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Efecto de la leche de cabra en la calidad sensorial y tiempo de procesado del dulce de leche

Ciencia y Tecnología Alimentaria, vol. 4, núm. 5, julio, 2005, pp. 315-318

Sociedad Mexicana de Nutrición y Tecnología de Alimentos
Reynosa, México

Available in: http://www.redalyc.org/articulo.oa?id=72450402
EFFECT OF THE GOAT MILK IN SENSORY QUALITY AND PROCESSING TIME OF DOCE DE LEITE

Abstract

Researches that contribute to a better technological use of the goat milk are still necessary. In this context, the present work had as objective the sensory evaluation of three formulations of Doce de Leite as well the influence of these formulations in processing time. The employed formulations contained cow milk (A), cow milk and goat milk in same proportions (B) and goat milk (C). The samples were submitted to an acceptance test and it was verified significant difference (P < 0.05) among the formulations. A Tukey test (P < 0.05) indicated that formulation B presented better acceptance in relation to formulation A. Statistically, the formulation C was not different to formulation B neither formulation A. It was also verified that formulation C presented smaller processing time, having a linear relationship between the soluble solids content and the processing time for the three formulations. © 2005 Altaga. All rights reserved.

Keywords: Sensory evaluation, goat milk, doce de leite, processing time.

Resumen

Son necesarias investigaciones científicas que contribuyan a un mejor uso tecnológico de la leche de cabra. En este contexto, el presente trabajo tiene como objetivo la evaluación sensorial de tres formulaciones de dulce de leche y la influencia de estas formulaciones en el tiempo de procesamiento. Las formulaciones empleadas fueron leche de vaca (A), leche de vaca y leche de cabra en las mismas proporciones (B) y leche de cabra (C). Las muestras se sometieron a un test de aceptación y se verificó una diferencia significativa (P < 0.05) entre las formulaciones. El test de Tukey (P < 0.05) indicó que la formulación B presentó mejor aceptación que la formulación A, y estadísticamente la formulación C se situó entre las otras formulaciones. También fue verificado que la formulación C presentó un tiempo de proceso menor, obteniéndose una relación lineal entre el contenido de sólidos solubles y el tiempo de procesamiento para las tres formulaciones. © 2005 Altaga. Todos los derechos reservados.

Palabras clave: Evaluación sensorial, leche de cabra, dulce de leche, tiempo de procesamiento.

Resumo

Son necessárias investigações científicas que contribuíam a um melhor uso tecnológico do leite de cabra. Neste contexto, o presente trabalho teve como objetivo a avaliação sensorial de três formulações de doce de leite e a influência destas formulações no tempo de processamento. As formulações empregadas foram leite de vaca (A), leite de vaca e leite de cabra nas mesmas proporções (B) e leite de cabra (C). As amostras sometidas a um test de aceitação verificaram-se uma diferença significativa (P < 0.05) entre as formulações. O test de Tukey (P < 0.05) indicou que a formulação B apresentou melhor aceitação que a formulação A, e estatisticamente a formulação C situou-se entre as outras formulações. Também foi verificado que a formulação C apresentou um tempo de processo menor, obtendo-se uma relação linear entre o contido de sólidos solubles e o tempo de processamento para as três formulações. © 2005 Altaga. Todos os direitos reservados.
INTRODUCTION

The goat milk is a product highly recommended in the childhood feeding and in cases that cow milk is non-tolerated (Sá, 1978). Furthermore, the goat milk and their products have great importance in the human nutrition: in many developing countries they are consumed in superior amounts to the cow milk and derivates by starving and malnourished people. In developed countries, goat milk products supply the gastronomic needs of connoisseur consumers, in a growing market (Haenlin, 2004).

From that reason is important and necessary studies and researches about processing of goat milk, in order to diffuse its potential in the market. It was observed that in Brazil, the main goat milk product sold actually is the whole milk (93%), followed by powder milk (4%) and other products (3%) (Anualpec, 2001). In such case, a great number of different goat milk products can be developed and/or improved in terms of sensory quality to acquire new consumers (www.boletimpecuario.com.br/artigod).

One of these products that can be developed with goat milk is the doce de leite, a typical Brazilian and Argentinean candy (Paylovic et al., 1992), obtained from the concentration of milk added of sucrose in atmospheric pressure, being optional and regular the use of other ingredients as glucose and starch (Brasil, 1997).

As well as in doce de leite, in other concentrated dairy products the great concern with the sensory quality is originated from the lactose crystallization. This problem happens due to a reduction in its solubility in function of the sucrose addition to the product, which takes an unpleasant sandy sensation when the candy is tasted (Coelho and Rocha, 1999).

To avoid the lactose crystallization and consequent loss of sensory quality, the concentration stage must be made under vigorous agitation without interruption, elevating the rate of heat transfer and reducing the processing time (Brennan et al., 1998).

The acceptance of a product by consumers is vital in development and improvement process of a product. Affective tests, measuring and analyzing statistically subjective attitudes of untrained panelists can be used with this purpose. In laboratorial conditions the tests interferences are easily controlled, being necessary a number of consumers situated among 25 and 50 (Stone and Sidel, 1993). Amerine, Pangborn and Roessler (1965) and ASTM (1976) suggested a minimum of 30 consumers when laboratorial tests are used. For affective tests hedonic scales are frequently used, in which the acceptance of a product is expressed in a scale that varies among the attributes like and dislike, in different degrees of intensity (Chaves and Sprosser, 2000).

Therefore, the goal of this work was evaluate the influence of goat milk in processing time of doce de leite for three different formulations (only goat milk, a mixture of goat milk and cow milk, and only cow milk), as well as the sensory evaluation of those three formulations using an affective test.

MATERIAL AND METHODS

Pasty doce de leite production

Pasty Doce de leite samples were elaborated at Laboratório de Engenharia de Processos of UESB, using whole milk (20.0 L), refined sugar (18% in weight, in relation to the milk), sodium bicarbonate (5.0 g) and salt (2.0 g). Three different formulations were used, with base in kind of used milk - formulation A with cow milk, formulation B with goat milk and cow milk in same proportions and formulation C with goat milk.

In preparation of the samples, sodium bicarbonate and salt were used to correction of acidity (0.16% in lactic acid, or 16 °Dornic). The corrected milk was submitted to heating (160 °C) until the ebullition point under constant manual agitation, using a big wood spoon. The milk was boiled during 5 minutes for a pre-concentration of the product when then the half of the requested sugar mass was added to the milk, keeping a constant manual agitation. After a period of 10 minutes, the remaining mass of the sugar was added and the pasty candy was concentrated, under constant manual agitation, until a final soluble solids content equal to 62% in weight (*Brix).

Determination of soluble solids content and processing time

The total processing time of the samples was based in final soluble solids content, which should be equal to 62% in weight (*Brix). Then, aliquots of 5.0 mL were collected in intervals of 10 minutes since the beginning of the process, for the three formulations. The soluble solids content in the samples was determinate through a portable refractometer. Therefore, was possible the determination of a relationship between the processing time and soluble solids content in the different formulations. Data obtained were analyzed using the statistical software SAEG® (Ribeiro Júnior, 2001).

Sensory evaluation

The samples were submitted to an acceptance test, in individual cabins, in the Laboratório de Análise Sensorial of UESB, using 33 panelists, among students, teachers and employees of the institution. The panelists evaluated the three formulations using a hedonic scale of 9 points, with ends in (1) «I disliked extremely» and (9) «I liked extremely».

The different samples were presented to consumers in plastic cups (50.0 mL) with 25.0 g of candy. The samples were presented at monadic mode (one per time), randomized and codified with three digits numbers, being attributed the code 571 for formulation A, 643 for formulation B and 110 for formulation C to avoid tendencies of consumers in the test.

The obtained data were submitted to a variance analysis (ANOVA), with P < 0.05, using the software SAEG® (Ribeiro Júnior, 2001) and a Tukey test was used (P < 0.05) for the analysis of the obtained averages. Acceptance scores data were also plotted in a frequency graph.
RESULTS AND DISCUSSION

**Soluble solids content versus processing time**

Experimental results indicate that *doce de leite* produced with the formulation C (only goat milk) reaches the final processing point in the smallest time interval (100 minutes), while the products elaborated with the formulations A and B obtained a processing time equal to 140 minutes.

In Figure 1 are showed the relationships between processing time and soluble solids content for the different formulations. Through a regression analysis, using the software SAEG®, it was determined that there was a linear relationship among those two factors, being the model parameters significatives by Student test ($t$ test) with 5% of probability. Soon, in studied conditions, the process of pasty *doce de leite* production can be explained, for the different formulations, by the equations 1 to 3.

To formulation A:
\[ \text{Conc} = 0.3677 \cdot t + 2.8560 \quad R^2 = 0.914 \quad (1) \]

To formulation B:
\[ \text{Conc} = 0.4083 \cdot t + 6.1876 \quad R^2 = 0.976 \quad (2) \]

To formulation C:
\[ \text{Conc} = 0.5609 \cdot t + 8.1364 \quad R^2 = 0.984 \quad (3) \]

The difference in time processing of different formulations can be explained partly by composition of different types of milk used in production of the samples. Goat milk and of cow milk presents similar amounts of sugars, proteins and ashes (Sá, 1978). However, the goat milk presents a smaller humidity content that the cow milk, 85.6% against 87.7%, respectively (Sađić et al., 2004). In such case, samples made with formulation C will have less water to be evaporated to reach the wish soluble solids content, taking consequently a smaller processing time, for the same operational conditions.

In general, fats act as an insulating material. However, although the goat milk presents a larger fat content that the cow milk (about 3.93% against 3.16%, Haenlin, 2004), its composition in fatty acids is very different. The goat milk presents a content of saturated fatty acids of short and medium chains (C4:0 until C14:0) 48% larger than the cow milk (Haenlin, 2004). The thermal conductivity of the saturated fatty acids increases with the reduction of carbon chain size (Formo et al., 1979). Soon, is expected that in goat milk the rate of heat transfer be larger than in cow milk.

Consequently, *doce de leite* produced with goat milk should present a smaller processing time when compared with the product processed using cow milk under the same conditions, what in fact was observed.

**Sensory evaluation**

The affective test for verification the acceptance of three *doce de leite* formulations produced was realized at individual cabins, according to the conditions already mentioned.

Most of panelists attributed acceptance scores between 6 and 9 for all formulations (Figure 2), indicating that all of the formulations obtained a good acceptance. In spite of asymmetry of presented data in relation to normal distribution, there is any problem in relation to variance analysis, once the presuppositions of model additivity, independence and normality of the errors, and

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The ANOVA test of obtained data is presented in Table 1. It was verified that exist significant difference (P < 0.05) among the formulations of *doce de leite* in relation to acceptance by the panelists. A Tukey test (P < 0.05) among the averages obtained for different formulations reveal that formulation B differed from formulation A. Statistically, the formulation C was not different to formulation B neither formulation A (Table 2).

**CONCLUSIONS**

It is observed that there was significant difference (P < 0.05) among the formulations of *doce de leite* used in the acceptance test. It was also verified by Tukey test (P < 0.05), that there wasn’t difference among the formulation C and the two others formulations (A and B). This information and the fact that the samples produced with formulation C presents smaller processing time, indicate the *doce de leite* as a product option to stimulate the increase in consumption of goat milk, besides aggregated value the that raw material.

**REFERENCES**


**Table 2.-** Medium values obtained to formulations of *doce de leite*. Medium values following by a same letter don’t differ amongst themselves by the test of Tukey (P < 0.05).

<table>
<thead>
<tr>
<th>Formulation</th>
<th>Medium value</th>
</tr>
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<tbody>
<tr>
<td>B</td>
<td>6.76&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>C</td>
<td>6.33&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>A</td>
<td>5.45&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

homogeneity of errors variance were not violated. Emphasis was given in this last one, being residual mean square (RMS) used as comparison term in the variance analysis.


