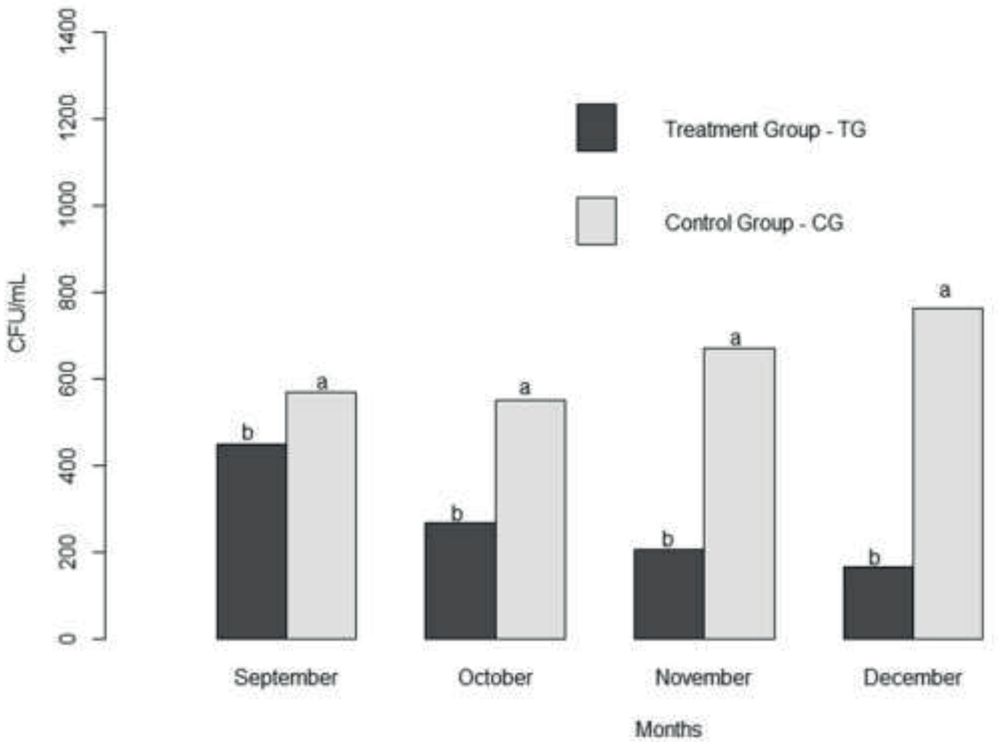

Figure 2. Behavior of geometric means for total bacterial count between groups evaluated from July to December 2019.

The non-significant improvement for SCC is related to the short term of the study, as the response to the implementation of good practices for SCC is not as immediate and significant as for TBC. Pre-and post-milking cleaning and hygiene are capable of reducing TBC by 98% on the first day of implementing good practices (Silva et al., 2011). Soares et al. (2019) observed that the results of implementing good practices for SCC are obtained in the next lactation after the animals have dried.

The significant increase in TBC in CG (33.7%) is believed to be related to the local rainy season (September to December), with rainfall of approximately 1,150 mm during this period according to the Brazilian National Institute of Meteorology (Inmet). Picinin et al. (2019) observed an increase in the SCC and TBC parameters during a period with rainfalls and high temperatures (October to January), favoring an increase in environmental contamination, accumulation of mud in the facilities, and higher occurrence of dirty teats at milking time. These factors, associated with failures in the milking routine, may cause high initial contamination.

Regarding the current legislation, TG properties presented geometric means of SCC and TBC within the standards of IN 76/2018, while the means of CG were out of the standard relative to TBC. According to IN No. 77/2018, properties with results of geometric mean out of the CPP standards must have the milk collection interrupted and will only return to the collection with results of a new sample analyzed by the Brazilian Milk Quality Network (RBQL) within the regulatory standard (Instrução Normativa n° 76 e 77 2018). Thus, it is an important economic impact.

Thus, the State of Acre lacks much information related to the quality of the produced milk. The most recent study was carried out in 2009 by Embrapa Acre in the municipalities of Acrelândia, Porto Acre, and Rio Branco. The authors reported that the microbiological quality of the fresh milk collected on the platform was out of the standards required by legislation. The values were well above those of the present study, with an average of 2,052.52 x 1000 CFU/mL (Carneiro, Cavalcante, Braga, & Santos, 2015).

These producers had no direct financial return, as there are no bonuses or penalties for milk quality in the State of Acre. Bozo et al. (2013) evaluated the adoption of good practices in a quality payment program, which generated an increase in the monthly income of producers, with bonuses from R$ 120.00 to R$ 828.00, according to the production of each property.

Conclusion

The management tools applied to milk quality can generate significant results ($p<0.05$), indicated to identify weaknesses in rural properties, facilitating quick decision-making aiming at their correction, being characterized as a guiding document for the manager to carry out an action plan and goals to be met in the short and long term.

Several weaknesses were found related to the quality of milk from these properties and the resistance of some producers to implement good milking practices. It suggests a close relationship between producers and industry through quality improvement programs, incentives and technical assistance activities, and quality bonuses. Moreover, the culture of producers needs to be changed, as they have difficulties in absorbing information and applying low-cost simple management techniques.

A significant improvement ($p<0.05$) was obtained in the quality of the produced milk regarding TBC in TG, which did not occur in CG. On the contrary, no statistical difference ($p>0.05$) was observed between groups for SCC, and both have their indices according to the IN 77 legislation, thus contributing to the sustainability of the production sector.

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