DEVELOPMENT OF ICE CREAMS WITH ACEROLA PULP: SOURCE OF VITAMIN C

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RESUMO – O desenvolvimento de sorvetes com ingredientes que fornecem benefícios para a saúde, pode fornecer, além de um sabor agradável, qualidade nutricional para todos os tipos de público. O mercado para sorvete é extenso, oferecendo muitas variedades de sabores e cores para os consumidores. O uso de fruta na produção de sorvetes é uma alternativa para a oferta de produtos saudáveis ao consumidor. O presente estudo avaliou três formulações diferentes de sorvete contendo diferentes concentrações de polpa de acerola, a fim de se obter um alimento fonte de vitamina C. Foram realizadas análises físico-químicas e sensoriais. Todas as formulações mostraram elevado teor de vitamina C, variando de 476,72-617,82 mg/100 g. As formulações de sorvete acerola estão em conformidade com a legislação em vigor para gelados comestíveis, com teor de gordura que varia entre 3,57 e 7,11% e proteínas que variaram de 3,48 a 5,22%, todas as formulações avaliadas foram aceitas sensorialmente pelos consumidores.

A BSTRACT – The development of ice creams with ingredients that provide health benefits, may provide in addition a pleasant taste, nutritional quality for all types of public. The market for ice cream is extensive, offering many varieties of flavors and colors to consumers. The use of fruit in the production of ice creams is an alternative to providing health products to consumers. The present study evaluated three different ice cream formulations containing different acerola pulp concentrations, in order to obtain a food source of vitamin C. It was conducted physicochemical, microbiological and sensorial analyze. All formulations showed high content of vitamin C, ranging from 476.72 to 617.82 mg/100 g. The formulations of acerola ice cream are in accordance with current legislation for ice cream with fat content ranging from 3.57 to 7.11% and proteins that ranged from 3.48 to 5.22%, all formulations evaluated sensorially were accepted by consumers.

PALAVRAS-CHAVE: Malpighia emarginata, ácido ascórbico, inovação.

KEYWORDS: Malpighia emarginata, ascorbic acid, inovation.

1. INTRODUCTION

The population has increasingly tried to relate their food to their health, and to develop new food products that meet the demands of these consumers for healthy food and pleasant taste has been a challenge ever since (Crizel, 2014).

Acerola (Malpighia emarginata) is a fruit of an original Central American plant that has been propagated in South America, including Brazil, due to its adaptation to soil and climate (Favaro-Trindade, 2006). According to Lima et. al (2012) acerola has attracted industry’s attention and interest
due to its high vitamin C content, in addition to contain carotenoids and phytochemicals, such as flavonoids.

Acerola is also a good source of phenolic compounds, which have a great antioxidant activity (Pereira, 2013).

Brazil is one of the major world producers in the fruit segment, and it is currently the greatest world producer of acerola, having the state of Ceará responsible for 14.32 % of this national production (Nunes, 2015; Pereira, 2013; Bicas, 2011).

This fruit shows better consumption conditions within 3 days after harvest. Because of this short period of time it becomes difficult to commercialize it as a fresh fruit, making it necessary the use of technologies for its commercialization in new products, such as ice cream, gelatin, juice, soft drinks, nectar, jelly, gum, fruit conserve, yogurts and sodas (Marques, 2013; Bicas, 2011).

All age groups and social classes enjoy ice cream, as a refreshing food with a wide variety of ingredients that can enrich and diversify the product. The ice cream is still considered a complete and highly nutritious food, because it provides a range of nutrients such as proteins, carbohydrates, lipids, vitamins A, B1, B2, B6, C, D, E and K, calcium, phosphorus and other minerals (Maia, 2008).

According to Resolution RDC No. 266 from September 22nd, 2005, ice cream is a frozen product obtained from an emulsion of fat and protein; or a mixture of water and sugar(s). It can be added to other(s) ingredient(s) once providing they do not misrepresent the product (Brazil, 2005).

Vitamin C, a group of compounds that exhibit biological activity similar to L-ascorbic acid, has a high nutritional value. Among its various properties its antioxidant function can be mentioned, which protects healthy cells of the body against damage caused by excess free radicals (Cunha, 2014).

For those reasons, this study aimed the development of an ice cream rich in vitamin C, having acerola as the source of this vitamin.

2. MATERIAL AND METHODS

2.1 Ice Cream Formulation and Production

Three different formulations of acerola ice cream were developed, differing only by the amount of whole milk and acerola pulp added to the ingredients, which consisted of 40%, 45% and 50% of pulp in the formulations identified as F1, F2 and F3, respectively, as shown in Table 1.

Table 1 - Acerola ice cream formulations.

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Formulations</th>
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<tbody>
<tr>
<td></td>
<td>F1</td>
</tr>
<tr>
<td>Whole milk</td>
<td>27%</td>
</tr>
<tr>
<td>Powdered whole milk</td>
<td>5%</td>
</tr>
<tr>
<td>Sugar</td>
<td>14%</td>
</tr>
<tr>
<td>Powder glucose</td>
<td>5%</td>
</tr>
<tr>
<td>Milk cream</td>
<td>8%</td>
</tr>
<tr>
<td>Stabilizer</td>
<td>0.4%</td>
</tr>
</tbody>
</table>
Emulsifier 0.6% 0.6% 0.6%
Acerola pulp 40% 45% 50%

The productions were performed in the dairy pilot plant of IFCE Sobral. Before starting the production process of the formulations the utensils and equipment used were sanitized with chlorinated water 200 ppm solution for 15 minutes. Right after the ingredients were weighed, with the exception of the acerola pulp, and homogenized in an industrial blender for 10 minutes, then pasteurized at 65° C for 30 minutes. After pasteurization the mix was cooled to the temperature of 10° C and overnight aged under refrigeration. In the next day the acerola pulp was added to the mix and then taken to beat and aeration, down to -7° C. The ice cream was stored at -18° C.

2.2 Physicochemical Analysis

The physicochemical analyses made in the acerola ice creams were all performed in triplicate. Moisture was determined by dry residue at 105° C. Ashes analysis was performed in a muffle furnace at 550° C. Proteins analysis was performed by the Kjeldahl method. Lipids analysis was performed using the Bligh Dyer method. Measurements of pH were obtained by direct immersion of the electrode in the samples. Soluble solids results were obtained by bench refractometer. Carbohydrates were obtained by the calculation of the difference in other analyzed fractions. Vitamin C was determined by the Tillmans method, which is based on the reduction of 2,6-dichlorophenol-indophenol (DCFI) by ascorbic acid.

All analyses were performed according to the Adolf Lutz Institute (2008).

2.3 Microbiological Analysis

The microbiological analysis performed in the ice cream were Thermotolerant coliforms, DNA-se positive Staphylococcus, were determined by plating 1 ml of adequate dilution on Petrifilm Plates (3M Microbiology, St. Paul, MN, USA) according to methods AOAC 991.14, AOAC 997.02 e AOAC 2003.08 (AOAC, 2003); and Salmonella sp/25mL as indicated for ice cream on Resolution RDC No. 12 of January 2nd, 2001 issued by National Health Surveillance Agency, using petrifilm plates (Microbiology 3M St. Paul, MN, USA). The presence of Salmonella sp. was investigated by conventional methodology (Silva et al., 2007).

2.4 Sensory Analysis

For sensory analysis, an acceptance test was applied using a 9 points hedonic scale, where 9 represented the highest grade "liked extremely" and 1 represented the minimum grade "disliked extremely". The analysis was performed with 120 untrained panelists, analyzing attributes such as appearance, aroma, texture, taste, overall acceptance. Purchase intent was measured using a 5 points scale ranging from “I would certainly buy it” to “I would certainly not buy it”. The samples were served in 50 ml plastic cups, containing about 30g of ice cream.

2.5 Result Analysis

The results were analyzed using the Variance Analysis (ANOVA) and the Tuckey test, a 5% significance level, was used to define the difference among formulations. The statistical evaluation was performed using Statistica7.0 (Statsoft Inc., Tulsa, EUA).

3. RESULTS AND DISCUSSION
3.1 Physicochemical Analysis

The results of physicochemical analyses are shown in Table 2.

Table 2 - Means and standard deviation results of the physicochemical analysis.

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Formulations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F1</td>
</tr>
<tr>
<td>Moisture (g/100g)</td>
<td>68.84±0.07</td>
</tr>
<tr>
<td>Ashes (g/100 g)</td>
<td>0.65±0.00</td>
</tr>
<tr>
<td>Proteins (g/100 g)</td>
<td>5.22±0.50</td>
</tr>
<tr>
<td>Lipids (g/100g)</td>
<td>7.11±1.14</td>
</tr>
<tr>
<td>pH</td>
<td>4.25±0.01</td>
</tr>
<tr>
<td>Soluble solids (* Brix)</td>
<td>36.67±2.88</td>
</tr>
<tr>
<td>Carbohydrates (g/100 g)</td>
<td>18.18±1.58</td>
</tr>
<tr>
<td>Vitamin C (mg/100 g)</td>
<td>476.72±6.53</td>
</tr>
</tbody>
</table>

*Same letters in the same line do not show significant difference (p ≤ 0.05) in the Tukey test.

F1 = ice cream with 40% of acerola pulp. F2 = ice cream with 45% of acerola pulp. F3 = ice cream with 50% of acerola pulp.

It may be noted that the analyses of ash, soluble solids and carbohydrates showed no significant difference (p > 0.05) between themselves.

The values obtained for moisture were different among the three samples, showing a higher value was the sample with the highest concentration of acerola pulp. The averages for moisture found for the three samples in this study were higher than reported in the Food Composition Table (IBGE, 2009), that shows a value for moisture on ice cream of 63.30%.

The ashes results showed an average very close to the reported in Food Composition Table (IBGE, 2009) (0.6g / 100g).

Aguiar et al. (2015) studying the physicochemical preparation and characterization of acerola ice cream found a protein amount of 2.82 g/100g and 2.77 g/100g for ice cream with 45% and 50% of acerola pulp, respectively. This study showed superior protein results for ice cream with the same concentration of acerola pulp, these being 5.10 g/100 g and 3.48 g/100g respectively, also lying in accordance with Technical Regulation for ice cream (Brazil, 2005), which establishes a minimum content of 2.5% of protein.

The lipid analysis showed results with no statistical difference between F2 and F3 samples, showing differences only with the F1 sample. Technical Regulation for ice cream (Brazil, 2005) requires a minimum of 3.0% of fat for it, so the values obtained are within the standards established by ANVISA.

In the result of soluble solids were obtained values within the parameters established by Ordinance No 379 from April 26th, 1999, on Technical Regulation for ice cream and preparation bases for ice cream, where the value to soluble solids has to be bigger than 30g / 100g.

According to Favaro-Trindade (2006), acerola products that have been subjected to pasteurization and freezing processes have a higher vitamin C retention at the end of the storage period. Analyzing Aguiar et al. (2015) studies could be verified vitamin C contents of 494.56 mg/100g.
and 589.8 mg/100g in her ice cream with 45% and 50% of acerola pulp, respectively. The vitamin C contents found in this study were superior, which are 526.18 mg/100 g and 617.82 mg/100g for the same acerola pulp concentrations studied by Aguiar et al.

3.2 Microbiological Analysis

The presence of E. coli was not detected, nor Staphylococcus aureus or Salmonella sp/25mL in any of the samples analyzed in this study. Thus the acerola ice cream developed met within the standards required by Resolution No. 12 of ANVISA from January 2nd, 2001 (Brazil, 2001).

3.3 Sensory Analysis

The results obtained through the analysis applied to verify sensory acceptance by consumers are shown in Table 3.

Table 3 - Results regarding the attributes questioned on sensory analysis of acerola ice cream.

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Formulations</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F1</td>
<td>F2</td>
<td>F3</td>
<td></td>
</tr>
<tr>
<td>Appearance</td>
<td>7.98±0.92</td>
<td>7.71±1.09</td>
<td>7.58±1.17</td>
<td></td>
</tr>
<tr>
<td>Aroma</td>
<td>7.73±1.00</td>
<td>7.31±1.52</td>
<td>7.17±1.56</td>
<td></td>
</tr>
<tr>
<td>Texture</td>
<td>7.84±1.08</td>
<td>7.71ab±1.09</td>
<td>7.33b±1.33</td>
<td></td>
</tr>
<tr>
<td>Taste</td>
<td>7.68±1.13</td>
<td>6.87±1.92</td>
<td>6.68b±1.69</td>
<td></td>
</tr>
<tr>
<td>Overall acceptance</td>
<td>7.69±1.01</td>
<td>7.33ab±1.27</td>
<td>7.01b±1.30</td>
<td></td>
</tr>
<tr>
<td>Purchase intent</td>
<td>4.06±0.87</td>
<td>3.73ab±0.97</td>
<td>3.34b±1.12</td>
<td></td>
</tr>
</tbody>
</table>

*Same letters in the same line do not show significant difference (p ≤ 0.05) in the Tukey test.

F1 = ice cream with 40% of acerola pulp. F2 = ice cream with 45% of acerola pulp. F3 = ice cream with 50% of acerola pulp.

The attributes appearance and aroma showed no significant difference in the results, where the two were on the acceptance scale "liked moderately", as well as the global acceptance attribute. Favaro-Trindade et al. (2006) testing the acceptability of ice cream added 15% of acerola pulp obtained a result for aroma between 5.15 and 6.00.

The texture was different between F1 and F3 samples, which showed no difference with sample F2, showing acceptability in all the samples in scale 7 of "liked moderately".

As for flavor characteristic the sample more acceptable was F1, getting the range of "like moderately" and presenting significant difference with samples F2 and F3, which were in the range of "like slightly". In the study of Favaro-Trindade, et al., (2006) the sample with the highest acceptability of flavor resulted in 6.58, values near of samples F2 and F3 of this study.

For purchase intent the result was "possibly buy" for sample F1, and "might buy / might not buy" for samples F2 and F3.

4. CONCLUSION
It was developed an ice cream rich in vitamin C (476.72c ± 6.53), having 40% of acerola pulp with an acceptance between liked moderately and liked a lot. Concentrations above this value (45% and 50% acerola pulp) resulted in formulations that interfere in flavor sensory attribute, with acceptance between liked slightly and liked moderately.

5. REFERENCES


