

**ANALYSIS OF SCC AND SPC INDICES IN MILK TANKS AND THEIR
CORRELATION WITH GOOD PRACTICES IN DAIRY CATTLE FARMING**

**ANÁLISE DOS ÍNDICES DE CCS E CPP EM TANQUES DE LEITE E SUA
CORRELAÇÃO COM AS BOAS PRÁTICAS NA BOVINOCULTURA LEITEIRA**

**ANÁLISIS DE LOS ÍNDICES DE CCS Y CPP EN TANQUES DE LECHE Y SU
CORRELACIÓN CON LAS BUENAS PRÁCTICAS EN LA GANADERÍA
LECHERA**

 <https://doi.org/10.56238/sevened2025.039-004>

**Renê Ferreira Costa¹, Marielly Maria Almeida Moura², Daniel Ananias de Assis Pires³,
Otaviano de Souza Pires Neto⁴, Juliano Santos Siqueira⁵, Matheus Pereira da Silva⁶,
Emerson Márcio Gusmão⁷, Maria Eduarda Ramalho Lopes⁸, Ivete Mariana Pereira de
Souza⁹, José Roberto Maciel Menezes Junior¹⁰, Isadora¹¹, Nysa Neves Alves¹², Hávilla
Lopes Pereira¹³, Pedro Henrique Alves de Oliveira¹⁴**

ABSTRACT

The present study aimed to evaluate the influence of adopting Good Milking Practices (GMP) on milk quality parameters, specifically the Standard Plate Count (SPC) and Somatic Cell Count (SCC), in rural properties of the Montes Claros (MG) microregion. This is a descriptive, documentary, retrospective, and quantitative research conducted in October 2023, with a sample of six farms from the local dairy basin. Data were analyzed through Tables and tables created using Excel software. The results indicated that property P2, which showed the highest adherence to GMP, obtained the lowest SCC (264,000 somatic cells/mL) and SPC (21,000 CFU/mL) values, reflecting better hygienic-sanitary milk quality. In contrast, property

¹ Doctoral student in Animal Production. Faculdades Integradas do Norte de Minas (Funorte).

E-mail: renecostavet@gmail.com

² Dr. in Plant Production. Faculdades Integradas do Norte de Minas (Funorte).

E-mail: maryszootecnia@gmail.com

³ Dr. in Animal Production. Faculdades Integradas do Norte de Minas (Funorte).

E-mail: piresdaa@gmail.com

⁴ Dr. in Animal Production. Faculdades Integradas do Norte de Minas (Funorte).

E-mail: otaviano.neto@funorte.edu.br

⁵ Master's degree in Animal Production. Faculdades Integradas do Norte de Minas (Funorte).

E-mail: Juliano.siqueira@funorte.edu.br

⁶ Master's student in Animal Production. Universidade Estadual de Montes Claros (Unimontes).

E-mail: matheuspereiraagrohorse@gmail.com

⁷ Master's degree in Animal Biology. Universidade Estadual de Montes Claros (Unimontes).

E-mail: Emerson.gusmao@unimontes.br

⁸ Undergraduate student in Veterinary Medicine. Faculdades Integradas do Norte de Minas (Funorte).

E-mail: maria.lopes@soufunorte.com

⁹ Master's student in Plant Production. Universidade Estadual de Montes Claros (Unimontes).

E-mail: ivetemary894@gmail.com

¹⁰ Undergraduate student in Veterinary Medicine. Universidade Estadual de Montes Claros (Unimontes).

E-mail: robertomenezesmedvet@gmail.com

¹¹ Master's student in Animal Production. Universidade Estadual de Montes Claros (Unimontes).

¹² Undergraduate student in Veterinary Medicine. Centro Universitário Uma.

¹³ Master's student in Animal Production. Universidade Estadual de Montes Claros (Unimontes).

E-mail: havillalp@gmail.com

¹⁴ Doctoral student in Animal Science. E-mail: p213109@gmail.com

P3, with lower adherence to the recommended practices, presented the highest SCC (1,170,000 somatic cells/mL) and SPC (23,000 CFU/mL) indices, indicating milk of lower quality. It is concluded that the proper implementation of Good Agricultural Practices has a direct positive influence on reducing SCC and SPC indices, promoting the production of milk with higher microbiological and hygienic-sanitary quality, thus contributing to food safety and enhancing the product's market value.

Keywords: Good Agricultural Practices. Hygienic-Sanitary Milk Quality. Food Safety.

RESUMO

O presente estudo teve como objetivo avaliar a influência da adoção de Boas Práticas de Ordenha (BPO) sobre os parâmetros de qualidade do leite, especificamente a contagem padrão em placas (CPP) e a contagem de células somáticas (CCS), em propriedades rurais da microrregião de Montes Claros (MG). Trata-se de uma pesquisa descritiva, documental, retrospectiva e quantitativa, realizada em outubro de 2023, com uma amostra de seis propriedades da bacia leiteira local. Os dados foram analisados por meio de gráficos e tabelas elaborados no software Excel. Os resultados indicaram que a propriedade P2, que apresentou maior adesão às BPO, obteve os menores valores de CCS (264.000 células somáticas/mL) e CPP (21.000 UFC/mL), refletindo melhor qualidade higiênico-sanitária do leite. Em contrapartida, a propriedade P3, com menor adesão às práticas recomendadas, apresentou os maiores índices de CCS (1.170.000 células somáticas/mL) e CPP (23.000 UFC/mL), indicando leite de menor qualidade. Conclui-se que a implementação adequada das boas práticas agropecuárias tem influência positiva direta na redução dos índices de CCS e CPP, promovendo a produção de leite com maior qualidade microbiológica e higiênico-sanitária, contribuindo para a segurança alimentar e valorização do produto no mercado.

Palavras-chave: Boas Práticas Agropecuárias. Qualidade Higiênico-Sanitária do Leite. Segurança Alimentar.

RESUMEN

El presente estudio tuvo como objetivo evaluar la influencia de la adopción de Buenas Prácticas de Ordeno (BPO) sobre los parámetros de calidad de la leche, específicamente la Recuento en Placa Estándar (RPE) y la Recuento de Células Somáticas (RCS), en propiedades rurales de la microrregión de Montes Claros (MG). Se trata de una investigación descriptiva, documental, retrospectiva y cuantitativa, realizada en octubre de 2023, con una muestra de seis propiedades de la cuenca lechera local. Los datos fueron analizados mediante gráficos y tablas elaborados en el software Excel. Los resultados indicaron que la propiedad P2, que presentó mayor adhesión a las BPO, obtuvo los valores más bajos de RCS (264.000 células somáticas/mL) y RPE (21.000 UFC/mL), reflejando una mejor calidad higiênico-sanitaria de la leche. En cambio, la propiedad P3, con menor adhesión a las prácticas recomendadas, presentó los índices más altos de RCS (1.170.000 células somáticas/mL) y RPE (23.000 UFC/mL), indicando leche de menor calidad. Se concluye que la implementación adecuada de las Buenas Prácticas Agropecuarias tiene una influencia positiva directa en la reducción de los índices de RCS y RPE, promoviendo la producción de leche con mayor calidad microbiológica e higiênico-sanitaria, contribuyendo a la seguridad alimentaria y a la valorización del producto en el mercado.



Palabras clave: Buenas Prácticas Agropecuarias. Calidad Higiénico-Sanitaria de la Leche. Seguridad Alimentaria.

1 INTRODUCTION

The milk production chain is one of the most relevant segments of Brazilian agribusiness, playing a strategic role in generating employment and income, both directly and indirectly, in several municipalities in the country (Rocha; Oak; Resende, 2020). In 2019, the gross value of primary milk production reached R\$ 35 billion, positioning it as the seventh most economically important agricultural product in Brazil (Brasil, 2020). In this scenario of significant economic relevance, there is also an increase in global demand for products of animal origin and the continuous growth in the consumption of milk and dairy products.

This movement, combined with society's growing concerns about environmental and animal welfare issues, imposes on dairy farms the need to improve their production systems. To meet these requirements, it is essential to increase productivity in line with the preservation of the health and well-being of herds, as well as the mitigation of environmental impacts. Such a context demands high levels of efficiency in production processes, ensuring the sustainability and competitiveness of the sector (Bahlo *et al.*, 2019; Bianchi *et al.*, 2022).

The quality of milk is defined by a set of physicochemical and microbiological parameters that determine its composition, safety and technological aptitude. The physicochemical evaluation includes the quantification of total protein, casein, fat, lactose, total solids (TS), non-fat solids (NGS), free fatty acids (FFA) and citric acid content, in addition to measurements of pH, freezing point (FPD), density and titratable acidity (Turner scale), which are fundamental to estimate the suitability of milk for the production of derivatives such as curd (Calahorrano-Moreno *et al.*, 2022).

At the microbiological level, the somatic cell count (SCC) is used as an indicator of mammary gland health and management hygiene, while different chemical contaminants and pathogens, such as *Escherichia coli*, *Staphylococcus aureus* and *Streptococcus uberis*, are associated with milk spoilage and reduced shelf life. These changes compromise the sensory and technological characteristics of the product, generating economic losses and reducing the final quality in the industry (Zalewska *et al.*, 2025).

Considering the multiple routes of contamination, both direct and indirect, bovine milk can present different contaminants of a chemical and microbiological nature (Calahorrano-Moreno *et al.*, 2022). In order for the product to meet the quality standards established by Brazilian legislation, the somatic cell count (SCC) must be equal to or less than 500,000 cells/mL, while the standard plate count (CPP) — an indicator of the population of viable bacteria per milliliter — must not exceed 300,000 CFU/mL, the latter being related to both

intramammary infections and environmental sources and fomites in contact with milk (Brazil, 2018).

Under ideal conditions, freshly milked milk from healthy cows has a low total bacterial count ($<10^3$ CFU/mL); however, these values can rise rapidly when the product is kept at room temperature. Immediate storage in sanitized containers and refrigerated at 4 °C slows microbial growth until pasteurization is carried out in processing units (Rinaldi *et al.*, 2010; Cheng and Han, 2020). Therefore, the implementation of good hygiene practices in milking, associated with sanitary, nutritional and environmental management, is essential to keep the initial microbial load of milk low. The cleaning of equipment and teats, combined with disease control, reduces SSC and SCC, preventing changes in the composition of the product. The provision of a balanced diet and thermal comfort minimize animal stress and favor the health of the mammary gland. Adequate environmental conditions and waste management complement the prevention of contamination (Mogotu *et al.*, 2022). In addition, the adoption of good management and hygiene practices in dairy production contributes to the significant reduction of SCC and CPP, directly impacting the quality and safety of the final product. The improvement of these parameters is reflected in the greater acceptance of milk in the market, in compliance with legal requirements and in the valorization of the raw material, favoring the competitiveness of the sector (Carneiro; Shah; Ribeiro, 2023).

In summary, the present study aimed to evaluate the influence of the adoption of Good Milking Practices on the Standard Plate Count (SSC) and the Somatic Cell Count (SCC) in dairy farms located in the microregion of Montes Claros, aiming to establish the relationship between hygienic-sanitary practices and the quality indicators of the milk produced.

2 MATERIALS AND METHODS

The research characterized as descriptive, involves the collection and analysis of data regarding Good Agricultural Practices (GAP) and milk quality indexes in rural properties. The purpose was to describe the relationship and evaluate the reciprocal influence between the adoption of BPAs and milk quality within the study period. The theoretical foundations for the analysis of the theme were based on the works of Rocha (2020), Linhares, Landin and Ribeiro (2021), Anésio and Dornelas (2020).

Data collection was carried out in October 2023, in six dairy farms located in the municipalities of Montes Claros, Bocaiúva and Francisco Sá, which are part of the dairy basin in the North of Minas Gerais. The selected properties supplied milk to the same dairy and

were chosen based on the profile of suppliers in the industry, considering criteria such as availability of producers, authorization of access to the facilities, presence of individual cooling tank and logistical feasibility for transporting the samples.

In each property, the information was obtained through direct observations and analysis of records provided by the responsible Veterinarian, including zootechnical indices and animal management. These data supported the completion of a checklist prepared by the researchers, consisting of 19 items related to the conditions of the milking equipment, management during milking and hygiene procedures. Each topic was classified as "yes" when the practice was adopted or "no" when non-existent, allowing the level of compliance with Good Agricultural Practices (GAP) to be identified.

In collaboration with the cooperative responsible for milk collection, the results of laboratory analyses were obtained regarding milk quality, represented by the indicators of tank count (SCC) and (CPP), calculated from the geometric means of the collections carried out in the reference month.

The research, of a documentary nature and quantitative approach, was based on data provided by the Veterinarian and the cooperative, considering only the execution of the practices. Then, the information regarding the management and milking routine were organized, together with the results of SCC and CPP, in electronic spreadsheets (Microsoft Excel®), which allowed the comparative analysis and the quantitative description of the indicators between the farms.

3 RESULTS AND DISCUSSION

In this study, six milk supplier properties that presented samples in non-compliance with the counting parameters of (CCS) and (CPP) were visited, together with the Veterinarian in charge. The visits took place in October 2023, with the collection of information for analysis of the adoption of Good Agricultural Practices (GAP). The evaluation was carried out using checklist spreadsheets, and the results were compiled and presented graphically, allowing the subsequent comparison of the values of SSC and SCC of the tank milk. In the properties evaluated, there was a wide variation in the results obtained, especially in the SCC values, which suggests problems related to the health of the herd. As shown in Table 1, only the P2 farm presented SCC values below the limit established by Normative Instruction No. 76, while all the others presented averages above the maximum allowed value (500,000 cells/mL).

Regarding the results of (CBT), all properties presented values within the limits established by Normative Instruction No. 76, with geometric means below 75,000 CFU/mL, as shown in Table 1. The maximum value allowed by this regulation is 300,000 CFU/mL, evidencing compliance with the results obtained.

Table 1

Geometric mean values of Somatic Cell Count (SCC) and Standard Plate Count (SSC) of tank milk from six dairy farms located in the north of Minas Gerais

Milk indicators	quality	Rural Properties					
		P1	P2	P3	P4	P5	P6
CCS (cells/mL)		702.000	264.000	1.170.000	619.000	551.000	916.000
				0			
CPP		25.000	21.000	23.000	66.000	74.000	51.000

Source: The authors (2025).

The evaluation of the conditions of the equipment (Table 2) showed that, of the six properties analyzed, four presented milking systems in good condition. However, none of them had a record of specialized maintenance of this equipment in the six months prior to the survey. Regarding the cooling tank, only the properties P5 and P6 had been maintained in the period evaluated. The absence of adequate preventive and corrective maintenance directly compromises the microbiological and physicochemical quality of milk, contributing to increases in the values of Somatic Cell Count (SCC) and Standard Plate Count (CPP). These parameters, when high, increase the risk of occurrence of acidic milk and antibiotic residues, which compromises its compliance with legal quality standards. The adoption of appropriate management practices, in line with milk quality standards, favors not only the improvement of the quality of the final product, but also the increase in productivity and profitability of the dairy activity (Anésio; Dornelas, 2020).

Table 2

Operational conditions of milking equipment in six dairy farms located in the north of Minas Gerais

Checklist for Analysis of Milking Equipment Conditions	Rural Properties					
	P1	P2	P3	P4	P5	P6

Is the milking equipment in good condition?	NO	YES	YES	YES	YES	NO
Is the maintenance of the milking equipment up to date? (made in the last 6 months)	NO	NO	NO	NO	NO	NO
Is cooling tank maintenance up to date? (made in the last 6 months)	NO	NO	NO	NO	YES	YES

Source: The authors (2025).

The analysis of milking management (Table 3) revealed that five of the six farms did not meet at least one of the nine parameters evaluated. However, all establishments correctly performed the mug test, pre-dipping, over-milking and post-dipping, in addition to including the management of calf feedings immediately after milking, indicating adherence to the basic practices essential to the procedure. Regarding over-milking, the properties P2, P4 and P5 did not present this stage, and were also those with the lowest mean SCC, which suggests that the absence of this practice can negatively impact breast health and increase the somatic cell count. Additionally, the compliance with the milking line and with the zootechnical records revealed non-conformities only in P4. Regarding the recording of cases of clinical mastitis, only P2 and P5 maintained this control, which is important for epidemiological monitoring and decision-making. Barbosa, Costa and Bombonato (2022), when evaluating five farms in the Alto Paranaíba region (MG), identified critical failures in milking practices such as absence of pre- and post-dipping, inadequate cleaning of teats and lack of equipment maintenance as factors directly related to the increase in the prevalence of mastitis and SCC. The adoption of Good Milking Practices (BPO), combined with staff training and equipment maintenance and calibration, led to a significant reduction in mastitis in the analyzed properties.

Table 3

Evaluation of milking management parameters in six dairy farms located in the north of Minas Gerais

Checklist for milking management evaluation.	Rural Properties					
	P1	P2	P3	P4	P5	P6
Is the mug test performed on all milkings?	YES	YES	YES	YES	YES	YES
It is performed pre-dipping	YES	YES	YES	YES	YES	YES

Is the pre-dipping drying?	YES	YES	YES	YES	YES	YES
Is milking removed before cows are overmilked?	NO	YES	NO	YES	YES	NO
Is post-dipping carried out, or are the cows placed with the cows immediately after milking?	YES	YES	YES	YES	YES	YES
Are cows managed calmly without stress ?	NO	YES	NO	YES	NO	YES
Do you perform milking line?	YES	YES	YES	NO	YES	YES
Do you make zootechnical notes of the animals?	YES	YES	YES	NO	YES	YES
Do you take notes and control cases of clinical mastitis?	NO	YES	NO	NO	YES	NO

Source: The authors (2025).

The evaluation of the hygiene practices of the milking equipment indicated that five of the six properties fully complied with the recommended protocols, according to the checklist adopted in the research. Only the P6 farm presented a non-conformity, related to the absence of the pre-rinsing step recommended as the first phase of immediate cleaning after milking. This step is essential for the removal of milk residues not conducted to the cooling tank, avoiding the formation of biofilms and facilitating the action of subsequent detergents and sanitizers. By relating the diagnosis of the hygienic-sanitary conditions of the animals and the milking equipment with the results of SCC and SSC (Table 1), it was observed that, although the P6 farm had a satisfactory performance in the parameters related to the conditions of the animals and the organization of the milking line, it presented high values of SCC and SSC in the milk of the tank. This result may be associated with deficiencies in the milkers' personal hygiene procedures, an aspect that was not evaluated in this study. Similar results were described by Linhares, Landin, and Ribeiro (2021), who, when analyzing two properties in the municipality of Bom Jardim de Minas (MG), found that the P1 property, even correctly following the pre-dipping and post-dipping practices, had high SCC. The authors suggest that, in these cases, the cause may be related to the difficulty in diagnosing and controlling subclinical mastitis, reinforcing the need for complementary health monitoring strategies.

Table 4

Characterization of the procedures for cleaning milking equipment in six dairy farms located in the north of Minas Gerais

Checklist for Milking Equipment Cleanliness Assessment	Rural Properties					
	P1	P2	P3	P4	P5	P6
Are liners disinfected between milkings?	YES	YES	YES	YES	YES	YES
Pre-rinse is performed	YES	YES	YES	YES	YES	NO
Hot water cycle with detergent	YES	YES	YES	YES	YES	YES
Physical removal of waste	YES	YES	YES	YES	YES	YES
Acid rinse	YES	YES	YES	YES	YES	YES
Equipment and utensils are cleaned and sanitized	YES	YES	YES	YES	YES	YES
Is there a person responsible for monitoring the hygiene of utensils and equipment?	YES	YES	YES	YES	YES	YES

Source: The authors (2025).

According to Nascimento *et al.* (2021), sanitization carried out with the use of disinfectants reduces the burden of pathogens to levels considered safe. In this context, the producers' technical knowledge about the hygiene procedures of the milking equipment is decisive to ensure the quality of the milk throughout the production stages and based on armazenamento. Com checklist tables presented, the data obtained were integrated, aiming to correlate the main indicators of raw material quality with the number of items served in each property. This analysis allowed us to identify which parameters exerted the greatest influence on the maintenance of low values of these indicators, as shown in Table 5.

Table 5

Evaluation of the microbiological quality and somatic cell count (SCC) of tank milk according to the management practices identified in the checklists applied

Number of practices analyzed performed in each checklist	Rural Properties					
	P1	P2	P3	P4	P5	P6
Conditions of milking equipment	0	1	1	1	2	1
Evaluation of milking management	6	9	6	6	8	7

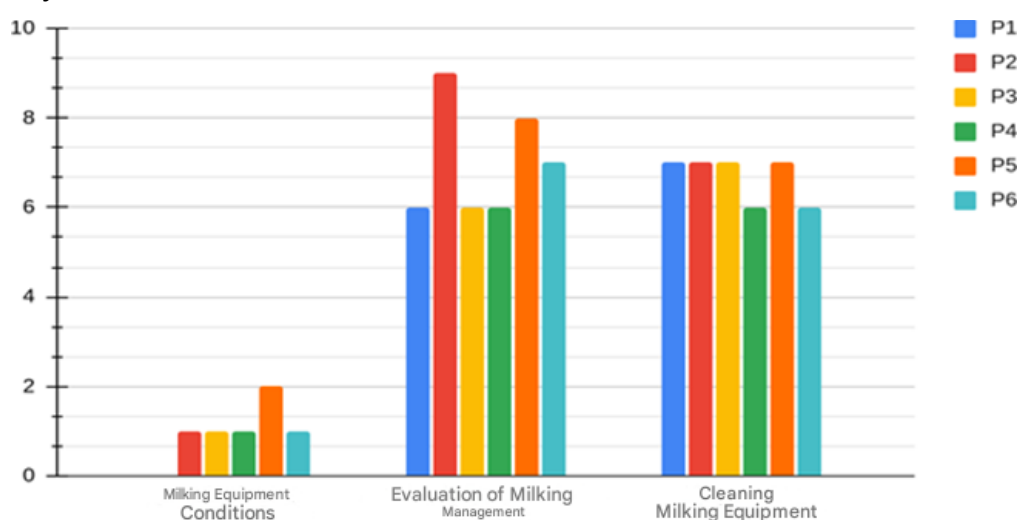
Milking Equipment Cleaning	7	7	7	6	7	6
Total Quantity	13	17	14	13	17	14

Source: The authors (2025).

The data presented in Table 5 were graphically organized in Figure 1, allowing a better visualization and comparison of the performance of each property in terms of the practices adopted.

Figure 1

Comparison of good agricultural practices observed and evaluated through checklists on each property



Source: The authors (2025).

It is observed that the rural property P2 (represented in red) presented the highest sum of good agricultural practices (GAP), reflected in the lowest values of count (SCC), with 264,000 somatic cells/mL, and (CPP), with 21,000 CFU/mL. These results indicate a higher quality of the milk produced. In contrast, the P3 (yellow) property obtained the highest levels of SCC (1,170,000 somatic cells/mL) and CPP (23,000 CFU/mL), showing the lowest milk quality among those evaluated. Thus, as shown in Table 1, the classification of the farms in ascending order of SCC parameter associated with herd health was: P2, P4, P5, P1, P6 and P3. In relation to the SSC indicator of hygiene during milking and management, the order was: P2, P3, P1, P6, P4 and P5. According to Linhares, Landin, and Ribeiro (2021), the joint analysis of CCS and CPP, combined with the application of checklists, allows the identification of flaws in the processes of obtaining milk, facilitating the implementation of corrective measures. However, the effectiveness of these actions depends directly on the commitment

of rural producers to modify inappropriate practices and invest in technologies, products and equipment that ensure higher milk quality.

4 CONCLUSION

Farms that correctly adopted BPAs presented, in most cases, lower SCC and CPP, indicating better milk quality and contributing to food safety and public health. The quality of milk impacts the entire production chain, benefiting producers, industry and consumers. Products with better hygienic-sanitary standards generate greater confidence in the market and increase the competitiveness of the dairy sector, especially in the face of quality bonus policies. Some farms that adopted management practices still had high SCC rates, which may be related to the low effectiveness in the execution of the practices, an aspect not analyzed in this study. Factors such as the quality of milking cleanliness can be addressed in future research.

REFERENCES

- Anésio, G. C. L., & Dornelas, A. M. (2020). Qualidade do leite. Encontro Internacional de Gestão, Desenvolvimento e Inovação (EIGEDIN), 4(1), 1-12. <https://periodicos.ufms.br/index.php/EIGEDIN/article/view/11672/8202>
- Bahlo, C., & et al. (2019). The role of interoperable data standards in precision livestock farming in extensive livestock systems: A review. *Computers and Electronics in Agriculture*, 156, 459-466. <https://doi.org/10.1016/j.compag.2018.12.007>
- Barbosa, E. R., Costa, E. S., & Bombonato, N. G. (2022). Novas propostas e estratégias para redução da CCS em fazendas que possuem incidência e prevalência da mastite no rebanho leiteiro, na região do Alto Paranaíba (MG). *Revista Perquirere*, 19(1), 226-244. <https://revistas.unipam.edu.br/index.php/perquirere/article/view/2928/519>
- Bianchi, M. C., & et al. (2022). Diffusion of precision livestock farming technologies in dairy cattle farms. *Animal*, 16(11). <https://doi.org/10.1016/j.animal.2022.100650>
- Brasil. Ministério da Agricultura, Pecuária e Abastecimento. (2020). Valor Bruto da Produção Agropecuária. <https://www.gov.br/agricultura/pt-br/assuntos/noticias/vbp-e-estimado-em-r-689-97-bilhoes-para-2020/202003VBPelaspeyresagropecuariapdf.pdf>
- Brasil. Ministério da Agricultura, Pecuária e Abastecimento. (2018). Instrução Normativa nº 77, de 26 de novembro de 2018. Diário Oficial da União. <https://www.gov.br/agricultura/pt-br/assuntos/producao-animal/plano-de-qualificacao-de-fornecedores-de-leite/arquivos-do-pqfl/IN772018QualificodefornecedoresdeleiteatualizadapelaIN5919.pdf>
- Calahorrano-Moreno, M. B., & et al. (2022). Contaminants in the cow's milk we consume? Pasteurization and other technologies in the elimination of contaminants. *Research*, 11, 91. <https://doi.org/10.12688/f1000research.108779.1>

- Carneiro, I. A., Sousa, F. A., & Ribeiro, G. L. (2023). Qualidade de leite: estudo comparativo de padrões microbiológicos. *Revista Educação, Saúde e Meio Ambiente*, 2(13), 761-772. <https://revistas.unicerp.edu.br/index.php/vitae/article/view/2525-2771-v2n13-4>
- Cheng, W. N., & Han, S. G. (2020). Bovine mastitis: risk factors, therapeutic strategies, and alternative treatments – a review. *Asian-Australasian Journal of Animal Sciences*, 33(11), 1699-1713. <https://doi.org/10.5713/ajas.20.0156>
- Linhares, J. C., Landin, A. P. M., & Ribeiro, L. F. (2021). Avaliação das boas práticas agropecuárias (BPA's) na ordenha em relação à qualidade do leite. *Revista Gestão, Tecnologia e Ciências*, 10(32), 1-35. <https://revistas.fucamp.edu.br/index.php/getec/article/view/2527>
- Mogotu, M. W., & et al. (2022). Assessment of hygiene practices and microbial safety of milk supplied by smallholder farmers to processors in selected counties in Kenya. *Tropical Animal Health and Production*, 54(4), 220. <https://doi.org/10.1007/s11250-022-03214-7>
- Nascimento, G. R., & et al. (2021). Caracterização das práticas atuais da limpeza de tanques de refrigeração de leite na região do semiárido brasileiro. *Research, Society and Development*, 10(13), 2-6. <http://dx.doi.org/10.33448/rsd-v10i13.20192>
- Rinaldi, M., Li, R. W., & Bannerman, D. D. (2010). A sentinel function for teat tissues in dairy cows: dominant elements of the innate immune response define early *E. coli* mastitis response. *Functional e Integrative Genomics*, 10, 21-38. <https://doi.org/10.1007/s10142-009-0133-z>
- Rocha, D. T., Carvalho, G. R., & de Resende, J. C. (2020). Cadeia produtiva do leite no Brasil: produção primária. <http://www.infoteca.cnptia.embrapa.br/infoteca/handle/doc/1124858>
- Rocha, J., & et al. (2020). Avaliação da qualidade do leite “in natura”: um estudo de caso. *Ciência e Natura*, 42, 1-17. <https://doi.org/10.5902/2179460X40464>
- Zalewska, M., & et al. (2025). The quality and technological parameters of milk obtained from dairy cows with subclinical mastitis. *Journal of Dairy Science*, 108(2), 1285-1300. <https://doi.org/10.3168/jds.2024-25346>