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Full Length Research Paper

Influence of storage of refrigerated milk on yield and sensory characteristics of queso fresco

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The aim of this study was to evaluate the quality of milk stored at different temperatures and storage times and the influence on yield and sensory characteristics of queso fresco. The milk collected was stored at temperatures of 3 and 7°C for times of 24, 48, 72 and 96 h for analysis and processing of queso fresco. Cheeses were stored at 3°C for times of 24 h, 5, 9, and 13 days and were evaluated for yield, production and sensory profile by the acceptability test. Cheeses stored for up to 13 days were analyzed for pH and titratable acidity. The mean results of the analyses of milk and sensory profile of queso fresco were compared by the Tukey test at 5% significance. It was observed that most results of refrigerated milk showed significant differences. Yield, production and sensory profile of queso fresco showed no significant differences. Regarding the coefficient of agreement of the sensory analysis of queso fresco, the mean values were between three and five points. Quesos frescos showed variations in titratable acidity and pH. Storage influenced the quality of refrigerated milk; however, it showed no changes on yield and sensory profile of queso fresco.

Key words: Fresh milk, storage, processing, acceptance testing, coefficient of agreement.

INTRODUCTION

The storage of milk under refrigeration for short time aims to preserve the microbiological and physicochemical characteristics of the raw material. However, even if stored at low temperatures, milk can present the growth of psychrotrophic microorganisms and produce low-quality dairy products. It is extremely important that raw milk is obtained in adequate sanitary conditions and stored at low temperatures, so you can maintain the microbiological count at low levels (Fagundes et al., 2006). The milk cooling controls the multiplication of mesophilic aerobic, but around 4 to 7°C allows the growth of psychrotrophic microorganisms that multiply well at

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temperatures (Saeki and Matsumoto, 2010). Casarotti et al. (2009), will state that psychotropic bacteria are important in deteriorating milk and dairy products.

Among dairy products, cheeses are the most hampered in relation to the quality of refrigerated milk. In addition to the presence of microorganisms, chemical composition is another factor that influences the yield and sensory characteristics of cheeses. The yield of cheese is not only influenced by volume of milk, but also by proportion of protein in milk, being an important economic factor of the dairy industry (Wedholm et al., 2006). Lilbaek et al. (2006), report that maximizing yield without compromising quality is a key concern for manufacturers of industrial cheeses.

The economic losses associated with reductions in manufacturing yield due to the activity of proteases and lipases from psychrotrophic bacteria in refrigerated milk can be significant for industries of cheeses (Barbosa et al., 2009).

Studies aimed at assessing the quality of milk and yield of dairy products obtained from raw materials stored for long periods even at proper temperatures can result in significant information for milk and cheese processing industries. Thus, this study aims to evaluate the quality of milk stored at different times and temperatures and the influence on yield and sensory characteristics of queso fresco.

MATERIALS AND METHODS

This project was submitted to the Ethics Research Committee of the Federal Institute of Education, Science and Technology of Goiás, Brazil and approved under Protocol n^{0}. 006/2013. Fresh milk was obtained from isothermal tank of a Dairy Industry at temperature of 16°C. To assess the quality of milk before collection, preliminary analyses on industrial platform were carried out. The results of milk samples indicated characteristic milk color and odor; the alizarol test showed pink-purple color and no lumps, negative result for antibiotics and fraud and titratable acidity (16°Dornic) within limits required by Brazilian legislation (Brasil, 2011) for processing of queso fresco.

The milk was packaged in milk cans with capacity of 50 L, properly cleaned and sanitized. The milk was filtered to remove any dirt, following storage in cold chamber at temperatures of 3°C and 7°C, using storage times of 24, 48, 72 and 96 h resulting in eight treatments. Six litres of milk at two temperatures and three replicates per treatment were used, where the analyses and processing of queso fresco were carried out. Milk samples refrigerated at 3 and 7°C were studied and assessed from the storage time of 24 h; after collection, milk showed no differences in physicochemical characteristics at 3 and 7°C.

Analysis of refrigerated milk

Electronic analyses were performed at the Laboratory of Milk Quality - Center for Food Research, School of Veterinary and Animal Science, Federal University of Goiás, Brazil. Contents of fat, protein, lactose, total dry extract (TDE) and degreased dry extract (DDE) were assessed using the IDF methodology (2000). Analysis of somatic cells count (SCC) was determined according to IDF (2006) and total bacterial count (TBC) by IDF (2004). The pH analyses were determined as IAL (2008) and titratable acidity by AOAC n°. 947.05 (1998), both held at the Laboratory of Animal Products - Campus Rio Verde, Goiás, Brazil.

Processing of queso fresco

Quesos frescos were processed according to good manufacturing practices for queso fresco in every storage time and temperature of refrigerated milk, according to methodology of Behmer (1999). The milk was pasteurized by slow heating to a temperature of 65°C/30 min under constant shaking in a previously sanitized container, followed by immediate cooling to a temperature of 32°C and was added of lactic acid and calcium chloride. For the addition of rennet to milk temperature was raised to 38°C.

For the manufacture of cheeses, calcium chloride was added at a ratio of 40 to 100 L of milk, lactic acid with industrial purity of 85% in the proportion of 25 mL per 100 L of milk diluted in 2.5 L of water and 9 mL liquid curd to 10 milk liters. After coagulation, the dough was cut into grains of approximately two inches of edge and left to stand for three minutes. Followed by discontinuous and slow stirring for 20 min and finally held at shaping.

The first turning of the cheeses was performed in 15 min, followed by the addition of sodium chloride on the cheese after resting for 30 min, and again turning the second addition of sodium chloride on the surface of the cheese (1.5% compared the total weight of the cheese). After the last turning, the cheeses were taken to a cold room at 3°C for 24 h (control), unmolded, packed in polyethylene bags and the cheeses were stored in refrigerated incubator for 13 days at temperature of 3°C.

Analyses of queso fresco

Quesos frescos were analyzed at Laboratory of Animal Products. During the storage time of queso fresco (24 h, five, nine, and 13 days), pH was analyzed by IAL methodology (2008) and titratable acidity by AOAC n°. 920,124 (1995).

The crude yield of cheeses was calculated as the difference between the milk volume used and the weight of cheeses after one day of storage (Equation 1).

$$\text{Crude yield (L/Kg)} = \frac{V}{Pq} X\ 100 \quad (1)$$

Where, V= milk volume, Pq = weight of cheese after one day of storage

Cheese production was determined by the weight of cheeses after one day of storage. Adjusted yield (Equation 2) and adjusted production (Equation 3) were obtained as Furtado (1999).

$$\text{Adjusted yield (L/Kg A)} = \frac{V \text{ x } (100 - Up)}{Pr \text{ x } ST} \quad (2)$$

Where, V= milk volume, Up = desired percentage of moisture, Pr = cheese production (kg), ST = total solid content of cheese.

$$\text{Adjusted production (Kg)} = \frac{Pr \text{ x } ST}{100 - Up} \quad (3)$$

Where, Up = desired percentage of moisture, Pr = cheese production (kg), ST = total solid content of cheese.

Table 1. Average values of fat, protein, lactose, total dry extract (TDE),degreased dry extract (DDE), pH, titratable acidity, somatic cells count (SCC) and total bacterial count (TBC) of refrigerated milk stored at 3 and 7°C/24, 48, 72 and 96 h.

Variable	Temperature (°C)	Storage time of milk (h)			
		24	48	72	96
Fat (%)	3	3.12^{bA}	3.04^{aA}	3.01^{aA}	3.04^{aA}
	7	3.47^{aA}	3.01^{aB}	2.58^{bC}	2.42^{bC}
Protein (%)	3	3.10^{aB}	3.11^{aB}	3.11^{aB}	3.18^{aA}
	7	3.10^{aB}	3.11^{aB}	3.13^{aB}	3.21^{aA}
Lactose (%)	3	4.55^{aA}	4.56^{aA}	4.55^{bA}	4.56^{bA}
	7	4.54^{bB}	4.55^{bB}	4.57^{aA}	4.58^{aA}
TDE (%)	3	11.74^{bA}	11.66^{aA}	11.62^{aA}	11.77^{aA}
	7	12.06^{aA}	11.62^{aB}	11.23^{bC}	11.19^{bC}
DDE (%)	3	8.61^{aB}	8.62^{aB}	8.61^{aB}	8.74^{aA}
	7	8.60^{aB}	8.62^{aB}	8.65^{aB}	8.77^{aA}
pH	3	6.94^{aA}	6.93^{aA}	6.93^{aA}	6.92^{aA}
	7	6.93^{aA}	6.91^{bAB}	6.92^{aA}	6.89^{bB}
Titratable acidity (% lactic acid)	3	16.92^{aA}	17.42^{aA}	17.66^{aA}	18.16^{bA}
	7	17.20^{aB}	18.53^{aB}	18.53^{aB}	20.75^{aA}
TBC (UFC/mL)	3	$7.9x10^{5aAB}$	$4.2x10^{5aB}$	$3.1x10^{5aB}$	$2.9x10^{6bA}$
	7	$6.2x10^{5aB}$	$6.2x10^{5aB}$	$7.1x10^{5aB}$	$5.1x10^{6aA}$
SCC (CS/mL)	3	$3.1x10^{5aA}$	$2.9x10^{5aA}$	$2.9x10^{5aA}$	$2.8x10^{5aA}$
	7	$4.1x10^{5aA}$	$3.0x10^{5aAB}$	$1.8x10^{5bBC}$	$1.5x10^{5bC}$

Means followed by different letters, uppercase in the line and lowercase in the column differ by the Tukey test at 5% probability.

Sensory analysis of queso fresco

Quesos frescos processed and stored under refrigeration at 3°C for the period of 24 h were evaluated through the acceptability test for attributes of color, odor, sour taste, bitter taste and texture. Sensory analysis consisted of individual evaluation of cheese samples using the five-point hedonic scale, whose extremes were: 1 - dislike very much and 5 - liked very much, being conducted with 17 adult, untrained volunteer panelists, consumers of queso fresco, selected based on interest and availability to participate in the sensory testing throughout the experiment.

Statistical analysis

Milk analyses were performed using a completely randomized design in triplicate for each replicate of the treatment, totaling nine results. The results were evaluated in a split-plot (2 x 4 x 4) scheme, in which curves were storage temperatures, subplots were the storage time of milk and sub subplots the storage time of cheese. The average results were compared by the Tukey test using the Sisvar Software (Ferreira, 2003) with significance level of 5%. pH and titratable acidity of quesos frescos were expressed as regression curves using Excel software, version 2007, from Microsoft Office.

The results of the sensory analysis of cheeses were compared by the Tukey test at 5% probability through the Sisvar Software (Ferreira, 2003). To complement the sensory analysis results, the percentage of the coefficient of agreement among judges with respect to the scores given was analyzed using the Consensor software (Silva et al., 2010a).

RESULTS AND DISCUSSION

Analysis of refrigerated milk

Table 1 shows the average values of the analyses of refrigerated milk stored at 3 and 7°C for 24, 48, 72 and 96 h. The average fat content of refrigerated milk stored at temperature of 3°C showed similar results ($p>0.05$); however, for storage at 7°C, results show significant reduction ($p<0.05$). In the interaction between storage temperature and time of refrigerated milk, it was observed that the fat results were different ($p<0.05$), except for the storage time of 48 h, showing similar results ($p>0.05$).

The mean fat results of milk refrigerated at 7°C/72 and 96 h showed values outside the standards required by Brazilian legislation (Brasil, 2011), which recommends at least 3%. According to Silva et al. (2010b), variations in fat content are influenced by several factors such as nutritional management, heat stress and inadequate mixing during milk collection.

The mean fat results for milk stored at 7°C/72 and 96 h were lower than the other storage times. To conduct this study, milk was stored in milk cans without constant stirring, causing fat separation.

During milk collection, the lack of adequate homogenization may have led to underestimation of fat results. It is known that the main milk component is fat and its reduced content by inadequate mixing may result in changes in the other milk components such as increased protein and lactose contents.

Samples of refrigerated milk stored for 96 h at temperatures of 3 and 7°C showed higher levels of protein, with a significant difference ($p<0.05$) from the other storage times. However, when evaluating temperature versus storage times of milk, the results were similar ($p>0.05$).

For the average levels of lactose, samples refrigerated at 3°C showed no difference in results ($p>0.05$). However, at temperature of 7°C, milk samples showed increased lactose content at the end of the storage period (72 and 96 h) ($p<0.05$).

In evaluating the temperatures in each storage time of refrigerated milk, it was observed that the lactose content differed significantly ($p<0.05$), with higher results in storage times of 24 to 48 h for temperature of 3°C, and higher mean values at 7°C at the end of the storage period.

In the work of Forsbäck et al. (2011), it was observed that milk samples stored for up to five days showed high levels of protein and lactose due to the reduced fat content in milk. In the present study, the low fat content in milk samples stored up to 96 h evidenced the high protein and lactose values in refrigerated milk samples.

The TDE value of refrigerated milk samples stored at 3°C showed similar results ($p>0.05$), but for temperature of 7°C, the TDE values decreased when the storage time increased ($p<0.05$). Interactions between temperature and storage time of refrigerated milk, with the exception of the storage time of 48 h ($p>0.05$), showed significant differences ($p<0.05$) between TDE results.

Refrigerated milk stored at temperatures of 3 and 7°C for 96 h showed higher DDE values ($p<0.05$). However, when evaluating storage temperature and time, the mean DDE values showed no significant differences ($p>0.05$).

According to Oliveira et al. (2012), the high mean TDE value is due to the fat content, which is similar to the DDE value, since this variable is obtained from the difference between TDE and the fat content. In this study, refrigerated milk samples stored at 7°C/24 h showed higher TDE values due to the high average fat contents present in milk, since TDE is obtained from the sum of all components but water.

In contrast, the high fat levels provided lower DDE levels for refrigerated milk stored at 3 and 7°C for up to 72 h, since DDE is the sum of all components but water and fat.

The pH of milk samples stored at 3°C for 96 h showed significant similarities ($p>0.05$). For milk refrigerated at 7°C/24 h, the pH was similar for storage times of 48 and 72 h ($p<0.05$), but the storage time of 96 h differed from storage times of 24 and 72 h ($p<0.05$). Regarding the interaction between temperature and time, the pH of milk stored at temperature of 3°C was higher than milk stored for 48 and 96 h ($p>0.05$).

The mean titratable acidity value of milk refrigerated at 3°C for 96 h did not differ significantly ($p>0.05$). When stored at 7°C, the titratable acidity was proportion to the increased storage time of refrigerated milk ($p<0.05$). When evaluating storage temperature and time, refrigerated milk stored for 96 h at 7°C showed higher titratable acidity when compared to temperature of 3°C ($p<0.05$). To meet the quality standard of milk required by instruction normative 62/2011 (Brasil, 2011), the minimum and maximum limits for titratable acidity of milk should be between 0.14 and 0.18 g of lactic acid /100 mL.

The high average titratable acidity value of milk stored at 7°C for 96 h was influenced by increasing storage time and temperature. Since pH and titratable acidity are inversely proportional, it was expected that milk refrigerated at 3 and 7°C for 96 h with higher titratable acidity levels showed low mean pH values.

The mean TBC values for storage time of 96 h of milk refrigerated at 3°C were similar to the storage time of 24 h ($p>0.05$). However, there was an increase in the TBC values for refrigerated milk stored at 7°C for 96 h and in the interaction with temperature of 3°C ($p<0.05$).

According to Vallin et al. (2009), the variation of temperature and storage time of milk and inadequate sanitation are factors that influence the quality of refrigerated milk. In the present study, the processes of sampling, temperature raise and storage time of milk refrigerated at 3°C in times of 24 and 96 h and 7°C for 96 h resulted in increased TBC values.

The SCC value was similar for milk samples stored at 3°C for up to 96 h ($p>0.05$). Storage at 7°C for times of 24 h indicates higher mean SCC versus times of 72 and 96 h ($p<0.05$). The interaction of temperature and storage time was similar in times of 24 and 48 h ($p>0.05$) for variable SCC. In the work of Paula et al. (2004), it was verified that from the first to the fourth day of storage, there was a reduction in the average SCC, which may be attributed to cell breakdown. In the present study, the decrease SCC in samples refrigerated at 7°C was due to the high storage time and temperature of refrigerated milk

Table 2. Mean values of crude yield, adjusted yield, production and adjusted production of queso fresco stored for 24 h produced with milk refrigerated at 3 and 7°C/24, 48, 72 and 96 h.

Variable	Temperature (°C)	Storage time of milk (h)			
		24	48	72	96
Crude yield (L/Kg)	3	5.01^{aA}	4.88^{aA}	5.28^{aA}	5.09^{aA}
	7	4.88^{aA}	4.93^{aA}	5.02^{aA}	5.07^{aA}
Adjusted yield (L/Kg)	3	5.08^{aA}	4.88^{aA}	5.30^{aA}	5.29^{aA}
	7	4.98^{aA}	4.99^{aA}	5.11^{aA}	5.23^{aA}
Production (Kg)	3	1.20^{aA}	1.23^{aA}	1.14^{aA}	1.18^{aA}
	7	1.23^{aA}	1.22^{aA}	1.20^{aA}	1.19^{aA}
Adjusted production (Kg)	3	1.18^{aA}	1.23^{aA}	1.13^{aA}	1.14^{aA}
	7	1.21^{aA}	1.20^{aA}	1.18^{aA}	1.15^{aA}

Means followed by different letters, uppercase in the line and lowercase in the column differ by the Tukey test at 5% probability.

and the use of preservative bronopol to preserve samples prior to analysis, these factors were essential for cell degradation in refrigerated milk during storage.

Analyses of queso fresco

Table 2 shows the mean values of crude yield, adjusted yield, production and adjusted production of queso fresco produced with milk refrigerated at 3 and 7°C stored for 24, 48, 72 and 96 h. The mean crude yield, adjusted yield, production and adjusted production of queso fresco values were similar ($p>0.05$) in both storage temperature and time and interaction between them.

Several factors can affect the yield of cheeses such as milk composition, amount of components lost in whey, amount of salt added to cheese and amount of water retained in the cheese (Emediato et al, 2009). In the study by Pretto et al. (2012), the levels of fat, protein and casein were positively and strongly correlated with cheese yield. Silva et al. (2012) observed that the reduction in cheese yield was due to the high SCC in milk.

In the present study, differences in temperature (3 and 7°C), storage time (24, 48, 72 and 96 h), low SCC, high protein content and decreased fat content of milk refrigerated at 7°C did not affect the yield and production of queso fresco. It is known that milk with high protein content is valuable for the dairy industry because protein is the component responsible for the increase in the cheese yield, in addition to the low SCC. Thus, in this study, these factors were essential for the absence of significant variation in yields and production of queso fresco produced with milk refrigerated at 3 and 7°C stored for up to 96 h.

The similarities observed in the production and yield of queso fresco could be attributed to the dissolution of fat during milk pasteurization, to the high protein content found and the average low SCC, within the maximum limits (6.0 x10^5SC /mL) allowed by instruction normative 62/2011 (Brasil, 2011).

Figure 1 shows the regression curve for titratable acidity of queso fresco stored for 24 h, five, nine and 13 days.

Cheeses stored for up to 13 days and processed with milk stored at 3°C/48 h (R^2 = 0.9321) and 72 h (R^2 = 0.9808) showed significant differences for titratable acidity. However, for time of 72 h, higher acidity after 13 days of storage was observed. Cheeses manufactured with milk stored at 3°C/24 h (R^2 = 0.1558) and 96 h (R^2 = 0.7906) showed similar variations for titratable acidity levels. Figure 2 shows the regression curve for titratable acidity of queso fresco stored for 24 h, five, nine, and 13 days. Cheese processed with milk stored at 7°C/24 h (R^2 = 0.4464), 48 h (R^2 = 0.9968) and 72 h (R^2 = 0.9600) showed different behaviors for the mean titratable acidity values during storage for up to 13 days.

For time of 24 h, the acidity of cheeses increased with nine days and decreased after 13 days of storage, but in the storage time of 48 h, acidity was constant from the fifth day on. However, in the storage time of 72 h, the titratable acidity showed increasing behavior. Cheese samples stored for up to 13 days made with milk stored at 7°C for 96 h (R^2 = 0.8359) showed linear increasing titratable acidity.

In the study by Cunha et al. (2002), the titratable acidity of Minas cheese increased during 30 days of refrigerated storage. Queiroga et al. (2009) reported that the release of whey after packaging can eliminate the lactose content and influence the acidity values. Changes in titratable

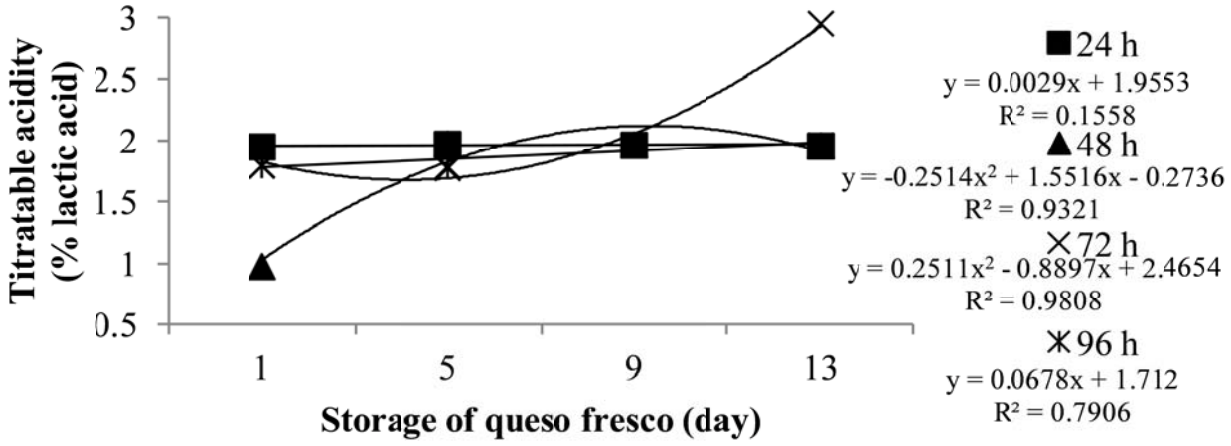

Figure 1. Regression curve for titratable acidity of queso fresco stored for 24 h, five nine and 13 days processed with milk refrigerated at 3°C/24, 48, 72 and 96 h.

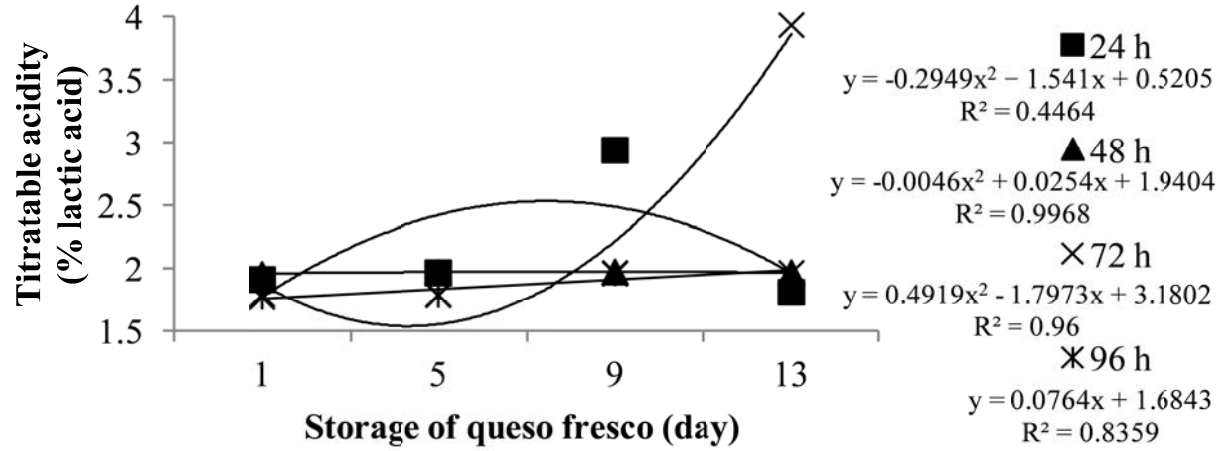

Figure 2. Regression curve for titratable acidity of queso fresco stored for 24 h, five, nine and 13 days processed with milk refrigerated at 7°C/24, 48, 72 and 96 h.

acidity values found in this study for cheese processed with milk refrigerated at 3 and 7°C up to 96 h may be due to the release of whey after packaging throughout the shelf life, since the lower the release of whey, the greater the retention of lactose, with consequent production of cheese with high acidity.

The results of the regression curve for the pH of queso fresco stored for 24 h, five, nine, and 13 days are shown in Figure 3. Cheese processed with milk stored for 24 h (R^2 = 0.9333), 72 h (R^2 = 0.9926) and 96 h (R^2 = 0.6429) showed different behaviors during the storage time. For time of 48 h, the pH of cheeses was constant throughout the shelf life; therefore, it was not possible to generate the regression curves and determine the R^2 value.

Figure 4 shows the results of the regression curve for the pH of quesos frescos stored for 24 h, five, nine, and 13 days. Cheese processed with milk stored for 24 h (R^2 = 0.9953), 48 h (R^2 = 0.8364) and 72 h (R^2 = 0.8077) showed no similarity in pH values of cheese samples stored for up to 13 days. However, in the storage time of 96 h (R^2 = 0.02), pH showed linear behavior with respect to storage time of 13 days.

Gigante et al. (2006) found that storage temperatures of 4 and 20°C for up to 28 days did not affect the pH of samples. Pereira et al. (2003) reported that the higher average pH value found for Minas cheese was due to the use of lactic acid in cheese processing. Comparing Figures 3 and 4, it could be observed that the pH of cheeses stored for 13 days and processed with milk at 3 and 7°C for up to 96 h showed similar values during the

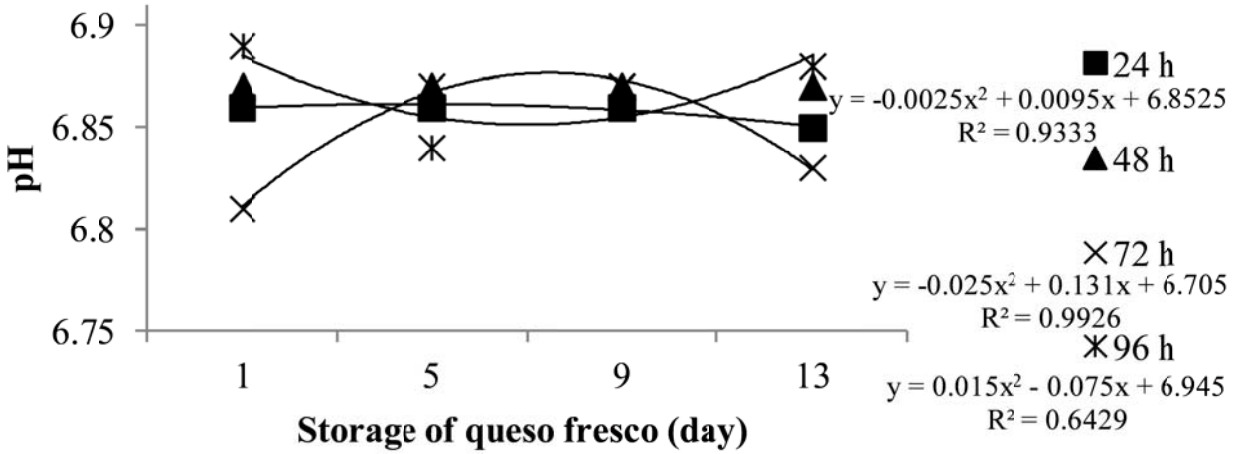

Figure 3. Regression curve for pH of queso fresco stored for 24 h, five, nine and 13 days processed with milk refrigerated at 3°C/24, 48, 72 and 96 h.

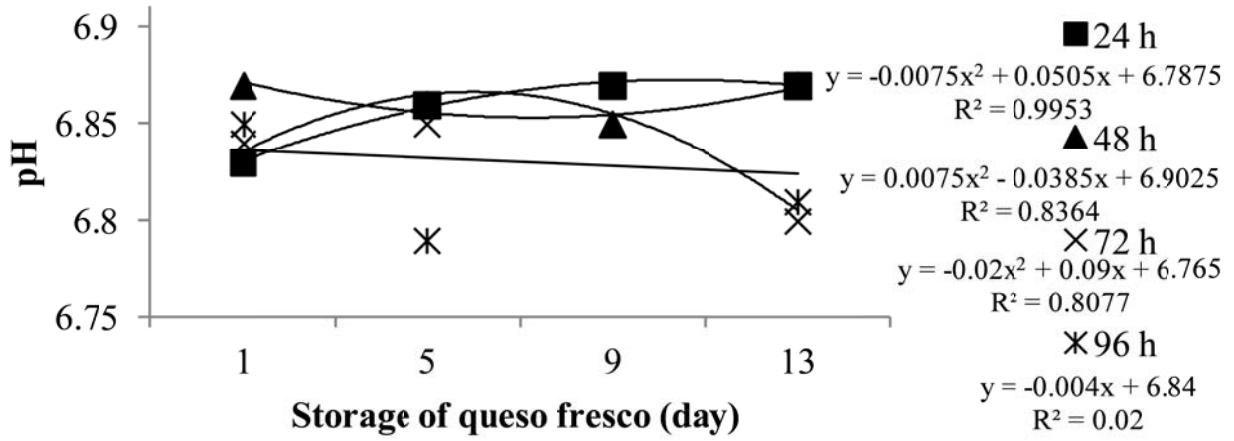

Figure 4. Regression curve for pH of queso fresco stored for 24 h, five, nine and 13 days processed with milk refrigerated at 7°C/24, 48, 72 and 96 h.

storage time, since the use of lactic acid for the processing of queso frescos is critical for adjusting the mean pH values.

Sensory analysis of queso fresco

The sensory analysis of queso frescos stored for 24 h and processed with milk refrigerated at 3 and 7°C for up to 96 h of storage, through acceptance test, was performed in order to evaluate if panelists were able to identify and inform the presence of significant difference between samples (Table 3). Table 3 shows the average values of the sensory analysis for color, odor, sour taste, bitter taste and texture of quesos frescos stored for 24 h and processed with milk refrigerated at 3°C and 7°C/24, 48, 72 and 96 h. The mean values of the acceptance test of queso fresco stored for 24 h and processed with milk refrigerated at temperatures of 3 and 7°C for up to 96 h were similar in all variables ($p>0.05$) both in the interaction between time and temperature and the evaluation of temperature and storage time.

Antonello et al. (2012) reported that the high microbial count may indicate a potential risk to the health of consumers and suggest possible economic losses arising from the rejection of cheeses, which is caused by sensory changes caused by microbial action. Schuster et al. (2006) demonstrated that pasteurization was effective in eliminating pathogenic microorganisms which might occasionally be present in raw milk.

Table 3. Average values of the sensory analysis for color, odor, sour taste, bitter taste and texture of quesos frescos stored for 24 h and processed with milk refrigerated at 3 and 7°C/24, 48, 72 and 96 h.

Variable	Temperature (°C)	Storage time of milk (h)			
		24	48	72	96
Color	3	4.47^{aA}	4.76^{aA}	4.88^{aA}	4.53^{aA}
	7	4.24^{aA}	4.82^{aA}	4.82^{aA}	4.71^{aA}
Odor	3	3.94^{aA}	4.00^{aA}	3.82^{aA}	4.24^{aA}
	7	3.94^{aA}	4.12^{aA}	4.29^{aA}	4.41^{aA}
Sour taste	3	3.41^{aA}	3.88^{aA}	4.06^{aA}	3.53^{aA}
	7	3.59^{aA}	4.06^{aA}	4.06^{aA}	3.88^{aA}
Bitter taste	3	3.18^{aA}	4.00^{aA}	3.88^{aA}	3.53^{aA}
	7	3.18^{aA}	3.88^{aA}	3.71^{aA}	3.82^{aA}
Texture	3	3.82^{aA}	4.35^{aA}	4.35^{aA}	4.47^{aA}
	7	4.00^{aA}	4.41^{aA}	4.47^{aA}	4.53^{aA}

Means followed by different letters, uppercase in the line and lowercase in the column differ by the Tukey test at 5% probability.

Table 4. Means and coefficient of agreement (CA) of panelists in the sensory evaluation for color, odor, sour taste, bitter taste and texture of quesos frescos stored for 24 h processed with milk refrigerated at 3 and 7°C/24, 48, 72 and 96 h.

Milk temperature (°C)	Storage time of milk (h)	Color		Odor		Sour taste		Bitter taste		Texture	
		Mean	CA (%)	Mean	CA (%)	Mean	CA (%)	Mean	CA (%)	Mean	CA (%)
3	24	4.47	62.11	3.94	51.28	3.41	27.28	3.18	15.00	3.82	34.30
	48	4.76	74.18	4.00	38.02	3.88	35.54	5.00	44.18	4.35	56.78
	72	4.88	86.05	3.82	35.54	4.06	39.02	3.88	43.22	4.35	55.49
	96	4.53	62.11	4.24	50.60	3.53	19.95	3.53	33.02	4.47	58.53
7	24	4.24	51.45	3.94	41.21	3.59	29.28	3.18	11.77	4.00	37.89
	48	4.82	79.79	4.12	44.22	4.06	37.89	3.88	34.54	4.41	53.91
	72	4.82	79.79	4.29	49.74	4.06	39.02	3.71	25.64	4.47	59.26
	96	4.71	69.35	4.41	54.71	3.88	46.13	3.82	34.30	4.53	64.50

In this study, queso fresco processed with milk stored at 7°C for up to 96 h showed no unfavorable sensory characteristics in relation to time and high temperature of the refrigerated milk, which may be explained by the maintenance of stable temperature used in cold chambers for refrigerated milk storage and used in the processing of queso fresco. These factors were essential to maintain the sensory characteristics of cheeses, since the high count of microorganisms in refrigerated milk used for cheese processing is partially reduced during pasteurization, which probably will produce dairy products with characteristics similar to those processed with refrigerated milk of low microbial count.

To better assess the agreement between panelists on the correlation between scores given by the five-point hedonic scale and the average scores of all panelists, data were evaluated by the coefficient of agreement shown in Table 4.

Cheese processed with milk at 3°C/72 h showed greater coefficient of agreement and average scores given by panelists regarding color. For odor, the queso fresco sample showing the highest average scores and coefficient of agreement was that processed with milk at 7°C/96 h.

The highest percentage of agreement for the acid taste was for cheese processed with milk stored at 7°C for 96 h. However, the best means were for quesos frescos processed with milk refrigerated at 3°C/72 h and 7°C/48 and 72 h. For bitter taste, queso fresco processed with milk stored at 3°C/48 h showed greater coefficient of agreement and mean score of 5.00 in the hedonic scale.

Queso fresco processed with milk stored at 7°C for 96

h showed the highest coefficient of agreement and average texture.

Machado et al. (2004) performed sensory analysis of Minas cheese from the region of Serro and found average score of 6.00, which attributed the rating: liked slightly. Due to the higher coefficient of agreement and average scores given by panelists to queso fresco processed with milk refrigerated at 3 and 7°C for up to 96 h, the results of this study indicated that the mean scores ranged from did not like / nor disliked and liked very much for all variables. The agreement index among panelists for parameters color, odor, sour taste, bitter taste and texture for cheese processed with milk refrigerated at 3 and 7°C for 24, 48, 72 and 96 h, showed good acceptability in relation to the mean values of scores given by panelists.

Conclusion

The sampling and storage of milk refrigerated at 3 and 7°C for up to 96 h influenced the quality of refrigerated milk. Yield, production and sensory profile of queso fresco were not influenced by the use of milk refrigerated at 3 and 7°C for up to 96 h. The acidity of queso fresco was influenced by the release of whey after packing throughout the shelf life. The constant pH of queso fresco was due to the use of lactic acid during processing.

Conflict of Interests

The author(s) have not declared any conflict of interests.

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