ABSTRACT: The aim of this work was to evaluate the effect of addition of açai pulp on the sensorial features of probiotic Yogurts, thus defining the parameters for its use in processing. Yogurts with increasing açai pulp concentrations (3, 5 to 7 w/v %) was manufactured and submitted to sensorial evaluation, using discriminative (multiple paired comparison) pulp) and affective (acceptance) tests. The results suggested that the level of preference increased with increase in the proportion of açai pulp in the Yogurt formulation. The main attributes contributing to acceptance of the Yogurts containing more açai pulp (5% and 7 w/v %) were flavor and color (p<0.05). Consistency and aroma presented also better scores for both products, although without statistical difference. It is possible to produce probiotic yogurts with açai pulp with good sensory acceptance respecting the other technological parameters involved.

KEY WORDS: açai pulp, probiotic yogurts, sensorial evaluation

INTRODUCTION

Probiotics are bio-preparations containing live cells or metabolites stabilising the autochthon microbial flora that colonise and compose the intestinal flora of animals and humans, and showing a stimulating effect on the digestive and immune processes of the host (Fuller, 1989). Several studies (have documented their clinical and therapeutic effects on human health and the benefits attributed to the ingestion of food products containing these types of culture (Saarela et al., 2000; Salminem, 2000) Probiotic Yogurts represent more than 7.5% of the Australian Yogurt market (Kailasapathy and Rybka, 2004) and in Europe they have reached 13% of the total Yogurt market, representing a financial movement of about 889 million dollars/year, the French market being the biggest consumer centre, reaching approximately 219 million dollars/year (Stanton et al., 2001).

Açaí (Euterpe oleracea), a typically Amazonian palm, grows spontaneously in the north of Brazil in the states of Pará, Amazonas, Maranhão and Amapá. The “fruit” is a small coconut with a diameter of 1.0 to 1.5 cm, mean weight of 0.5 to 1 g and 25% moisture content, and its pulp consists of a succulent 1 mm-thick layer with an intense purple, almost black, colour. Açai pulp is very rich in anthocyanin, a natural purple pigment widely distributed in the vegetable kingdom and possessing antioxidant properties aiding in the combat of cholesterol, thus increasing the potential of this pulp on the external market (Pereira et al., 2003). Preference of the product in the southeast of Brazil, mainly in Rio de Janeiro and São Paulo, grew considerably in the late nineties. In these new consumption centres, acai is marketed by street vendors and is mostly consumed by people who frequenting gym clubs and beaches (Suframa, 2003).

Sensory analysis can be defined as a scientific discipline used to analyse, interpret and quantify reactions in foods related to the human senses, and uses knowledge from various other disciplines (Simpson et al., 1998). It is extremely important in food product development, and is an increasing concern of modern food industries.

Our recent work indicated that probiotic açaí Yogurts could be used as an adequate carrier of probiotic bacteria (Almeida et al., 2008). However it is not sufficient; besides the sensory appeal of the product to consumer is crucial, as if the product does not have or retain organoleptic qualities for the duration of its shelf-life, it will not be supported by consumers with repeated purchases (Heena et al., 2006).

Favaro-Trindade et al. (2006) produced fermented acerola ice cream with and without probiotic cultures (control). Although the viable counts of microorganisms remained above the recommended limit of 10⁶ cfu/g during the frozen storage, the
sensory analysis indicated the samples elaborated with the traditional cultures of yougurt – without probiotic cultures – were better preferred in terms of aroma, taste and global acceptance, suggesting the difficulty to manufacture fermented foods with probiotic cultures and emphasizing the importance of strict sensory studies in the probiotic product development.

In this context, the objective of this work was to evaluate the effect of addition of acai pulp on the sensorial features of probiotic Yogurts, thus defining the parameters for its use in processing.

MATERIAL AND METHODS

Yogurt processing

The products were elaborated in the Laboratory Complex of the Institute of Nutrition of the Federal University of Rio de Janeiro. The levels of acai pulp were defined in preliminary laboratory tests. Four products were manufactured: control (Y, with no acai pulp), Yogurt 1 (Y, with 3% w/v acai pulp), Yogurt 2 (Y, with 5% w/v acai pulp) and Yogurt 3 (Y, with 7% w/v acai pulp). For all the formulations, with and without acai pulp, the following basic mixture was used: 10 litres type C pasteurised milk, (CCL, São Paulo, Brazil), 4% w/v skimmed milk powder, (Elegê, São Paulo, Brazil) and 10% w/v sugar (Guarani, São Paulo, Brazil). This mixture was heated to 45ºC and submitted to homogenisation for 15 minutes. After this period, the temperature was reduced to 40ºC and 2% w/v lactic starter containing Lactobacillus delbrueckii sp bulgaricus and Streptococcus thermophilus (Chris Hansen, Valinhos, Brazil) and 2% w/v probiotic culture including Lactobacillus acidophilus and Bifidobacterium bifidum (Chris Hansen, Valinhos, Brazil) were added. Yogurt fermentation was carried out maintaining the temperature at 40ºC and monitoring the pH every 30 minutes until reaching a pH close to 4.6. The mixture was then immediately cooled to room temperature (25ºC) by immersion in a 15L container filled with constantly changed cold water. This basic mixture was then divided into 4 x 2.5 L portions, adding acai pulp at the concentrations of 3, 5 and 7% respectively. Each mixture was homogenised using an upright blender (Black and Decker, São Paulo, Brazil), filled into 0.1L polyethylene cups and stored at 5ºC.

Sensory Evaluation

The sensory evaluation was carried out 48 hours after processing using both discriminative and affective tests, with the participation of seventy volunteers of both sexes, between 21 and 50 years of age, selected as a function of interest, availability and consumption of dairy products, specifically: whipped Yogurt. The discriminative test was a multiple paired comparison test, comparing the various treatments in increasing order of acai pulp concentration (Y1, Y3, and Y5) with the control, containing no acai pulp (Y). The panellist was asked to test the samples from left to right, comparing them with the control, and evaluate the degree of difference on a structured scale. The degree of preference of the Yogurts was presented significantly better scores than those of the control (Yc, mean 5.0) and of those elaborated with 3 w/v % acai pulp (Y3, mean 4.1), suggesting there are differences among the yogurts.

<table>
<thead>
<tr>
<th>Yoghurt</th>
<th>Mean Score¹,²</th>
</tr>
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<tbody>
<tr>
<td>Yc</td>
<td>5.0ᵃ</td>
</tr>
<tr>
<td>Y3</td>
<td>4.1ᵃ</td>
</tr>
<tr>
<td>Y5</td>
<td>2.7ᵇ</td>
</tr>
<tr>
<td>Y7</td>
<td>2.9ᵇ</td>
</tr>
</tbody>
</table>

¹Means followed by the same letter and in the same column do not differ significantly (p>0.05); ²Scores 1 = much better than the standard, 5 = no difference from the standard and 9 = Much worse than the standard.
Acceptability of Yogurts containing açai pulp

Table 2 shows the means for the scores and the hedonic distribution for overall acceptability of the Yogurts fermented with açai pulp. The formulations containing 5% and 7 w/v açai pulp, products B and respectively, were the most accepted, presenting scores of 6.0 (liked slightly) and 6.7 (liked moderately), with no significant difference between them (p>0.05). The results obtained for the sensory analysis of the Yogurts suggested that the level of preference increased with increasing proportion of açai pulp in the formulation.

<table>
<thead>
<tr>
<th>Yoghurt</th>
<th>Overall preference Score1,2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y₃</td>
<td>5.0*</td>
</tr>
<tr>
<td>Y₅</td>
<td>6.0*</td>
</tr>
<tr>
<td>Y₇</td>
<td>6.7*</td>
</tr>
</tbody>
</table>

1Means followed by the same letter and in the same column do not differ significantly (p>0.05); 2Scores 1 = disliked a lot, 5 = neither liked nor disliked and 9 = liked a lot.

Table 3 shows the hedonic results for the attributes of colour, aroma and consistency, confirming the previous statistical analyses. Yogurts with greater açai pulp contents presented better performance with respect to all the attributes, although statistical difference was only ascertained for the attribute of colour. The characteristics mainly contributing to acceptance of the Yogurts containing more açai pulp (5% and 7 w/v %) were, above all, flavor and color (p<0.05). Consistency and aroma presented also better scores for both products, although without statistical difference.

This could be related to the tendency of modern consumer of acquiring manufactured food products similar to the natural ones, a common characteristic nowadays. Additionally, it is should be mentioned the açai pulp sold on the market normally has a very intense colour, and this could be fixed in the sensory memory of the panelist, making him associate any product derived from this fruit with an intense colour.

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Yoghurts1,2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Y₃</td>
</tr>
<tr>
<td>Color</td>
<td>5.45*</td>
</tr>
<tr>
<td>Aroma</td>
<td>6.40*</td>
</tr>
<tr>
<td>Consistency</td>
<td>5.81*</td>
</tr>
<tr>
<td>Flavor</td>
<td>5.06*</td>
</tr>
</tbody>
</table>

1Means followed by the same letter and in the same column do not differ significantly (p<0.05); 2Scores 1 = disliked a lot, 5 = neither liked nor disliked and 9 = liked a lot.

The sensory attribute of colour, as an aspect of the appearance of a food product, is inserted within a determined expectation for the acceptability of the product. Thus if this attribute is judged negatively by the consumer, other quality factors, such as flavour and texture, will also be so evaluated. In addition this will affect the overall preference of the product (Chan and Cane-Martinelli, 1997).

A previous study confirmed this hypothesis, using two sensory panels composed of people from different age ranges, showing that, most of the times, colour significantly affected acceptance and flavour. Food products prepared with a formulation aimed at increasing the colour showed a significantly improved performance with respect to the attributes of flavour and appearance (Clysdesdale, 1993). In another study, orange and cherry beverages presented values for overall acceptance that increased with increasing colour and showed decreasing values when the colour of the products was similar to the levels used in commercial products, even when the sensory panel detected an increase in flavour (Francis, 1997).

The results of this work indicate that probiotic bacteria did not have a negative impact at the acceptance of probiotic Yogurts, mainly Y₅ e Y₇, indicating a potential market for these products.

Indeed, researches indicate good sensorial performance of probiotic products, even when compared to the same one without probiotic cultures, suggesting the absence of adverse effects on the food product caused by the presence of these microorganisms. Heena et al. (2004) obtained similar results when adding Lactobacillus acidophilus in a frozen vegetarian dessert. The panel could not distinguish between fresh product inoculated with one and the control product containing no probiotic bacteria, even after seven-month storage.

Aragon-Alegro et al. (2007) related the absence of significant difference in preference of samples of probiotic, symbiotic towards control (without probiotic culture) chocolate mousse. The probiotic sample considered the most preferred product by the sensorial panel.

Hekmat and Reid (Hekmat and Reid, 2006) compared the sensory properties of probiotic yogurt to the standard one. The former showed better performance by the panelists by their appearance, without significant difference towards their flavour. It was contested the addition of probiotic bacteria did not inhibit the standard yogurt cultures or overtly contribute to acid production from conversion to lactose to lactic acid.

CONCLUSION

The addition of açai pulp influenced the sensorial evaluation of the probiotics yogurts. Overall, the products with increasing amounts of açai pulp (5% and 7 w/v %) presented greater acceptance by the sensory panel for all the attributes evaluated, mainly due their flavour and colour, although their consistency and aroma were also important. It is possible to formulate probiotic yogurts containing açai pulp with good sensory performance, respecting the other technological parameters involved.

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