

**Microbiological and physicochemical evaluation of the UHT milk marketed in
Nossa Senhora da Glória – SE****Avaliação microbiológica e físico-química do leite UHT comercializado em
Nossa Senhora da Glória – SE**

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ABSTRACT

UHT milk is defined as the homogenized milk submitted at 130 °C to 150 °C for 2 to 4 seconds in a continuous flow system and cooled to a temperature below 32 °C and packed under aseptic conditions. One of the obstacles of the production chain is the suitability of the product to the quality standards. The objective was to evaluate the microbiological and physicochemical quality of UHT milk marketed in the city of Nossa Senhora da Glória, Sergipe. Samples of three brands were evaluated regarding the mesophilic aerobic bacteria count, sporulated bacteria count, pH, acidity, density, cryoscopic index, protein, fat, total dry extract, defatted dry extract, cooking and alcohol stability. All samples were according to the microbiological standard. Variations were observed in relation to the physicochemical analysis only in the cryoscopic index and pH. The adoption of quality control programs in the milk production chain is fundamental for obtaining products according to the quality standards and prevention of economic losses.

Keywords: quality, heat treatment, consumption, long life.

RESUMO

O leite UHT é definido como o leite homogeneizado submetido a 130 °C a 150 °C por 2 a 4 segundos em um sistema de fluxo contínuo e resfriado a uma temperatura abaixo de 32 °C e embalado em condições assépticas. Um dos obstáculos da cadeia de produção é a adequação do produto aos padrões de qualidade. O objetivo foi avaliar a qualidade microbiológica e físico-química do leite UHT comercializado na cidade de Nossa Senhora da Glória, Sergipe. Amostras de três marcas foram avaliadas quanto à contagem de bactérias aeróbicas mesofílicas, contagem de bactérias esporuladas, pH, acidez, densidade, índice crioscópico, proteína, gordura, extrato seco total, extrato seco desengordurado, estabilidade de cozimento e álcool. Todas as amostras estavam de acordo com o padrão microbiológico. Variações foram observadas em relação à análise físico-química apenas no índice crioscópico e pH. A adoção de programas de controle de qualidade na cadeia produtiva do leite é fundamental para a obtenção de produtos de acordo com os padrões de qualidade e prevenção de perdas econômicas.

Palavras-chave: qualidade, tratamento térmico, consumo, longa vida.

1 INTRODUCTION

The milk industry in Brazil has shown a continuous annual growth, with a direct impact on the increase of the variety of dairy products, which has a great social role over employment, income and economy (Silva et al., 2012). The practicality and the lifespan are determining factors for the commercial appreciation of this product.

When it is received by the factory, the milk is pasteurized to inactivate pathogens and about 99% of the microbiota that is sensitive to heat treatment (Polizeli et al., 2020; Tronco, 2013). With the progress of the studies about thermal resistance of micro-organisms and other dairy products, more severe fluids were developed in order to extend the conservation of the lifespan of the product in a safe way (Berson et al., 2010).

For the attainment of the UHT milk, it is submitted to a temperature between 130° C to 150° C, for 2 to 4 seconds. Next, it is cooled to a temperature of, at most, 32° C, and packed in an aseptic packaging; treatments that confer longer lifespan to the product during storage without the necessity of refrigeration (Brazil, 1997). It is permitted by legislation the use of stabilizers of 0.1% at most, so that the milk remains stable until the end of its lifespan (Machado, 2010). For being nutritious, the UHT milk forms an excellent means of cultivation of deteriorating micro-organisms and pathogens (Silva & Veloso, 2011).

For this reason, the evaluation of the quality of the refrigerated raw milk is extremely important, considering the direct relation between the quality of the raw material and the final quality of the product (Kartheek et al., 2011). The low quality of the UHT milk goes beyond a public health problem. In other words, it is also a social problem associated to consumer respect, as well as affecting its physicochemical, microbiological and sensorial characteristics, with consequent reduction of the lifespan of the product (Rosa et al., 2015; Nielsen et al., 2017). The low quality of the raw material is the cause of the increase of defects such as icing, sedimentation, unwanted flavors and odors and the presence of fraudulently added adulterants, in order to mask the low quality of the refrigerated raw milk destined to the production of UHT milk (Pinto et al., 2006; Souza et al., 2014).

However, in Brazil, the raw milk used as the raw material still shows low quality, specially in northeastern Brazilian States, such as in Sergipe countryside, which is considered the biggest dairy production in the State of Sergipe (Ribeiro & Bonfim, 2011). The lack of good hygiene and

good farming practices (GFP) is an obstacle in great part of the milk producing properties of this region. Many producers still haven't adjusted to the changes and demands established by the Normative Ruling 62 (Brazil, 2011).

According to Novaes et al. (2017) the milk process chain in Brazil still needs improvements and constant quality monitoring, and that the segmentation of corrective and preventive measures must be intensified, specially in North and Northeast Brazil. The government and the industry can suggest corrective and preventive measures to enhance the milk attainment in the region (Ribeiro & Bonfim, 2011). This way, the objective was to evaluate the microbiological and physicochemical quality of the integral UHT milk marketed in the city of Nossa Senhora da Glória, Sergipe.

2 MATERIAL AND METHODS

The experiments were conducted at the Multifunctional Dairy Lab in Instituto Federal de Sergipe, Glória campus. A previous research was realized in the local commerce of the city of Nossa Senhora da Glória, Sergipe, about the most marketed milk brands. The microbiological and physicochemical quality of three integral UHT milk brands that are marketed in the city of Nossa Senhora da Glória, Sergipe, localized in Sergipe countryside, which has the biggest milk production in the State of Sergipe, were evaluated. The purchased samples from the local commerce were named as "A", "B" and "C".

2.1 MICROBIOLOGICAL ANALYSIS

The purchased integral UHT milk brands were evaluated about the count of mesophilic aerobic micro-organisms, according to the Normative Ruling 62 (Brazil, 2003) and the sporulated bacteria count after the heat treatment of the UHT milk at 80°, for 10 minutes (Wehr & Frank, 2004). The analyses were realized in triplicate. The findings were interpreted on the basis of microbiological quality standard (Brazil, 1997).

2.2 PHYSICOCHEMICAL ANALYSIS

The physicochemical analysis of pH, acidity, density, cryoscopic rate, protein, fat, total dry extract (TDE), defatted dry extract (DDE), cooking, and alcohol stability 68° GL, were realized in triplicate according to the methodology described by the Normative Ruling 68 (Brasil, 2006). The analyses of protein, fat and cryoscopy were realized in a milk ultrasonic analyzer, model Ekomilk M Cap-Lab, and the cryoscopic rate in an Electronic Cryoscope MK-540 Flex. The findings were interpreted on the basis of standards established by the current legislation (Brazil, 1997).

3 RESULTS AND DISCUSSION

A low count of mesophilic aerobic bacteria was determined in all integral UHT milk brands that were evaluated (Table 1), were below 1.0×10^2 UFC.mL⁻², which is the maximum permitted value (Brazil, 1997). The samples of the three UHT milk brands showed a sporulated bacteria count below 1.0×10^2 UFC.mL⁻¹, thus, according to the standard established by the current legislation (Brazil, 1997). The presence of heat-resistant bacteria in UHT milk indicates low quality of the raw material and inappropriate hygiene procedures (Costa et al., 2016). Among the thermotolerant bacteria, it is important to highlight the *Bacillus sporothermodurans* associated to the proteolysis and lipolysis in milk (Rossi Júnior et al., 2006). However, Pinto et al. (2017), detected bacteria that form deteriorating spores in the milk. Among 20 brands, 45% showed a count of mesophilic aerobic micro-organisms above 1.0×10^2 UFC.mL⁻¹.

The sporulated bacteria were identified as *Bacillus subtilis/amyloliquefaciens*, *Bacillus licheniformis*, *Bacillus pumilus* and *Bacillus megaterium*, and 31% to 33% showed proteolytic and lipolytic activity, respectively. The authors concluded about the existence of a potential risk of deterioration of the product during its shelf life. High counts of this microbial group indicate the occurrence of contamination after the process, damage on the packaging, failures in the sterilization process, and inappropriate productive process or the possible existence of mesophiles with high heat resistance (Rossi Júnior et al. 2006).

Other factors associated to the contamination of the UHT milk are related to packaging, in which there are microholes, or hermeticity errors in the closing, may be the cause of cross-contamination in the product. In spite of the commercial and nutritional importance UHT milk has in the Brazilian market, some inadequacies in relation to the microbiological and physicochemical technical standards are found in the product. (Bersot et al., 2010; Souza et al., 2014; Pinto et al., 2017).

Table 1 – Count of mesophile aerobic micro-organisms and sporulated micro-organisms in integral UHT milk samples, of three brands, trade in Nossa Senhora da Glória, Sergipe.

Brands	Mesophile Aerobic Bacteria (UFC.mL ⁻¹)	Sporulated Bacteria (UFC.mL ⁻¹)
A	$<1,0 \times 10^0$	$<1,0 \times 10^0$
B	$<1,0 \times 10^0$	$<1,0 \times 10^0$
C	$3,0 \times 10^1$	$1,5 \times 10^1$
Legislation*	$< 1,0 \times 10^2$ UFC.mL ⁻¹	$< 1,0 \times 10^2$ UFC.mL ⁻¹

*Decree 370/1997 (Brazil, 1997).

It was determined through physicochemical analyses of fat, protein, total and defatted dry extract, density, acidity, alcohol proof at 68°GL, and cooking test of the UHT milk, that all brands were in compliance with the established standards (Table 2) in the Technical Regulation of Identity and Quality of UHT milk (Brazil, 1997).

In relation to the cryoscopic rate, it was observed that samples from brand A showed inferior values related to the limit established by the legislation (Table 2), of frauds for the addition of restoratives to the milk, which modify the cryoscopy values (Machado, 2010).

Table 2 – Physicochemical parameters in integral UHT milk samples traded in Nossa Senhora da Glória, Sergipe.

Analysis	Samples			Legislation*
	A	B	C	
Protein %	3,11	3,36	3,12	Mínimo 2,9*
Fat %	3,50	3,00	3,30	Mínimo 3,0*
Total Dry Extract (TDE) %	11,71	11,46	11,52	Mínimo 11,2
Skimmed Dry Extract (SDE) %	8,21	8,36	8,22	Mínimo 8,2*
Density at 15 °C (g/cm ³)	1,0286	1,030	1,031	1,028 a 1,031
Cryoscopy °H	-0,556	-0,535	-0,535	-0,530 a - 0,550°H
pH	6,58	6,68	6,74	6,60 a 6,80
Acidity (°D)	18	16	16	14 a 18 °D*
Alcohol Stability 68° GL	Estável	Estável	Estável	Estável*

*Decree 370/1997 (BRAZIL, 1997).

In relation to the pH values, the samples from brands B and C showed values within legal standards and, the samples from brand A showed an inferior value related to the range established by the Decree 370/1997, from 6.60 to 6.68 (Brazil, 1997). pH values below 6.5 provide an increase of the occurrence of salt imbalance in the milk, as well as negatively reflecting on thermal stability. UHT milk tends to acidify during storage, considering that with thermal treatment the decomposition of lactose into organic acids with consequent pH reduction and the increase of acidity level occurs. This situation contributes for the deterioration of the product and reduction of its lifespan. This way, stabilizing salts are added to the product.

Souza et al. (2014), while evaluating samples from 20 brands in relation to the count of mesophilic aerobic bacteria, pH, cryoscopic rate, density, alcohol stability at 68°GL, peroxide search, neutralizers, starch, chloride, and sucrose, determined the high percentage of brands in disagreement with the microbiological standard, as well as the presence of frauds for adding neutralizing and restorative substances to the milk in some brands. The authors determined the

necessity of implementing good hygienic practices to production, storage, transportation, and processing of the milk, in order to prevent contamination and consequent quality and economic losses. They highlighted that the presence of preservative, neutralizing, and restorative substances are frauds that show the lack of control in the process, and the lack of awareness on the part of the milk production chain components.

4 CONCLUSIONS

The observation that one of the brands is inappropriate for consumption indicates the necessity of a more severe control of industrial quality from the selection of the raw material. For this, it is indispensable the implementation and adoption of the BPA, BPF and APPCC in the milk production chain, in order to obtain a product with high quality standard, according to the current legislation.

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