EFFECT OF THE PARTIAL SUBSTITUTION OF SUCROSE BY NEOTAME ON THE SENSORY AND CONSISTENCY CHARACTERISTICS OF_plain_yogurt

EFFECTO DE LA SUSTITUCIÓN PARCIAL DE SACAROSA POR NEOTAME EN LAS CARACTERÍSTICAS SENSORIALES Y DE CONSISTENCIA DE_YOGUR NATURAL

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Received 29 March 2007; Accepted 4 July 2007

Abstract

The purpose of this study was to evaluate the effect of the partial substitution of sucrose by neotame on the sensory and physical characteristics of plain yogurt. Yogurts consisted of a 100 % sucrose control and 3 formulations with 25, 37.5, and 50 % of the sucrose substituted by neotame. Sweetness of all treatments was evaluated using time-intensity (TI) techniques. Yogurts with 37.5 and 50 % sucrose substituted by neotame were perceived as sweeter and of longer sweetness duration. The sweetness profile of 25 % sucrose substituted by neotame yogurt was comparable to that of the sucrose sweetened control. During TI evaluations, differences in metallic aftertaste were identified, however, 3-AFC tests (n = 36) showed similar d’ values for all yogurts. Consumers (n = 100) did not express preference for any of the yogurts. All treatments presented a similar behavior for pH, water activity, consistency, and titratable acidity.

Keywords: sensory evaluation, neotame, yogurt, time-intensity.

1. Introduction

Neotame is a relatively new alternative sweetener approved by the FDA in 2002. It is a high potency nonnutritive sweetener, which is considered as the potential successor of aspartame. As a close derivate of aspartame, it has intrinsic qualities such as a clean sweet taste, close to sucrose. It offers additional advantages, such as: a status of a no-calorie sweetener, greater stability in the neutral pH range, when compared to that of its predecessor aspartame, allowing its application in baked goods, and a chemical inertness towards reducing sugars, without the possibility of undesirable Maillard-type reactions, and towards aldehydic derivates, without the possibility of Schiff base formation, allowing its association with reducing sugars and flavoring agents based on aldehydic constituents. Furthermore, it generates a relatively competitive cost as a result of its high sweetness potency (Nofre and Tinti, 2000).

It produces an insignificant release of methanol and phenylalanine into the organism after intake, for example, the neotame hydrate releases 8.08 % of MeOH on a weight basis, the potential MeOH content of a beverage formulated with 17 mg L-1 of neotame (corresponding to the sweetness of a 10 % sucrose solution) is 1.37 mg L-1; this amount is approximately 220 times lower than that of 1 L of tomato juice. In the case of phenylalanine, using the same concentration, 17 mg L-1, its content is 7.08 mg L-1, and the amount released through metabolic...
pathways from 17 mg of neotame is below 0.7 mg, approximately 90 to 5700 times less than the phenylalanine content of fruits, the food with the lowest phenylalanine content (Nofre and Tinti, 2000).

Perception of sweetness is a dynamic process which requires temporal evaluation for complete characterization (Noble et al., 1991). In the study of intense artificial sweeteners, the temporal characteristics of the taste response, taste onset and lingering aftertaste, is a crucial aspect for their general acceptability (Ott et al., 1991). The temporal properties of various nutritive and nonnutritive sweeteners have been assessed in model solutions and beverages by time-intensity (TI) techniques (Matysiak and Noble, 1991; Larson-Powers and Pangborn, 1978).

Neotame and sucrose have been assessed at comparable levels of sweetness in water, sweetness augmented with increasing concentration of neotame in water, although other attributes such as bitterness, sourness, and metallic taste, generally associated to artificial sweeteners, were insignificant (Prakash et al., 2002). In a similar study with a cola beverage, the increase in neotame concentration improved desirable attributes, such as cola flavor, sweet taste and mouthfeel, without increasing the non-desirable attributes licorice, bitter, sour and metallic (Prakash et al., 2002).

The optimum pH for maximum stability of neotame is about 4.5, very close to the pH present in yogurt. Sensory results have shown neotame has excellent functionality (sweetness) in yogurt, no more than 75 % of the panelists rated the sweetness as not quite sweet enough; and after a 6 week period, the typical shelf life of the product, about 98 % of the initial neotame remained (Prakash et al., 2002).

Sweetness has been directly correlated with the general acceptability of plain (Barnes et al., 1991a), and raspberry and strawberry flavored yogurts (Barnes et al., 1991b). Keating and White (1990) found a constant preference for plain and fruit flavored yogurts sweetened with sorbitol and aspartame over a 42 day evaluation period, when compared to those sweetened with sucrose, sucrose plus monoammonium glycyrrhizinate, acesulfame-K, fructose, sodium saccharin, calcium saccharin, high fructose corn syrup plus monoammonium glycyrrhizinate, and dihydrochalcone. McGregor and White (1986, 1987) showed yogurts made with 90 % high fructose corn syrup was preferred over yogurts sweetened with sucrose, and 42 and 55 % high fructose corn syrup.

Response bias is a problem encountered in sensory difference testing, and can be dealt with by two experimental strategies, the first is to use forced choice procedures such as 2-AFC or 3-AFC tests and the second is the adoption of multiple criterions such as the R-index. The latter, may also be used for the analysis of ranked preference data. The utilization of the R-index presents certain advantages; it gives a measure of the probability of a sample being preferred over others, and eliminates the differences in the distances between numbers or categories of hedonic scales found among individuals (O’Mahony, 1992).

The use of nonnutritive sweeteners in the dairy industry is widely accepted. However, little information is available regarding the use of neotame in dairy and other food systems. The purpose of this study was to evaluate the effect of the partial substitution of sucrose by neotame on the sensory and physical characteristics of plain yogurt.

2. Materials and methods.

2.1 Yogurt preparation.

The yogurt treatments were made as 1.6-kg batches consisting of 2 % fat raw milk from the university farm (Universidad Autónoma Chapingo), 10 % w/w of solids non fat (SNF) adjusted with skim milk powder (La Suiza; Pasteurizadora Jersey del Noroeste, S.A., Tijuana, BC), 1 % w/w of stabilizer CC-7623 (modified starch, Kosher gelatin, pectin and calcium sulfate; Continental Custom Ingredients, Chicago, IL), and sweeteners. Four treatments (Table 1) with a sweetness equivalency of 5 % sucrose, the sweetness level commonly used for plain yogurt (The Nutrasweet Co., 2006), were elaborated. Fat content and solids non fat (SNF) of raw milk were determined using an Ekomilk-M milk analyzer (Bulthee 2000 Ltd., Bulgaria), and standardized to the values mentioned. Milk standardized in fat and SNF was heated to 65 °C, and stabilizer and sucrose were added and mixed using an industrial blender. The mixes were then heated in a water bath to 85 ºC and held for 30 min.

Table 1. Neotame and sucrose concentrations used for the elaboration of yogurts with a sweetness equivalent to 5 % sucrose.

<table>
<thead>
<tr>
<th>Partial substitution of sucrose by neotame (%)</th>
<th>Neotame % as formulated*</th>
<th>Sucrose % as formulated*</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.0</td>
<td>5.00</td>
</tr>
<tr>
<td>25</td>
<td>0.00014375</td>
<td>3.75</td>
</tr>
<tr>
<td>37.5</td>
<td>0.000215625</td>
<td>3.125</td>
</tr>
<tr>
<td>50</td>
<td>0.0002875</td>
<td>2.50</td>
</tr>
</tbody>
</table>

*Estimated use levels and sweetness contribution for a blend of sucrose and neotame (The Nutrasweet Co., 2006).

The base mixes were inoculated with 3 % w/w of a lyophilized culture of Lactobacillus delbrueckii ssp. bulgaricus and Streptococcus salivarius ssp. thermophilus (MY800, Ezal; Rhodia Food, France) and incubated at 42 °C to the desired acidity of 6.5 mg·mL⁻¹ of lactic acid. Reduction in the total solids...
content of yogurt treatments by the decrease in the percentage of sucrose used to partially sweeten them was not compensated. Neotame was added to yogurt cooled to 12 °C and stirred. Yogurts were stored at 12 °C.

2.2 Time-intensity measurements

A 5 member panel consisting of 3 male and 2 female students and employees of the department of Agroindustrial Engineering at Universidad Autónoma Chapingo, between the ages of 23 and 50 years, and with experience in sensory testing received 24 h of training, 4 h a week during a 6 week period, in the TI technique described by Swartz (1980), and Swartz and Furia (1977) with the following variation: sweetness intensity was recorded on stationary graph paper at 4 s intervals. A sweetness scale ranging from 0 to 10, where 0 is no perception and 10 is extremely strong, was used. Recording time was orally marked every 4 s by the panel leader. Panelists introduced half a teaspoon of product into their mouth for each evaluation. Yogurt was kept whole inside the mouth during the first three measurements (4, 8 and 12 s), and gel rupture and disintegration initiated at 12 s by pressing the sample with the tongue against the palate. At 20 s the sample had been completely swallowed by all panel members. The recording graph paper presented marks at 12 and 20 s to remind panelists of the instructions for these specific times. Panelists developed TI curves for each treatment. All treatments were evaluated in triplicate at 12 °C on the third day after yogurt elaboration. Several TI indices were determined: the maximum intensity of the TI response (IMAX), the total time or duration of the TI response from ingestion to extinction (TTTOT), the time to reach maximum intensity (TMAX), the total area under the TI curve (AREA), the area under the time to reach maximum intensity (TBEF), the area under the TI curve before the maximum intensity (ABEF), the area under the TI curve after the maximum intensity (AABE35), and the ratio of the area after the maximum intensity to the area before the maximum intensity (AAFT). All TI indices were measured in triplicate. Time-intensity curve profiles of each yogurt were determined by calculating means of the 4 s intensity values for the responses given by the five judges. Mean values were plotted versus time to give a visual representation of the TI properties of each treatment.

2.3 Difference Test

Throughout TI evaluations, judges identified a metallic aftertaste in some samples; therefore a 3 alternative forced choice (3-AFC) test, a directional triangle test where the panelists receive three samples simultaneously, two of them are identical, and are asked to indicate the sample that is higher or lower in a specified sensory attribute (O’Mahony et al., 1994), was conducted with the purpose of evaluating if consumers could identify differences among yogurts for metallic aftertaste. All 4 treatments were evaluated by a group of consumers (n = 36) comprising students, staff and faculty from Universidad Autónoma Chapingo. Completely randomized and balanced samples were presented in coded plastic cups at 12 °C.

According to Thurstonian modeling, each time a product is tasted, it will vary in its flavor intensity. Such variation can be represented by a continuous frequency distribution, commonly a normal distribution, along a flavor intensity axis whereby the height of the distribution represents how commonly each intensity will occur. When evaluating two food samples, a measure of the overlap of the two distributions, the distance between the two means of the flavor intensity, measured in units of standard deviation will be given by d’ (O’Mahony et al., 1994). Therefore, values of d’ were obtained for each pair of comparisons from the tables provided by Ennis (1993), and variance between samples was calculated in order to determine differences among them (Bi and Ennis, 1997).

2.4 Preference Test

A preference test was conducted with a group of consumers (n = 100) comprising students, staff and faculty from Universidad Autónoma Chapingo, of ages between 17 and 70 years. They were presented with 4 coded randomized yogurt samples (0, 25, 37.5 and 50 % sucrose substituted by neotame), and asked to rank the samples according to their preference. Data was analyzed using the R-index (O’Mahony, 1992; Bi and O’Mahony, 1995) and by a Friedman analysis (Meilgaard et al., 1999).

2.5 Consistency

Yogurt consistencies were measured in triplicate every 48 h during 6 days using a TA-XT2i texture analyzer (Stable Micro Systems; Surrey, England) in 100 g samples at 12 °C. Uniaxial compression force was measured using a 0.035 m diameter back extrusion acrylic disc (A/BE35) with pre-test, test, and post-test crosshead velocities of 1 mm/s, and penetrating a distance of 30 mm in a cylindrical container of 0.075 m of height and a 0.06 m diameter. A 5-kg load cell was used.

2.6 Analytical Measurements

Acidity, pH and water activity of yogurts were measured in triplicate every 48 h during 6 days. For pH, a Corning 430 pH meter (Corning, NY) calibrated with pH 7 buffer was used (Sigma de México, Mexico), acidity was determined by titration with 0.1 N NaOH and reported as mg·mL⁻¹ of lactic acid.
acid, and an Aqualab water activity meter adjusted to 25 ºC (Decagon, WA) was used for water activity.

2.7 Statistical Analysis

2.7.1 Analysis of sensory data

Analysis of variance for a randomized complete block design with four treatments in five blocks, where blocks were panelists, according to the model: index = yogurt treatment + panelist, was applied to all TI indices to determine if they were statistically different (P < 0.05). Differences between means were determined using least significant difference procedures. Data were analyzed by SAS version 8.02 (SAS Institute, Inc., Cary, NC).

A randomized complete block design, where blocks were consumers, was used for the preference test, and data were analyzed using the Friedman statistic.

2.7.2 Analysis of instrumental data

Analysis of variance (completely randomized design with 3 replications) was performed on instrumental data (consistency, pH, water activity and acidity) for each date, in order to identify statistical differences (P < 0.05). Least significant difference procedures were used for pairwise comparisons. Data were analyzed by SAS version 8.02 (SAS Institute, Inc., Cary, NC). To represent statistical values in the graphics, standard error bars were used.

3. Results and discussion

3.1 Time-intensity measurements

TI curves for sweetness of yogurts with 0, 25, 37.5 and 50 % sucrose substituted by neotame are shown in Fig. 1. Treatments with 0 and 25 % sucrose substituted by neotame presented similar TI profiles, while 37.5 and 50 % sucrose substituted by neotame yogurts showed larger TI curves, suggesting an increase in sweetness and duration of the stimulus for treatments with a greater content of neotame. Analysis of variance of TI indices (Table 2) indicated that yogurts were different in terms of sweetness intensities over time (P < 0.001). Yogurts formulated with 100 % sucrose and 25 % sucrose substituted by neotame presented a lower IMAX than those formulated with a 37.5 and 50 % neotame substitution. This suggests that despite the use of the equisweetness levels of neotame recommended by the manufacturer, the sweetener should be first tested to determine the concentration of each synthetic sweetener in combination with sucrose equal in initial sweetness intensity to 5 % sucrose plain yogurt at 12 ºC. The sweetness potency of neotame when compared with sucrose varies; it is about 6000 to 10,000 times that of sucrose on a weight basis (Nofre and Tinti, 2000). Differences in initial sweetness perception due to the proportions used to partially substitute sucrose were probably due to the variation in the sweetness potency of neotame at different concentrations.

Fig. 1. TI sweetness profiles of yogurts with a sweetness equivalent to 5 % sucrose and sweetened with 100 % sucrose (●), 25 % neotame and 75 % sucrose (○), 37.5 % neotame and 62.5 % sucrose (▼), and 50 % neotame and 50 % sucrose (▲). A sweetness scale ranging from 0 to 10 was used, where 0 is no perception and 10 is extremely strong.

Table 2. Mean values of TI indices for 5 % sucrose equivalent sweetness of yogurts sweetened with sucrose and neotame-sucrose blends.

<table>
<thead>
<tr>
<th>Indexes</th>
<th>0</th>
<th>25</th>
<th>37.5</th>
<th>50</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMAX</td>
<td>4.57b</td>
<td>4.55b</td>
<td>5.57a</td>
<td>5.98a</td>
<td>0.12</td>
</tr>
<tr>
<td>TMAX</td>
<td>9.87b</td>
<td>10.13b</td>
<td>13.33a</td>
<td>15.73a</td>
<td>0.81</td>
</tr>
<tr>
<td>TTOT</td>
<td>40.00d</td>
<td>44.80d</td>
<td>54.40b</td>
<td>67.20a</td>
<td>1.49</td>
</tr>
<tr>
<td>AREA</td>
<td>117.27c</td>
<td>130.92c</td>
<td>198.53b</td>
<td>270.99a</td>
<td>9.21</td>
</tr>
<tr>
<td>ABEF</td>
<td>31.80c</td>
<td>32.51c</td>
<td>59.85b</td>
<td>78.41a</td>
<td>4.53</td>
</tr>
<tr>
<td>AAFT</td>
<td>85.47c</td>
<td>98.41c</td>
<td>138.68b</td>
<td>192.57a</td>
<td>7.08</td>
</tr>
<tr>
<td>RATIO</td>
<td>5.29a</td>
<td>6.54a</td>
<td>5.08a</td>
<td>4.67b</td>
<td>2.42</td>
</tr>
</tbody>
</table>

Means within a row with different superscripts differ (P < 0.05).

1Indicators: IMAX = maximum intensity of the TI response; TTOT = total time (s) or duration of the TI response from ingestion to extinction; TMAX = time (s) to reach maximum intensity; AREA = total area under the TI curve; ABEF = area under the TI curve before the maximum intensity; AAFT = area under the TI curve after the maximum intensity; RATIO = ratio of the area after the maximum intensity to the area before the maximum intensity. SEM = Standard error of the mean.

Yogurts formulated with 100 % sucrose and 25 % sucrose substituted by neotame presented a shorter TMAX (10 s), than those substituted by 37.5 and 50 % neotame (avg 14.5 s). Ott et al. (1991) found that sucrose perceived intensity in deionized
water at 22 °C peaked within 10 s, a finding similar to our data regardless of the media and temperature difference. The perceived sweet impact of 37.5 and 50 % neotame treatments was slower, but of a greater perceived sweetness intensity. This was consistent with Birch (1986) who stated that intensely sweet substances seemed to have a slow reaction time.

The sweet intensities of yogurts formulated with 37.5 and 50 % sucrose substituted by neotame were of longer duration than the other two formulations. Prakash et al. (2002) reported that neotame requires a longer time to reach maximum intensity than sucrose, in addition to the fact that neotame has a greater sweetness duration. This is consistent with the results obtained for all yogurt treatments; as the proportion of neotame increased, so did the TTOT. Swartz (1980) found sweet intensity of a 4 % sucrose solution in deionized water, declined over a 36 s period, similar results were observed in our study for sucrose in yogurt (40 s) at a 5 % sweetness intensity. Differences in aftertaste can be observed in the areas under the curve; 0 and 25 % sucrose substituted by neotame treatments had a very similar profile. Total time, AREA, ABEF, and AAF were always greater for 50 % sucrose substituted by neotame yogurt. Results indicate that as greater concentrations of neotame were used to partially substitute sucrose in a 5 % sucrose equivalent sweetness yogurt, sweetness intensity and duration increased.

3.2 Difference test

The proportions of correct 3-AFC tests performed by subjects for metallic aftertaste of yogurts were used to determine values of d’ (Ennis, 1993). Yogurts with 25 and 37.5 % sucrose substituted by neotame were perceived as identical to the control sweetened with sucrose (d’ = 0). Differences between treatments with 0 and 50 % sucrose substituted by neotame were not significant (d’ = 0.46). The election of the triadic test, 3-AFC, was based on the criterion used. This criterion was the intensity of metallic aftertaste required for a subject to report the stimulus as being strong, α criterion. The criterion is the degree of difference required by a subject to report stimuli as different (O’Mahony, 1995). Furthermore, the 3-AFC test chosen uses triads with strong stimuli as odd samples, this presentation gives higher d’ values and thus greater power than tests with the weaker stimulus as odd (Tedja et al., 1994).

Metallic aftertaste is a characteristic of high intensity nonnutritive sweeteners; however, unless subjects were familiar with these sensations, they might have confused the residual taste of sucrose sweetened yogurts with that of neotame partially sweetened ones. The use of the traditional 3-AFC instructions, asking subjects to identify the stronger or more intense stimulus, could have contributed to such errors. Dessirier and O’Mahony (1999) modified the instructions of 3-AFC tests; after using a warm up to identify the sensations elicited by distilled water and NaCl, subjects were asked to identify the salty stimulus. This approach is suggested in future works, so that the task for the subjects is changed to deciding which stimulus is metallic aftertaste. In addition, it has been demonstrated that trained panels exhibit a higher sensitivity than consumers (O’Mahony and Rousseau, 2003), possibly accounting for the differences perceived by the trained panel, which consumers were not able to detect in the metallic aftertaste of yogurts.

3.3 Preference test

The R-index is commonly used in signal detection trials by categorization; however, it is also possible to use it with preference data. In this study, the R-index was defined as the probability of choosing any of the four yogurts evaluated as the most preferred sample when presented simultaneously with the other three. The critical R-index value was 59.66 % (P < 0.05; Bi and O’Mahony, 1995). This means the R-index can deviate from a nondetection value (50 %) in 9.66 % by chance, hence R-indices for yogurt comparisons were not significant (Table 3). Friedman analysis did not evidence differences in preference of yogurts either. Neotame, a close derivate of aspartame, was found to have comparable results with the findings of Keating and White (1990), who demonstrated sucrose and aspartame sweetened yogurts were preferred to those sweetened with sorbitol, sucrose plus monoammonium glycyrrhizinate, acet sulfame-K, fructose, sodium saccharin, calcium saccharin, high fructose corn syrup plus monoammonium glycyrrhizinate, and dihydrochalcone. Overall liking has been correlated to sweetness of yogurts (Barnes et al., 1991a). However, our results indicate that sweetener modification did not influence the overall preference of yogurts.

Table 3. R-indices for comparisons among yogurts sweetened with sucrose and neotame-sucrose blends and with a sweetness equivalent to 5 % sucrose.

<table>
<thead>
<tr>
<th>Compared concentrations (% sucrose substituted by neotame)</th>
<th>R-index</th>
</tr>
</thead>
<tbody>
<tr>
<td>50-0</td>
<td>58.38</td>
</tr>
<tr>
<td>37.5-0</td>
<td>57.85</td>
</tr>
<tr>
<td>25-0</td>
<td>50.76</td>
</tr>
<tr>
<td>50-25</td>
<td>58.14</td>
</tr>
<tr>
<td>50-37.5</td>
<td>50.49</td>
</tr>
</tbody>
</table>

3.4 Consistency

Differences in consistency of yogurt treatments did not exist during the first 4 days of storage (Table 4). However, a significant difference among treatments was found on the sixth day of storage, yogurt sweetened with 50 % sucrose and 50
% neotame presented a greater consistency. The consistency of yogurt is affected by the distribution of protein-protein bonds over the gel network (Tamime and Robinson, 1999), the slight decrease in sucrose content of 50 % sucrose sweetened yogurt could have contributed to stronger protein bonds, and therefore a greater consistency. Although differences after 6 days of storage were significant, values only varied by less than a tenth of a Newton, indicating that consistency was not greatly affected by sweeteners. The increase in the total mass, by the addition of 5 % sucrose, is insignificant; additionally the quantities of neotame used were very small (< 600 μg). Consistency of yogurts increased with time (Fig. 2). Similar results have been found (O’Neil et al., 1979; Salvador and Fiszman, 2004); at greater storage times an increase in yogurt consistency was observed. During the acidification of yogurt, casein micelles are partially disintegrated, and afterwards rearranged and aggregated to form a protein matrix consisting of micellar chains and clusters (Tamime and Robinson, 1999). During refrigerated storage, microbial activity is reduced by temperature; however the remaining activity allows the continuous acidification of yogurt. As acidity increases with storage time, so does yogurt consistency, due to the rearrangement and strengthening of protein bonds. The shapes of the consistency curves of all yogurt treatments were similar.

![Consistency values as a function of storage time for yogurts with a sweetness equivalent to 5 % sucrose and sweetened with 100 % sucrose (●), 25 % neotame and 75 % sucrose (○), 37.5 % neotame and 62.5 % sucrose (▲), and 50 % neotame and 50 % sucrose (▼).](image)

Table 4. Mean consistency values and standard errors of yogurts sweetened with sucrose and neotame-sucrose blends evaluated during refrigerated storage.

<table>
<thead>
<tr>
<th>Partial substitution of sucrose by neotame (%)</th>
<th>Consistency (N)</th>
<th>Storage time (d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.46±0.03</td>
<td>0.45±0.01</td>
</tr>
<tr>
<td>25</td>
<td>0.45±0.01</td>
<td>0.45±0.00</td>
</tr>
<tr>
<td>37.5</td>
<td>0.44±0.01</td>
<td>0.44±0.01</td>
</tr>
<tr>
<td>50</td>
<td>0.50±0.01</td>
<td>0.47±0.01</td>
</tr>
</tbody>
</table>

*Means within a column with different superscripts differ (P < 0.05).*

3.5 Analytical measurements

The pH, titratable acidity and water activity of yogurts showed little variation between treatments, from date of elaboration to the end of storage time. On day 0, no significant differences were found for pH and acidity, values ranged from 4.60 to 4.64, and from 0.68 to 0.71 mg·mL⁻¹ of lactic acid, respectively; while yogurts with 37.5 and 50 % sucrose substituted by neotame presented the greatest value for water activity (0.993), followed by 25 % neotame yogurt (0.991) and 100 % sucrose yogurt (0.988). After two days of storage, pH and acidity of yogurt, ranged from 4.50 to 4.52, and from 0.73 to 0.74 mg·mL⁻¹ of lactic acid, respectively, without showing significant differences; and water activities ranged from 0.990 to 0.992. On day 4, pH, water activity and acidity of treatments ranged from 4.41 to 4.43, 0.990 to 0.993 and 0.74 to 0.78 mg·mL⁻¹ of lactic acid, respectively; and on day 6, values for pH were in the range of 4.38 to 4.40, acidity varied from 0.77 to 0.80 mg·mL⁻¹ of lactic acid and water activity ranged from 0.990 to 0.993. Yogurt acidification developed as expected, Tamime and Deeth (1980) mention that the addition of sweeteners does not significantly affect lactose fermentation, and therefore the increase in yogurt acidity. Water activity remained constant, unlike pH and titratable acidity, which slightly decreased and increased, respectively, during storage. Similar results have been found for pH (Keating and White, 1990) and titratable acidity (O’Neil et al., 1979; Salvador and Fiszman, 2004) during longer storage periods.

Conclusions

Time-intensity profiles of 100 % sucrose and 25 % sucrose substituted by neotame sweetened yogurts were very similar and of less sweetness intensity and duration than 37.5 and 50 % sucrose substituted by neotame yogurts. Differences in metallic aftertaste, although identified by judges during TI evaluations, were not detected by consumers, who equally preferred sucrose and neotame-sucrose sweetened yogurts. Partial substitution of sucrose by neotame did not greatly affect the consistency, pH, titratable acidity, and water activity of yogurt.
Acknowledgments
The authors would like to thank The Nutrasweet Co. Mexico for a sample of neotame, Mónica Guzmán for her valuable comments, and the members of the sensory panel for their enthusiastic participation.

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