

Physicochemical Characterization of Bovine Milk Produced in the Amazon Region

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Abstract

Bovine milk is a food consumed by people of different age groups and provides essential nutrients to the diet. In Brazil, it is one of the most important products of Brazilian agriculture, being essential in the supply of food and in the generation of employment and income for the population in all regions of the country. In this context, the objective of this work was to verify the physicochemical characteristics of samples of milk produced in the northern region of the Brazilian Amazon. Eighteen samples were analyzed in which the average acidity content was 0.18 ± 0.13 , in which 4 of the samples did not comply with Brazilian legislation, which establishes the titratable acidity content must be between 0.14 and 0.18 expressed in grams of acid lactic acid / 100 mL. Monitoring the quality of bovine milk must be constant in health surveillance actions to protect consumer health.

Keywords: quality; acidity; health

1. INTRODUCTION

Milk has nutritional importance in human nutrition because it provides important macro and micronutrients for growth, development and maintenance of health (CERQUEIRA *et al*; 2020; GONÇALVES, 2018). It is produced all over the world, including in developing countries and family farming systems. It has economic importance as a source of income and survival for a large part of the world's population, in addition to being a vital source of nutrition. This product is food rich in proteins, fats and minerals, these attributes have made milk production gaining prominence and leading to a more careful look at its production, especially in its quality (BEZERRA *et al.*, 2022).

In Brazil, milk is one of the six most important products of Brazilian agriculture, being essential in the supply of food and in the generation of jobs and income for the population in all regions of the country (EMBRAPA, 2016). In 2020, it produced 25.53 billion liters of raw milk, so there was an increase of 514.000 million liters of milk compared to the previous year (IBGE, 2020). Brazil is the fourth world

producer of milk, behind only the United States, India and China (MULLER, RAMPEL, 2021). The state with the highest milk production is Minas Gerais (24.6% of milk produced), followed by Paraná, Rio Grande do Sul and Santa Catarina, respectively. In 2021, the South region led milk production with about 39% and together with the Southeast region they represent 77% of this market, while the North region is in last place in production with about 3.9% of participation (CARVALHO, ROCHA, 2022).

Safety in its production and factors that affect quality have raised research to protect the health of consumers and this includes the evaluation of quality characteristics such as acidity. Brazilian legislation establishes as a quality parameter for bovine milk that the titratable acidity must be between 0.14 and 0.18 in grams of lactic acid/100 mL (MAPA, 2017). Milk acidity can be classified as original or developed. The original results from the presence of its constituents, and the developed result from lactic acid, produced from bacterial growth (ALMEIDA *et al.*, 2021). The integral bacteria ferment the lactose in the milk producing lactic acid. In addition, it also increases osmolarity and decreases the bioavailability of calcium and phosphorus present. This reduction results from the chemical attack of lactic acid on casein micelles, leading to precipitation and consequently insolubilization of calcium, which, although present in milk and capable of quantitative detection through the usual laboratory techniques, has reduced bioavailability. Acidification destabilizes soluble proteins and casein micelles, favors coagulation, increases osmolarity, alters flavor (taste and odor) and reduces immunological value (ALMEIDA *et al.*, 2021).

Therefore, the nutritional quality of milk is closely related to the physical-chemical, sensorial and microbiological characteristics. Physical-chemical analyzes aim to assess the food value or industrial yield and also detect possible fraud (Mujica *et al.*, 2006). An increase in water concentration in milk has been shown to have an adverse effect on milk quality by increasing acidity, thus reducing milk shelf life (Faraz *et al.*, 2013).

Adulteration of milk can cause deterioration of the dairy product and ensuring the quality of milk requires the need and greater emphasis on regulatory aspects with advanced methods of analysis and monitoring of milk production (OKEKE *et al.*, 2018). Therefore, the objective of the work was to evaluate the sanitary quality of the boviyo bed in terms of acidity, following Normative Instruction (IN) n° 58, of November 6, 2019, from MAPA, recommends the Technical Regulations that establish the identity and quality characteristics that must present refrigerated raw milk, pasteurized milk and type A pasteurized milk.

2. MATERIALS AND METHODS

Sampling

A survey of brands and industries involved in the elaboration of dairy products in the state of Amazonas was carried out in supermarkets in the city of Manaus-AM-Brazil. The samples were acquired in original packaging, 1L plastic bottles, and immediately sent for analysis. The municipalities-regions of origin of the samples are mentioned in table 1.

Table 1. Amazon regions of bovine milk samples

Region	Samples
Apui	10
Autazes	08

Acidity test

Milk acidity was quantified by titration following the AOAC 947.05 method. Phenolphthalein was added to the sample, which will be titrated with 0.1 M NaOH, observing the spent volume to calculate the acidity of the sample.

3. RESULTS AND DISCUSSIONS

Table 2 shows the acidity values in which 04 samples exceeded the current legislation limit.

Table 2. Acidity content in bovine milk samples from the Brazilian Amazon region

Parameter	No. of samples	Average	Minimum	Maximum	Standard deviation	Samples >0.18	Maximum limit
Acidity in lactic acid m/v (%)	18	0.18	0.12	0.53	0.3	04	0.18

According to Brazilian legislation (Brazil, 2018) the titratable acidity must be between 0.14 and 0.18 expressed in grams of lactic acid/100mL. The average found between the samples was equal to 0.18%, which corresponds to the maximum value established by the legislation, however four of the samples did not meet the parameters described in the legislation, presenting a titratable acidity greater than the maximum limit.

The titratable or acquired acidity reflects the production of lactic acid and is an indicator of milk hygiene and conservation (Rheinheimer *et al.*, 2006). High acidity may be due to poor hygiene or inadequate transport, especially in relation to the temperature that determines the proliferation of bacteria and, consequently, the production of lactic acid (Andrade *et al.*, 2006). Low temperatures can help prevent or reduce the multiplication of most bacteria and decrease the activity of some degradative enzymes (LEIRA *et al.*, 2018).

BASTOS *et al.* (2018) e SILVA *et al.* (2015), carried out physical-chemical analyzes of milk in the southern regions of Espirito Santo, and in the city of Campos Gerais (MG), respectively, where tests for acidity were in accordance with legislation.

MOLINA *et al.* (2015) and SANTOS *et al.* (2011) found acidity values below the allowed value in 61% and 85% 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. According to RIBEIRO NETO (2012), alkalinity can be attributed to mastitis or the addition of neutralizers.

OKEKE *et al.* (2018) and FAYEYE *et al.* (2013) obtained the highest titratable acidity values of 0.24 and 0.28, respectively. But IMRAN *et al.* (2008) showed the highest acidity, ranging from 0.81 to 1.44. Therefore, these values higher than the parameter result from the action of bacteria in milk sugar.

5. CONCLUSION

The State of Amazonas has the production of bovine milk and derivatives, but unfortunately many producers are not properly regulated or follow artisanal production and this condition can affect the safety of the finished product.

The analysis of bovine milk produced in the Amazon region showed that in relation to the physical-chemical parameter, titratable acidity, about 22.2% of the samples have acidity above the maximum limit, due to the action of bacteria. The adoption of good practices in handling, storage, transport, regarding hygienic-sanitary issues involved in the milking process are essential to guarantee quality, avoiding economic losses to the producer, in addition to risk to the health of the consumer population. This data is intended to guide the quality of the product and will also serve as a subsidy for government agencies, as it will provide data on the manufacture, use, management and risk of consumption of milk and its derivatives in the region.

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