Chapter 42

Physical-chemical characterization of raw milk for the preparation of traditional milk candy

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ABSTRACT

A milk sweetie is a product, with or without the addition of other food substances, obtained by concentration and action of heat. This study aimed to evaluate the quality of raw and skimmed milk used to prepare traditional milk sweets, aiming to maintain quality in the final product. The physicochemical analyses performed were pH, stability by alcohol test, alizarol test, density, acidity by Dornic method, moisture, soluble solids, reductase, and tritium. For the preparation of the product, milk standardization was performed and its acidity was corrected to 13°D. The physicochemical analyses of the milk suries used for the production of milk conformed, except for moisture for skimmed milk.

Keywords: Milk, Physical Chemistry, Standardization.

1 INTRODUCTION

Sweet milk is a product from the dairy sector, some countries in South America and produce have a strong consumption of it, with Brazil, Argentina, and Chile being one of the great highlights (MACHADO, 2005).

According to Ordinance 354, of 04/09/97: " Sweet milk is understood as the product, with or without the addition of other food substances, obtained by concentration and action of heat at a normal or reduced pressure of reconstituted milk or milk, with or without the addition of milk and/or cream solids (partially replaced or not by monosaccharides and/or other disaccharides)" (BRASIL, 1997).

Milk sweets have some characteristics of their own, such as dark pasting and peculiar flavor, which is due to some reactions that occur in its elaboration stage, such as the Maillard reaction to which the product is subjected to heat treatment (FEIHRMANN, 2004).

In addition to being consumed in its pure form, as a form of dessert, currently, the product has been widely used in several other segments, as an ingredient for the elaboration of foods being them, cakes, biscuits, ice cream, etc. (DEMIATE et al., 2001).

The formulation of sweet milk consists essentially of concentrated milk with the addition of sugar. The product provides high nutritional value due to the presence of proteins and minerals in its constitution, in addition to the energy content it has. The implementation of new ingredients to the product has been studied in the processing stages since the search to meet the demands of consumers is a priority of the industries, to implement greater sensory and nutritional quality, and combine these factors with health benefits (PERRONE et. al., 2011; COLOMBO et. al., 2009).

The production of sweet milk in the country represents about 0.6% of the total products produced in dairy products. The state of Minas Gerais currently has the largest industrial dairy center in the country with 34% of the total companies, besides being the largest producer of Brazilian sweets with approximately 50% of Brazilian production (PERRONE et al., 2012).

This study aimed to evaluate the quality of raw and skimmed milk used to prepare traditional milk sweets, aiming to maintain quality in the final product.

2 MATERIALS AND METHODS

The present study was developed at the Food Laboratory of the State University of Pará - Campus XV, located in the municipality of Redenção-PA, based on bibliographic research on the subject, in which the traditional milk candy was prepared, to know the processing of the product and observe the quality of the kinds of milk used raw and skimmed. The milk used in the milk candy process was purchased at the local market in the city, the raw milk was transported in a thermal box to the laboratory and the skimmed milk was conducted at room temperature.

2.1 PHYSICOCHEMICAL ANALYSES IN RAW MILK

Physicochemical analyses were performed in triplicates in raw milk and skimmed milk to verify its quality so that it did not interfere with the organoleptic characteristics of the product to be prepared.

The determinations of pH, stability by alcohol test, alizarol test, density, acidity by dornic method, moisture, and soluble solids were developed according to the Adolf Lutz Institute (IAL, 2008), reductase following the method of Demeter & Elbertzhagen (1971) and ratio according to AOAC (1995).

- Hydrogenionic potential (pH): in calibrated meter immerses the electrode in the sample to read the result;
- Stability by alcohol test: 2 ml of alcohol 76% was added to 2 ml of the sample, agitated, and verified the presence or not of coagulation;
- Alizarol test: in a test tube containing 2 ml of alizarol solution, 2ml of the sample was added and the result was observed;

- Density: in 200 ml of the sample at 15°C, the lactodensimeter was introduced to quantify the density, and should always consider only the second reading.
- Acidity by dornic method: performed from acid-base titration in 10 ml of the sample using sodium hydroxide (NaOH) and the phenolphthalein indicator. The result was expressed from the equation shown below:

$$\text{Dornic degrees (°D)} = V \times 10$$

The percentage of lactic acid was determined by the equation:

$$\%\ \text{Lactic Acid} = 1/10 \times V$$

Where: V = Volume of NaOH used to neutralize 10 ml of the sample.

- Humidity: drying was done in an oven at 105°C in heating for a period of 3h until the constant weight of the sample was. The result was given by the following equation:

Where:

$$\%\ \text{Humidity} = 100xN$$

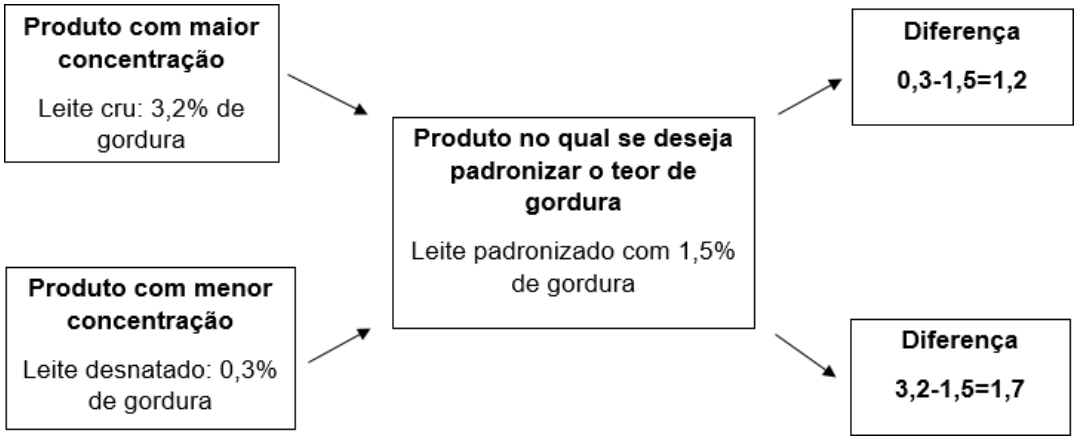
N = No. from Grams from moisture (loss from dough in g) P = number of grams of the sample

- Soluble solids in °BRIX: it was quantified in a portable refractometer, placing a drop of the sample between the prisms to visualize the result.
- Reductase: 1 ml of methylene blue was used for 10 ml of the sample, which after being bathed in cold water was placed in a 37° water bath. Every 30 minutes from the beginning of the test, the tubes were inverted for redistribution of fat and bacteria, always observing whether the sample was discolored for 90 minutes.
- Ratium: the ratium was obtained by dividing the soluble solids content by the titratable acidity (AOAC, 1995).

2.2 PREPARATION OF TRADITIONAL MILK CANDY

For the preparation of the product, the milk had its acidity corrected to 13°D using as neutralizing the sodium bicarbonate (NaHCO3). Pearson square (STEPHANI; PERRONE, 2012) as shown in Figure 1.

Figure 1 - Pearson square for standardization of milk at 1.5% fat.



*No reference values.

Raw milk parts: 1.2
Parts of skimmed milk: 1.7
Standardized milk parts: 2.9 (total) Raw milk percentage: 41.38%
Percentage of skimmed milk: 58.62%

In the composition of the sweet milk, the ingredients that are described in table 1 and developed according to Figure 2 were used.

Table 1 - Ingredients used for the preparation of sweet milk.

Description	Quantity
Raw Milk	2,896 L
Skimmed Milk UHT	4,103 L
Baking Soda Crystal	3.5 g
Sugar	1.4 kg

Figure 2 - Flowchart of the stages of the preparation of traditional milk candy.

Source: Prepared by the authors.

3 RESULT AND DISCUSSION

Through table 2 it is possible to visualize the results obtained for the alizarol test for the two milk samples analyzed, verifying that they are following the determination stipulated by the legislation. The alizarol test has great importance in the food industries since this analysis is routine in dairy products and serves to evaluate the acidity of milk and know if it can be submitted to the pasteurization process, with quality and yield, without coagulation (BORGES, 2014). In the study by Fernandes & Maricato (2010), there were no alterations in the 50 raw milk samples analyzed, in two periods of the year, dry and rainy, in the city of Bicas MG, he justified this fact that the bacteria present were not enough to increase the acidity of milk.

Table 2 - Qualitative analyses in UHT and informal skimmed milk marketed in the city of Redenção-PA and its respective reference parameters.

Analysis	Skimmed Milk	Raw Milk	Legislation
Test Alizarol	Red Brick	Red Brick	Stable (BRAZIL, 2002)
Alcohol Proof	No Coagulation	No Coagulation	Stable (BRAZIL, 2002)
	Reductase Without coagulation	No Coagulation	Min. 90 (BRAZIL, 2002)

*No reference values.

Regarding the alcohol test, it was found that the milk reached the standard reference since the sample submitted to the tests did not present coagulation in the test tubes, the stability of the alcohol test is used to detect milk samples with bacterial contamination, causing less stability during heat treatment (MAGALHÃES & SANTOS, 2013). Compared to the study by Castro & Luz (2014), which evaluated the quality of fresh milk before, and after 30 and 60 days of freezing, we observed results negative for all samples under different conditions, according to the research, showing that milk was not a fraud.

For the evaluation of the reductase test, UHT skimmed milk and raw milk did not present discoloration over 90 minutes in a water bath at 37°C, reaching the classification of "optimal" milk i.e., even after the exposure of the samples in a period lasting 5 hours there was no discoloration in the tubes since samples presented intact colors, i.e. intense blue, falling within the established Brazilian standardization. A result similar to that obtained by Fernandes & Maricato (2010), in which 100% of the raw milk samples presented reductase times between 172 and 240 minutes.

By checking table 2, it is possible to observe that the samples of skimmed milk and raw milk achieved close results for the pH parameter. However, Normative Instruction No. 51 does not establish reference values for the comparison of these ites. However, according to Embrapa (2014), the food industries stipulate values of 6.6 and 6.8 for "ideal" pH, considering the products that are within these limits able to follow the stages of technological processes.

Unlike the raw milk sample, skimmed UHT milk does not have specific legislation for the density parameter. Through the studies carried out at work, it was possible to verify that type c milk falls within the established limits of 1.028 to 1.034 because it reaches the minimum value established.

According to Rosa et al., (2015), the determination of density can serve as an indicative parameter of the total dry extract of UHT milk or even allow the detection of fraud by adding whey or water to milk, which consequently causes the reduction of the same.

Observing the results found for °Dornic, it was verified that the two types of kinds of milk remained between the limits of 14 to 18°D as recommended by the legislation. Samples with values higher than established may indicate a possible presence of microorganisms that act intensely in lactose fermentation, causing milk acidification (BJORKROTH; KOORT, 2011).

Although the classification of the analyzed kinds of milk differs, they present some similar results given the parameters evaluated, values of 7.0 were obtained for soluble solids (°Brix) in both samples. Although IN n°51 does not specify a standard reference value to be compared.

For the moisture test, only the raw milk sample presented moisture content values by the legislation that sets limits from 85 to 88%. The value for skimmed milk was not adequate since it reached values close to 92% for this parameter. Lima et al. (2009) obtained results similar to raw milk, as it also managed to correspond to the reference values.

Table 3 - Physicochemical analyses in UHT and informal skimmed milk marketed in the city of Redenção-PA and its respective reference parameters.

Skimmed Milk Analyses	**Raw milk**	Legislation
pH 6.4	6,48	*
Density 1,029*	1,028	1,028-1,034 (BRAZIL, 2002)
Dornic 18	18	14-18 (BRAZIL, 2002)
Soluble solids (°Brix) 7.0	7,0	*
Humidity (%) 91.85	87,82	85-88 (BRAZIL, 1951)

*No reference values.

Table 4 - Physicochemical analyses of sweet milk.

Analysis	**Sweet milk**	**Legislation/ literature**
PH	6,55%	6.0 - 6.75
°Brix	40,9%	66 - 68
Acidity	2,8%	Maximum 5 %
Ratio	14,6%	*

*No reference values.

The pH parameter is not included in the legislation, however, it is following the literature from 6.0 to 6.75 (IAL, 1985), Milagres et al. (2010) in Physical-chemical and sensory analysis of sweet milk produced without the addition of sucrose, pH values around 6.39% were found, being lower than the values obtained in this study. The pH for sweet is a very significant element, since the Maillard reaction occurs between pH 6.0 and 7.0, being optimized by increasing the degree of lactose hydrolysis, resulting in greater availability of reducing sugar (PAVLOVIC et al., 1994 apud CARVALHO, 2014). Contributing to the greater coloring of sweet milk.

As for the Brix attribute, there is no value established by the legislation. Perrone et al. (2011a) suggest that values are between 66°Brix and 68°Brix, which corresponds to a sweet with approximately 70% of total solids, which in turn represents a sweet with approximately 30% humidity which is regulated by Brazil (1997). In the study of Milagres et al. (2010) we found average values of 63°Brix in sweet milk added sugar. The literature states that the higher the content of total soluble solids, the shorter the evaporation time and manufacturing expenses, and the higher the yield in the manufacture of sweet milk (PERRONE et al., 2011; PERRONE et al., 2012).

Regarding acidity, it can be seen that it fits the established, showing that the amount of sodium bicarbonate added to reduce acidity was well used since the sweet did not obtain a floured or carved texture. Gaze et al. (2015) encountered great color variability among the analyzed samples that were available in the Brazilian market, inferring this distandardization to the different formulations and different parameters used in the manufacturing process, such as the intensity of heat treatment and the amount of sodium bicarbonate, sucrose and glucose (FERREIRA, 2012).

The rhium is one of the best parameters of flavor evaluation, being more representative than the isolated measurement of sugars and acidity (Pinto et al., 2003).

4 CONCLUSION

According to the legislation, all physicochemical analyses of milk used for milk candy production were in accordance, except for moisture for skimmed milk, in which it presented values above the established.

The physicochemical analyses of milk sweets contributed to the verification of standardization and homogeneity, with only ºbrix values lower than that found in the literature.

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