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https://doi.org/10.22239/2317-269x.01738

Quality of bovine milk produced in Brazil - physical-chemical and microbiological parameters: an integrative review

Qualidade do leite bovino produzido no Brasil - parâmetros físico-químicos e microbiológicos: uma revisão integrativa

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Received: 04 Aug 2020
Approved: 01 Feb 2021

ABSTRACT

Introduction: Milk is a rich and essential food to human health. The quality of milk can be influenced by several factors. **Objective:** To conduct an integrative review of scientific articles available on the Capes portal of journals, focused on making a diagnosis of milk quality through analysis of physical-chemical and/or microbiological parameters. **Method:** The descriptor used in the research was "milk quality" and to exclude from the search all studies that did not refer to bovine milk, "NOT" "human, maternal, buffalo, goat, goat, sheep" was typed. The following search mechanisms were also selected: "last ten years", "articles" and "any language", generating a total of 5,084 articles. Of this amount, 15 articles published in the period from 2012 to 2020 were selected. **Results:** The analysis of the articles allowed to infer that the physical- chemical aspects did not show significant changes in most of the analyzed samples; however, 93% of the articles showed microbiological changes in the milk and, therefore, decreasing of its quality. **Conclusions:** There is a need for the adoption of good farming and manufacturing practices, besides effective ways of storing collected milk to guarantee its quality, without compromising the health of the consumer and the financial return of the producer.

KEYWORDS: Milk; Analysis Methods; Food Quality; Cattle; Food Microbiology

RESUMO

Introdução: O leite é um alimento rico e essencial à saúde humana. A qualidade do leite produzido pode ser influenciada por diversos fatores. **Objetivo:** Realizar uma revisão integrativa de artigos científicos disponíveis no portal de periódicos da Capes, que tiveram como foco realizar um diagnóstico da qualidade do leite por meio de análises de parâmetros físico-químicos e/ou microbiológicos. **Método:** O descritor utilizado na pesquisa foi "qualidade do leite" e, para excluir da busca todos os estudos que não se referiam a leite bovino, digitou-se "NOT" "humano, materno, bubalino, cabra, caprino, ovino". Foram selecionados ainda os seguintes mecanismos de busca: "últimos dez anos", "artigos" e "qualquer idioma", gerando um total de 5.084 artigos. Desse montante, foram selecionados 15 artigos publicados no período de 2012 a 2020. **Resultados:** A análise dos artigos permitiu inferir que os aspectos físico-químicos não demonstraram alterações significativas na maior parte das amostras analisadas, porém 93% dos artigos demostraram alterações microbiológicas no leite e tendo, por isso, diminuição de sua qualidade. **Conclusões:** Mostra-se a necessidade de adoção de boas práticas agropecuárias e de fabricação, além de formas eficazes de armazenamento do leite coletado para garantir a sua qualidade, não comprometendo a saúde do consumidor e o retorno financeiro do produtor.

PALAVRAS-CHAVE: Leite; Métodos de Análises; Qualidade dos Alimentos; Bovinos; Microbiologia de Alimentos

INTRODUCTION

Brazil has dairy farming as one of its main economic activities and, according to the Food and Agriculture Organization of the United Nations[1], é o quarto produtor mundial de leite, it is the fourth world producer of milk, behind only the United States, India, and China. Dairy farming is practiced throughout Brazil, but there are producers of different technological and organizational levels, some from family farming or small cooperatives and others with properties of high technological level. This activity is important for the country, both in the social and economic context[2]. The milk production chain generates income and taxes, and dairy cattle is a link for the development of the primary sector, as well as having an important socioeconomic function[3].

In addition to the economic issue, through the generation of employment and income for the population, milk is still essential in the food supply[4] and can be considered one of the most complete foods[5], standing out for being a food of high nutritional value and being a source of proteins, lipids, sugars, minerals, and vitamins. In addition, it is necessary at all stages of human development, from birth to old age[6].

According to Martins et al.[7], the quality of the milk produced can be influenced by several factors, including those associated with the management, feeding, and genetic potential of the herds or those related to the collection and storage of milk, and refrigeration drastically reduces the multiplication of microorganisms in the milk.

The health of the mammary glands is another decisive factor in the quality of milk. During the milking process, for example, bacterial contamination can occur from the udder, the milker's hands, milking equipment, or poorly sanitized barrels and buckets. In these cases, the greatest contamination is by environmental microorganisms such as coliforms, particularly *Escherichia coli*. This contamination can also occur because of mastitis, which is a disease caused by both contagious pathogens and microorganisms from the environment[6]. Milk to be considered of good quality must have chemical, microbiological (total bacterial count - TBC), organoleptic, and somatic cell count (SCC) composition that meet the parameters required by law[8].

So that milk contamination does not occur, care such as hygiene of the milker, treatment of sick cows, cleaning, and daily disinfection of all equipment used in milking are essential. In addition, cooling the milk immediately after milking and collecting it in bulk are other important measures to ensure the microbiological quality of the milk, that is, the implementation of good practices in the stages of production and obtaining the milk, called good agricultural practices (GAP), is essential[9].

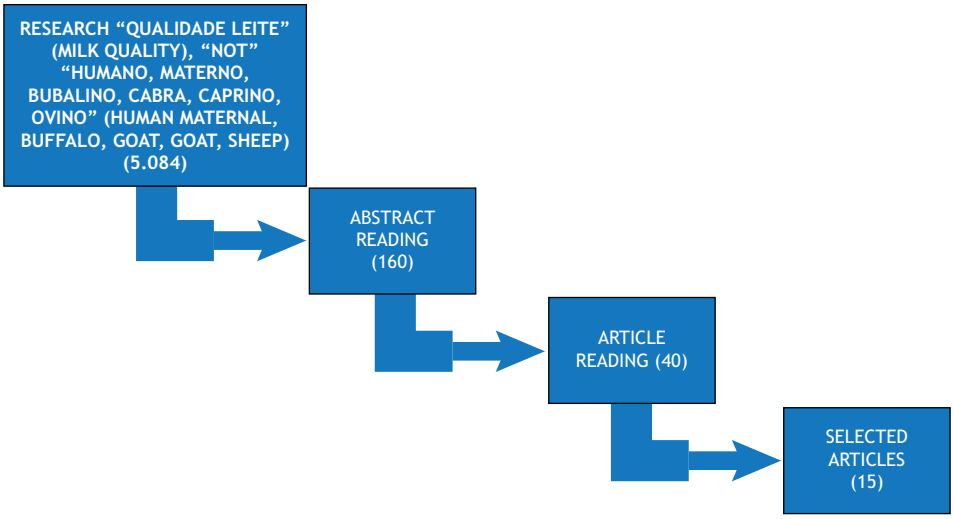
GAP consists of the production, processing, storage, transport, and distribution of raw materials, inputs, and agri-food products, maintaining all production links until they reach consumers. This provides a guarantee of quality and safety of milk quality, as well as adding value to the food production system and prevents possible contamination during the process of obtaining the product[9]. In addition, the Ministry of Agriculture, Livestock and Supply (MAPA) has milk quality monitoring programs, such as the *Programa Mais Leite Saudável* (PMLS) (More Healthy Milk Program, in English), which develops strategies to monitor the quality of milk produced in Brazil using tools such as the Brazilian Milk Quality and Monitoring System (SIMQL)[10].

This article aimed to carry out an integrative review of studies on the quality of bovine milk, *in natura* or processed, in which analyzes of physical-chemical parameters such as: acidity; density; percentage of fat, lactose, proteins, urea nitrogen; cryoscopic index; defatted dry extract (DDE) and total dry extract (TDE); and/or microbiological parameters such as: TBC, SCC, total and thermotolerant coliforms, *Salmonella* spp., mesophilic, psychrotrophic, and mastitic microorganisms such as *Staphylococcus* spp. Normative Instructions (NI) No. 76, of November 26, 2018[11], and No. 77, of November 26, 2018[12], of MAPA, regulate, respectively, the identity and quality characteristics that refrigerated raw milk, pasteurized milk, and type A pasteurized milk must present and the criteria and procedures for the production, packaging, conservation, transport, selection, and reception of milk.

METHOD

The journal platform of the Coordination for the Improvement of Higher Education Personnel (CAPES) was used. In the "advanced search" option, the descriptor "qualidade do leite" (milk quality) was typed for the search and as an exclusion criterion, "NOT" was typed "humano, materno, bubalino, cabra, caprino, ovino" (human, maternal, buffalo, goat, goat, sheep), in order to exclude the types of milk that were not bovine. In the field "data da publicação" (date of publication) we selected "últimos 10 anos" (last 10 years), in the field "tipo de material" (type of material), we selected "artigos" (articles) and in the field "idioma" (languages) we selected "qualquer idioma" (any language). A total of 5,084 articles were obtained. After reading the titles, 160 scientific articles were selected that mentioned the quality of bovine milk, which had their abstracts read. From this reading, 40 articles were selected for full reading. These articles included analyzes of the quality of bovine milk in different regions of Brazil. Of these, 15 articles from the last eight years (2012 to 2020) were selected. These articles presented analyzes of physical-chemical and/or microbiological parameters of milk and one of them (Ribeiro Neto et al.[13]) also presented a comparison of the influence of the periods of the year. The Figure shows the steps used to choose the articles.

To analyze the selected articles, the technique proposed by Bardin[14] called content analysis was used. From the reading of the selected articles, three categories were defined for the presentation of the results and discussion: milk collection and storage, physicochemical quality of milk, and microbiological quality of milk.



Source: Elaborated by the authors, 2020.

Figure. Steps used to choose the articles selected in this integrative review.

RESULTS AND DISCUSSION

The 15 selected articles presented results of physical-chemical and/or microbiological analyzes of bovine milk, according to the inclusion criteria. The Chart presents the selected articles, their objectives, and the main results obtained. The physical-chemical and microbiological parameters that were in disagreement with the legislation[11] were listed in more than 50% of the analyzed samples, in addition to the microorganisms found.

Milk collection and storage

The milk collection procedure and its transport need to follow international standards so that it is possible to compare analyzes from different laboratories. This promotes the diagnosis of milk quality on farms and in the industry, reaching consumers[28].

Samples were collected in sterilized flasks and kept in isothermal boxes in 40% of the analyzed articles, that is, six studies[15,17,19,20,24,26]. According to Leira et al.[29], low temperatures prevent or reduce the multiplication of most bacteria and decrease the activity of some degradative enzymes.

Four studies[13,16,22,23] used sterilized vials containing bronopol and azidiol-type preservatives. Preservatives are used to preserve the properties of the samples until they arrive at the laboratory for the analysis, and the vials must be opened only at the time of collection, being immediately closed afterwards[30]. Five studies[7,18,21,25,27], which corresponded to 33% of the analyzed articles, did not specify the form of collection and storage of milk samples.

Physicochemical quality of milk

Milk quality is evaluated by physical-chemical and microbiological parameters. Among the physical-chemical parameters we can mention analyzes such as: stability to alizarol, titratable acidity, relative density, and cryoscopic index. The composition of the milk is also an important indicator for its quality and, due to this, analyzes of the percentage of fat, protein, and lactose are carried out, in addition to TDE and DDE. These parameters reflect the health of the animals, the absence of chemical residues, and the conditions for obtaining and storing milk[31].

Of the 15 selected articles, ten (67%) presented data from the physicochemical analysis of milk. Bastos et al.[17], Molina et al.[18], Ribeiro Júnior et al.[21], and Silva et al.[25] performed acidity test, and Bastos et al.[17] and Silva et al.[25] found values as established in the legislation, from 0.14 g to 0.18 g of lactic acid/100 mL[11]. Molina et al.[18] and Ribeiro Junior et al.[21] found acidity values below the allowed in 61% and 54% of the samples, respectively, characterizing milk acidification. The acidity of milk is caused by the metabolism of microorganisms that cause the degradation of lactose, thus promoting an increase in the lactic acid content. Alkalinity can be attributed to mastitis or the addition of neutralizers[13]. Good quality milk should have a pH between 6.6 and 6.8, therefore slightly acidic[31].

Bastos et al.[17], Molina et al.[18], and Ribeiro Júnior et al.[21] performed relative density tests. The percentage of samples in disagreement for this parameter was, respectively, 10.3%, 10.0%, and 5.4%, thus, the three studies described values within the normal range for most samples.

Fresh, quality milk must have a relative density between 1.028 g/mL and 1.034 g/mL, at a temperature of 15°C[11]. The addition of water, in cases of fraud, reduces the density of the milk and the content of proteins, lactose, and mineral salts increase it[32].

Among the analyses, those of total solids or TDE were also performed by Bastos et al.[17], Martins et al.[7], Motta et al.[19], and Ribeiro Neto et al.[13] and none of the studies found values below the minimum reference content that is established by the current

Chart. Objectives of the selected articles, main results, and parameters in disagreement with the legislation[11].

Reference	Objectives	Main results and parameters in disagreement
Martins et al.[7]	Evaluate the microbiological and physicochemical quality and verify the occurrence of substances inhibiting microbial growth in raw milk from the individual and collective expansion tanks of a dairy industry located in the municipality of Rio Pomba, Minas Gerais.	Psychrotrophs, SCC, and presence of antimicrobials
Ribeiro Neto et al.[13]	To evaluate the quality of refrigerated raw milk under federal inspection of industries in several states of the Northeast region regarding chemical composition, SCC, and TBC.	SCC and TBC
Almeida et al.[15]	To characterize the refrigerated raw milk production system adopted in family farms in the municipalities of Bocaiúva, Francisco Sá, and Montes Claros, in the north of Minas Gerais, identifying the obstacles to milk production within the parameters established by the current legislation.	Presence of coliforms and *Staphylococcus* spp.: *S. aureus*, *S. intermedius*, *S. haemolyticus*, and *S. saprophyticus*
Angelis et al.[16]	It aimed to compare the TBC and SCC of raw milk obtained by manual and mechanized milking, and to measure the temperature of the milk at the time of reception at the dairy, in the city of Argirita, Minas Gerais.	TBC and SCC
Bastos et al.[17]	To evaluate the quality of refrigerated raw milk produced in family production units, in the south of Espírito Santo, to verify compliance with legal standards.	DDE and TBC, presence of antibiotics, cadmium, and lead
Molina et al.[18]	To evaluate the presence of foreign or fraudulent substances and the physicochemical and microbiological characteristics of the milk sold informally in the municipality of Itaqui, Rio Grande do Sul.	Acidity, TBC, SCC, and antibiotic residues
Motta et al.[19]	To investigate the main indicators of quality, nutritional constituents, presence of microorganisms, and detection of substances that inhibit bacterial growth in samples of informal cow's milk commercialized informally in the Southeast region of the state of São Paulo.	SCC and TBC Isolation of *Staphylococcus* spp., *Streptococcus* spp. and Enterobacteriaceae
Nascimento Neta et al.[20]	To evaluate the microbiological quality through the detection of spoilage and pathogenic bacteria in addition to the detection of antibiotic residues in refrigerated raw milk produced on family farms in the city of Alegre, Espírito Santo.	Presence of total coliforms and *Escherichia coli*
Ribeiro Júnior et al.[21]	Evaluate microbiological and physicochemical parameters of refrigerated raw milk produced in 99 properties in the region of Ivaiporã, Paraná, from August to October 2010.	TBC
Rigolin-Sá et al.[22]	To evaluate the presence of mastitis in cattle producing refrigerated raw milk, produced in 11 dairy farms in the southwest of Minas Gerais in the period 2012 and to verify compliance with the legislation (NI n° 62).	TBC and SCC. Presence of total and thermotolerant coliforms
Rosa et al.[23]	CCS, milk composition and urea nitrogen analyzed in order to verify the percentage of tank and individual samples of animals that met the parameters of the legislation (NI n° 51), in addition to indicating the best production system to ensure the best quality of milk in the central region of Rio Grande do Sul.	SCC
Sequetto et al.[24]	To evaluate the microbiological quality of refrigerated raw milk samples, stored in expansion tanks of rural properties in Zona da Mata Mineira, as well as the influence of types of milking and storage in community and individual tanks.	Presence of total coliforms and *Escherichia coli*, 40% mesophilic aerobic bacteria
Silva et al.[25]	To verify the quality of UHT milk from three brands, through physical-chemical and microbiological analyzes in Campos Gerais, Minas Gerais.	
Sola et al.[26]	To characterize the microbiological aspects related to the milk production of the Curraleiro Pé-Duro cattle herd, evaluating 226 samples of raw milk collected from January 2013 to January 2014, aiming at the search for *Salmonella* sp. in a rural property located in the state of Goiás.	Presence of *Salmonella* sp., *being S. heidelberg* and *S. schwarzengrund* most frequent
Reis et al.[27]	To carry out the diagnosis of 20 properties producing raw milk, in a family economy regime, aiming at the characterization of productive factors and their associations with aspects related to milk quality. All properties are located in the Alto Rio Grande micro-region, south of Minas Gerais.	SCC and TBC

Source: Elaborated by the authors, 2020.
SCC: Somatic cell count; TBC: Total bacterial count; DDE: Defatted dry extract; NI: Normative Instruction; UHT: Ultra High Temperature.

legislation of 11.4 g/100 g[11]. TDE or total solids can be understood as the sum of the concentration of all milk components, with the exception of water. On the other hand, non-fat solids (SNG) or DDE comprise all elements of milk, except water and fat, consisting of the difference between TDE and fat content[31].

Six articles[7,13,17,18,19,21] performed DDE or non-fat solids analysis. Bastos et al.[17], Molina et al.[18], and Motta et al.[19] found levels below the reference value that is established by current legislation, which is at least 8.4 g/100 g[11], for 85.0%, 61.9%, and 43.0% of samples, respectively.

The feeding of cattle is one of the main elements that influence the quality of milk, requiring diets with balanced nutritional values[29]. Of the articles analyzed, 53%, that is, eight articles[7,13,17,18,19,21,23,27] described results of analysis of the percentage of fat. In all studies, this parameter was within the established range, which is at least 3.0 g/100.0 g[11], for most samples.

Four of these studies[7,13,17,23] had all samples within the regularity and Molina et al.[18], Motta et al.[19], Reis et al.[27], and Ribeiro Junior et al.[21] reported 67.00%, 62.00%, 83.83%, and 75.00% of the samples in accordance with legislation, respectively. Ribeiro Neto et al.[13] observed a large variation of this parameter in their study, but this variation kept rates above the minimum limit defined by the legislation, with an average of 3.7 g/100 g. The percentage of fat in milk is positively influenced by the amount of fiber in the diet, that is, when there is a higher fat content, it means that there is greater availability of quality fiber in the diet of the herd[33]. Milk has an average fat concentration of 3.6%, however, in cases where the concentration is less than 2.0%, adulteration of this milk should be considered. Fat is one of the components that suffers the most adulteration, which may occur by adding water and/or skimming milk[18].

Seven studies[7,13,18,19,21,23,27] described results of percentage of milk protein. According to legislation, these levels must be at least 2.9 g/100 g[11]. Five studies[7,13,18,23,27] reported having all samples within the established and Motta et al.[19] and Ribeiro Junior et al.[21] reported 77.00% and 86.86% of samples in accordance with legislation, respectively. According to Leira et al.[29], the percentage of protein varies according to the breed and is proportional to the amount of fat present in the milk, that is, the greater the percentage of fat in the milk, the greater the protein content. For Ribeiro Neto et al.[13], the levels of fat and protein, and DDE were influenced in the analyzed periods of the year, with the levels of fat and protein being lower in the driest months of the year and DDE in the wettest periods.

However, when urea nitrogen levels were evaluated, Motta et al.[19] found levels below 10 mg/dL in 73.00% of the samples. Urea nitrogen does not have levels established by current legislation. According to Leão et al.[34], urea nitrogen has ideal values between 10 and 14 mg/dL, and these values are a consensus among several studies that sought to quantify a range in which this parameter would not have a negative effect on animals. There are several factors that alter the concentration of urea nitrogen in milk. Among them we can mention the diet, the production system, the season of the year, and the method of analysis, and a low protein diet can reduce the concentration of urea nitrogen in milk.

Four studies[7,13,21,23] also performed analyzes of lactose percentage and cryoscopic index, finding acceptable levels for these parameters. According to NI No. 76/2018[11], the minimum level of lactose in milk must be 4.3 g/100 g and the cryoscopic index must be between -0.512°C and -0.536°C. Lactose is the sugar in milk and comprises a good part of the total solids, while the cryoscopic index serves to identify fraud in milk. The freezing temperature of milk is lower than that of water due to dissolved substances, mainly lactose and mineral salts[31]. Silva et al.[25] and Molina et al.[18] carried out other analyzes to verify fraud in the milk, such as the presence of hydrogen peroxide and chlorides, with negative results.

Microbiological quality of milk

In order to have a parameter on the quality of milk produced on rural properties or processed by the industry, microbiological analyzes are necessary. According to MAPA's NI No. 76/2018[11], the necessary analyzes are TBC and SCC. The selected articles also presented analysis results for the research of mesophilic and psychrotrophic microorganisms, total coliforms, thermotolerant and *E. coli*, *Salmonella* spp., *Staphylococcus* spp., *Streptococcus* spp. and fungi[7,13,16,18,19,22,23,27].

Somatic cells are present in milk and are made up of the sloughing cells of the secretory epithelium and the body's leukocytes, coming from the bloodstream, including monocytes, lymphocytes, neutrophils, and macrophages. An increase in this number may be an indicator of subclinical mastitis[6]. This analysis is used as an indirect diagnostic criterion for subclinical mastitis, and there are several factors that influence SCC in milk, but infection of the mammary gland is the cause of greater interference. Mastitis causes an increase in this number, due to the defense cells migrating from the blood to the site of infection, in order to fight the causative agent[35].

Ten articles[7,13,16,17,18,19,21,22,23,27], 67% of those evaluated in this review, presented SCC data. The results showed that in eight[7,13,16,18,19,22,23,27], that is, 80% of these studies, the values were above the limit established by the legislation[11], which is a maximum of 500,000 CS/mL, in more than 50% of the analyzed samples.

Eight studies[13,16,17,18,19,21,22,27] presented the results for TBC and all reported values above the limits established by the legislation, which is a maximum of 300,000 colony forming units (CFU)/mL[11], for most samples (more of 50%). The TBC refers to the total number of aerobic microorganisms, allowing the evaluation of milk quality from the moment of milking to its storage[6].

According to Martins et al.[7], the most used analysis to monitor the microbiological quality of raw milk is the standard count of aerobic mesophilic microorganisms on plates, which quantifies the number of viable cells of microorganisms present in raw milk. For Santos et al.[36], mesophiles are microorganisms that multiply rapidly when milk is not stored under refrigeration and psychrotrophs are microorganisms that multiply at lower temperatures, from 0°C to 7°C.

Of the selected articles, 35%, that is, five[7,15,17,20,24], presented results for counting mesophilic and psychrotrophic organisms and reported psychrotrophic levels above 10^4 CFU/mL for respectively 90%, 30%, 16%, 10%, and 10% of the analyzed samples. Mesophilic and psychrotrophic organisms do not have levels specified in current legislation, but levels from 10^5 CFU/mL are sufficient to cause losses in milk composition. The refrigeration process of collected raw milk favors the proliferation of microorganisms from the psychrotrophic group, capable of developing at temperatures below 7°C[7]. The psychrotrophs found in milk are of environmental origin and may come from the soil, water, vegetation, or from the teat/udder and from inadequately sanitized milking equipment. These microorganisms are destroyed by heat treatment, but their enzymes are resistant[37].

Other groups of important mesophilic organisms in milk analysis are total and thermotolerant coliforms[29]. Among the articles

analyzed in this integrative review, five of them[15,20,22,24,25] presented data from the analysis of microorganisms from the coliform group (total and/or thermotolerant) and *E. coli*. The results showed high contamination by this group of microorganisms in four of the studies carried out[15,20,22,24], and only for Silva et al.[25] the results were negative.

The presence of thermotolerant coliforms and *E. coli* is associated with materials of fecal origin and is an indicator of unsatisfactory hygienic conditions. These microorganisms in high numbers indicate lack of hygiene in milking and inadequate cleaning of equipment and utensils that come into contact with milk and contaminated water[9]. In the etiology of mastitis there are contagious and environmental microorganisms. The main contagious agents are *S. aureus* and *S. agalactie* and among the environmental ones, *E. coli*, *Klebsiella pneumoniae* among others[38]. It should be noted that Silva et al.[25] performed analyzes on Ultra HighTemperature (UHT) milk. Sterilization, by the UHT process, gives rise to the so-called long life milk and aims to obtain a bacteriologically sterile product[39], which explains the negative result in the analyses.

Among the articles analyzed in this review, three also showed data from analysis of mastogenic microorganisms such as *Staphylococcus* sp[15,19,20], and Motta et al.[19] also performed the analysis of enterobacteria, streptococci, and fungi. The results showed high contamination in the study by Nascimento Neta et al.[20], and the study by Almeida et al.[15] reported isolation of *Staphylococcus* spp. in 9.05% (36) of the total samples analyzed, with the identified species: *S. aureus* (52.80%), *S. intermedius* (5.60%), *S. haemolyticus* (19.40%), and *S. saprophyticus* (22.20%). Martins et al.[7], Bastos et al.[17], and Molina et al.[18] described the presence of antimicrobial substances in the milk analyzed.

The microorganisms found in milk, in addition to causing changes such as the degradation of fat, proteins, and carbohydrates, which makes the product unacceptable for consumption, can cause foodborne infections. One of the most common examples of agents causing these infections are the mesophilic microorganisms of the genus *Salmonella*, which cause intestinal disorders, in addition to vomiting and malaise[40]. The study by Sola et al.[26] presented results of analysis of *Salmonella* spp. finding six isolates in 226 milk samples of the Curraleiro Pé-Duro breed. Coliform microorganisms, *Salmonella* spp., as well as mastogenic ones such as *Staphylococcus* spp., do not show levels specified in current legislation, NI No. 76/2018[11]. The articles analyzed in this review used NI No. 62, of December 29, 2011[41], and NI No. 51, of September 18, 2002[42], />, which aimed to regulate the production, identity, and quality of A, B, C, raw, refrigerated, and pasteurized milk, in addition to collection and transport. These laws were repealed by the current legislation: NI No. 76/2018[11] and NI No. 77/2018[12].

CONCLUSIONS

The analysis of the articles in this integrative review showed that the physical-chemical parameters did not show significant changes in most of the samples analyzed in the studies in question. Regarding the microbiological parameters, 93% of the studies analyzed here showed microbiological alterations in the milk, thus reducing its quality. The exception occurs in a single study that analyzed milk sterilized by the UHT process. TBC, SCC, and counts of mesophiles and psychrotrophs outside the established standards, contamination by microorganisms of the coliform group, *Salmonella* spp., *Staphylococcus* spp.,fungi, and presence of antimicrobials in the analyzed samples were verified.

The adoption of GAP and manufacturing is important to remedy this contamination, as well as the education of producers regarding the hygienic-sanitary issues involved in the milking process. The form of milk storage is also essential to guarantee its quality, thus avoiding losses in milk quality, which also cause economic losses to the producer, as well as a risk to the health of the consumer population.

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Author's Contributions

Müller TM – Conception, planning (study design), acquisition, analysis, data interpretation, and writing of the work. Rempel CR – Conception, planning (study design), data interpretation, and writing of the work. All authors approved the final version of the work.

Conflict of Interests

The authors inform that there is no potential conflict of interest with peers and institutions, politicians, or financial in this study.