ABSTRACT – Sodium reduction in food products is an urgent public health matter. However, in breadmaking it is challenging by various functions it has and by few substitution alternatives found. Thus, dry sourdough (DS) becomes an alternative, since its acidic character can intensify the salty taste. This study aimed to evaluate the sensory acceptance and purchase intent of French rolls made with different levels of DS and NaCl. Variables influenced the acceptance of external appearance, appearance and color of crumb, aroma, taste, texture and overall impression. It was possible to observe that at higher concentrations of NaCl there was an increase of acceptance of the rolls, while higher DS concentrations decreased their acceptance. Nevertheless, in the test with 5% DS, satisfactory sensory scores were achieved, and the reformulation resulted in a sodium reduction of 30%. These rolls obtained good acceptance of their sensory attributes (scores > 5.5) and positive purchase intent (56%).

KEYWORDS: sourdough, salt, affective test, sensory quality.

1. INTRODUCTION

The high intake of sodium has been a global concern as its excessive consumption can lead to an increase in the number of cases of hypertension, which is associated with greater risks of cardiovascular diseases, such as heart attacks and strokes, and also chronic kidney diseases (Gibson et al., 2000; He and MacGregor, 2009).

Given this scenario, the World Health Organization (WHO) has recommended a maximum daily intake of 5 g of salt, as a worldwide guideline. However, in developed countries, the consumption of salt can range from 6 to 18 g a day (Belz et al., 2012). In Brazil, approximately 11.4 g of salt are consumed daily, according to the Brazilian Household Budget Survey (POF, 2008-2009), conducted by the Brazilian Institute of Geography and Statistics (IBGE, 2013).

French rolls represent 46% of total consumption of bread (ABIP, 2012) in the Brazilian diet, contributing with 6% of the sodium intake (ABIA/IBGE, 2013). Moreover, the reduction of salt in baked goods presents a challenge, as, in addition to the influence it has on technological properties (Nogueira and Steel, 2016), it has a strong effect on sensory quality by conferring its characteristic salty taste and also enhancing or balancing the taste of other ingredients and reducing the sensation of bitterness in some products (Hutton, 2002).

Among the few strategies to reduce the sodium chloride content in food, there is its replacement with mixtures composed of other inorganic salts, such as potassium chloride and magnesium chloride. However, they have a negative impact on flavor, since they confer a bitter and astringent taste, which is not easily masked (Cauvain, 2007). The use of flavor enhancers has also been studied, and amongst them there is the enhancement of the salty taste with the addition of an acid
taste, as it is known from sensory analysis that acid and salty tastes are confounded when very diluted (McCutcheon, 1986).

In this approach, the use of sourdough becomes a promising alternative for the reduction of salt in breads, which based on acidification, can enhance the salty taste, helping to reduce the level of sodium chloride added to breads. Therefore, this work aimed to evaluate the sensory acceptance and purchase intent of French rolls with reduced sodium content by the addition of dry sourdough.

2. MATERIAL AND METHODS

2.1 Material

The ingredients used in the formulation of the rolls were wheat flour enriched with iron and folic acid, water, instant dry yeast for salty bread, dry sourdough Sapore Traviata, commercial sodium chloride and Fleischmann powdered dough improver (corn starch, stabilizers: sodium stearoyl lactylate and polysorbate 80, dough improvers: azodicarbonamide, ascorbic acid and alpha amylase).

2.2 Methods

Preparation of the rolls: Five test formulations and a control were produced according to Table 1, varying the quantities of dry sourdough (DS) and sodium chloride (NaCl) added within ranges that would permit evaluating effects on sensory attributes. The other ingredients were added in the following proportions: wheat flour (100%), water (60%), instant dry yeast (1.5%) and powdered dough improver (2%), based on flour weight.

The rolls were prepared by the modified straight dough method, in which the ingredients were mixed in a HAE 10 mixer (Hyppolito, BRA) for 4 minutes at low speed (90 rpm) and for the time necessary (~4.4±1.1 min) for the complete development of the gluten network at high speed (210 rpm). The dough was divided into portions of 65±1 g each, which were manually rounded and left at rest for 15 min. After this time, the dough portions were molded in a HM2 Hp 0.5 molding machine (Hyppolito, BRA) and then put in a 20B proofing chamber (Klimaquip, BRA), with temperature (30±3°C) and relative humidity (80±5%) controls, for the time required for the maximum development of the volume of the dough, without loss of resistance to touch (82 ± 7 min). Before placing the proofed dough portions in the oven, the surface was cut (for the formation of the typical cut opening), and these were then baked in a HF 4B professional oven (Haas, BRA), with top and hearth temperatures of 210±5°C and 215±5°C, respectively. After cooling for approximately 1 hour, the rolls were submitted to sensory analysis.

Sensory analysis: The six different French roll samples (five test samples + control) were submitted to an acceptance test using a 9-cm unstructured hedonic scale with “dislike extremely” and “like extremely” on its extremes for the assessment of the attributes external appearance, appearance and color of the crumb, aroma, taste, texture and overall impression of the rolls. As for the test of purchase intent, a structured 5-point scale, which ranged from “would certainly not buy” to “would certainly buy”, was used.

Statistical analysis: The results were evaluated by analysis of variance (ANOVA) and mean comparisons by Tukey's test (P≤0.05).

3. RESULTS AND DISCUSSION

3.1 Affective test
The acceptance of the external appearance of the rolls presented to the consumers was more influenced by DS (Table 1). For the better accepted tests (control, 2 and 5), i.e., those added of 0.00, 1.45 and 5.00% DS, it was possible to observe that the reduction of salt did not affect acceptance of the external appearance of the rolls, which maintained their typical characteristics: volume, adequate cut height and opening after baking, crispy crust and uniform golden-brown color, as can be seen in Figure 1.

Table 1 - Mean acceptance scores for the sensory attributes: external appearance and appearance and color of the crumb of the French rolls.

<table>
<thead>
<tr>
<th>Tests</th>
<th>NaCl <em>(g/100g)</em></th>
<th>DS <em>(g/100g)</em></th>
<th>External appearance</th>
<th>Appearance of the crumb</th>
<th>Color of the crumb</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.36</td>
<td>1.45</td>
<td>6.19 ± 2.01&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.82 ± 1.51&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.99 ± 1.50&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>2</td>
<td>2.14</td>
<td>1.45</td>
<td>7.21 ± 1.58&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.13 ± 1.54&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.22 ± 1.55&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>3</td>
<td>0.36</td>
<td>8.54</td>
<td>5.25 ± 2.20&lt;sup&gt;c&lt;/sup&gt;</td>
<td>5.71 ± 2.03&lt;sup&gt;c&lt;/sup&gt;</td>
<td>5.31 ± 2.15&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>4</td>
<td>2.14</td>
<td>8.54</td>
<td>5.91 ± 2.12&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>5.92 ± 2.04&lt;sup&gt;c&lt;/sup&gt;</td>
<td>5.49 ± 2.07&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>5</td>
<td>1.25</td>
<td>5.00</td>
<td>6.59 ± 1.76&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>6.69 ± 1.51&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.44 ± 1.62&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Control</td>
<td>1.80</td>
<td>0.00</td>
<td>7.26 ± 1.55&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.44 ± 1.43&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.56 ± 1.36&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Mean ± standard deviation. NaCl = sodium chloride; DS = dry sourdough. *Values correspond to the concentrations of NaCl and DS in g/100g of flour. An unstructured 9-cm hedonic scale was used to evaluate the attributes external appearance, appearance and color of the crumb, in which 0 = “dislike very much” and 9 = “like very much”. Means with the different letters in the same column differ statistically (P ≤ 0.05).

Figure 1 - French rolls external appearance.

The acceptance of the attributes appearance of the crumb and color of the crumb (Table 1) were strongly influenced by DS, which, when increased, led to a reduction of their score in the tests. Only the tests with 1.45% DS were similar to the control. The results also demonstrated that NaCl practically did not affect these attributes, which contributes to the reduction of salt in the rolls. In a previous study (Nogueira and Steel, 2016), we analyzed the instrumental color of the crumb of French rolls with different levels of NaCl and DS and observed, in addition to the influence of DS, the whitening effect of NaCl, an effect which was not mentioned by consumers.

For the acceptance of aroma (Table 2), only test 2 (2.14% NaCl, 1.45% DS) was similar to the control. Once again, DS negatively influenced the aroma. In tests with lower concentrations of DS (1, 2 and 5), the scores did not differ, that is, NaCl did not interfere in this parameter, thus enabling the reduction of salt at lower DS concentrations. The influence of NaCl was not observed, since the aroma is not directly influenced by salt (Lynch et al., 2009).

The acceptance of taste appears to have suffered the effect of both variables (Table 2). Test 2 (2.14% NaCl, 1.45% DS) and control (1.80% NaCl, 0.00% DS) showed the highest scores, demonstrating the important positive influence of salt on taste, since these tests presented the highest salt concentrations and low or no concentration of DS. However, higher concentrations of NaCl are
not desirable (test 2) from a nutritional point of view. In sequence, tests 4 (2.14% NaCl, 8.54% DS) and 5 (1.25% NaCl, 5.00% DS) obtained the highest scores. By analyzing these two tests, we can also verify the possibility of obtaining products with lower salt concentrations using an intermediate concentration of DS, in this case close to 5%. In test 5, it was possible to achieve a reduction of 30% of salt, for example.

For the tests with lower salt concentrations (tests 1 and 3), the acceptance scores were lower and considered inadequate, showing the importance of salt on the taste of the rolls. It was also observed that at very low salt concentrations, it was not possible to see the effect of DS on the salty taste, demonstrating that a certain quantity of salt is necessary.

Table 2 - Mean acceptance scores for the sensory attributes: aroma, taste, texture and overall impression and purchase intent of French rolls.

<table>
<thead>
<tr>
<th>Tests</th>
<th>Aroma</th>
<th>Taste</th>
<th>Texture</th>
<th>Overall impression</th>
<th>Purchase intent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6.53 ± 1.82&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>3.98 ± 2.44&lt;sup&gt;c&lt;/sup&gt;</td>
<td>5.41 ± 2.18&lt;sup&gt;d&lt;/sup&gt;</td>
<td>4.98 ± 2.16&lt;sup&gt;c&lt;/sup&gt;</td>
<td>2.69 ± 1.10&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>2</td>
<td>6.66 ± 1.71&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>6.67 ± 1.91&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.25 ± 2.08&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>6.86 ± 1.75&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.02 ± 0.96&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>3</td>
<td>5.22 ± 2.14&lt;sup&gt;c&lt;/sup&gt;</td>
<td>5.59 ± 2.28&lt;sup&gt;c&lt;/sup&gt;</td>
<td>5.01 ± 2.39&lt;sup&gt;d&lt;/sup&gt;</td>
<td>4.27 ± 2.00&lt;sup&gt;d&lt;/sup&gt;</td>
<td>2.28 ± 1.03&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>4</td>
<td>5.23 ± 2.23&lt;sup&gt;c&lt;/sup&gt;</td>
<td>4.90 ± 2.59&lt;sup&gt;b&lt;/sup&gt;</td>
<td>5.29 ± 2.41&lt;sup&gt;d&lt;/sup&gt;</td>
<td>5.06 ± 2.11&lt;sup&gt;c&lt;/sup&gt;</td>
<td>3.03 ± 1.29&lt;sup&gt;bc&lt;/sup&gt;</td>
</tr>
<tr>
<td>5</td>
<td>6.03 ± 1.91&lt;sup&gt;b&lt;/sup&gt;</td>
<td>5.56 ± 2.11&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.13 ± 1.98&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>5.93 ± 1.71&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.44 ± 1.14&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Control</td>
<td>6.96 ± 1.75&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.09 ± 1.66&lt;sup&gt;c&lt;/sup&gt;</td>
<td>6.96 ± 1.78&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.08 ± 1.52&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.40 ± 0.73&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Mean ± standard deviation. An unstructured 9-cm hedonic scale was used to evaluate the attributes aroma, taste, texture and overall impression, in which 0 = “dislike very much” and 9 = “like very much”. A structured 5-point scale was used for purchase intent, in which 1 = “would certainly not buy” and 5 = “would certainly buy”. Means with the different letters in the same column differ statistically (P≤0.05).

The good acceptance of the taste of test 5 (1.25% NaCl, 5.00% DS) is an interesting sensory result that shows that intermediate amounts of DS (close to 5%) can permit a reduction of NaCl. Miller and Jeong (2014), despite observing a difference between the control bread and those with reduced salt content, also found no difference in the taste of breads made with two types of sea salt (with medium and low sodium). According to Lynch et al. (2009), a reduction of 50% of salt would impact the taste.

The tests that showed greatest acceptance for texture were tests 2 (2.14% NaCl, 1.45% DS) and control (1.80% NaCl, 0.00% DS) (Table 2). However, similar to the acceptance of test 2, were the scores for test 5 (1.25% NaCl, 5.00% DS), which allows us to say that a desirable texture was obtained. The other tests (1, 3 and 4) were less accepted by consumers regarding this parameter, which can be explained by the higher concentrations of DS or by the lower concentrations of NaCl. In our previous study (Nogueira and Steel, 2016), in which we analyzed the instrumental texture (firmness) of French rolls with different levels of NaCl and dry sourdough, we did not observe the influence of these variables on this parameter. Thus, it can be noted that only consumers were able to detect differences in the texture of the rolls amongst the tests. This probably occurred because for instrumental texture we analyzed only the crumb, while for sensory acceptance of texture a slice including crumb and crust was evaluated.

For overall impression of the rolls (Table 2), test 2 (2.14% NaCl, 1.45% DS) and control (1.80% NaCl, 0.00% DS) were the most accepted again. Taste was the attribute that most affected overall impression. Test 5 (1.25% NaCl, 5.00% DS) obtained the second best overall acceptance (5.9). This acceptance may be considered desirable and demonstrates the possibility of using DS to reduce the amount of salt in French rolls. A similar result for overall impression was observed by Miller and Jeong (2014), who also obtained satisfactory scores for their breads with the addition of sea salt in breads with reduced sodium content. Girgis et al. (2003) believe that the reduction without detection is
25%. Different results of taste perception and overall impression are due to the different mechanisms used to achieve sodium reduction, either by simple removal of NaCl or by the addition of another ingredient.

3.2 Purchase intent test

The values obtained for the purchase intent of the rolls are also shown in Table 2. Test 2 (2.14% NaCl, 1.45% DS) and control (1.80% NaCl, 0.00% DS) presented the highest purchase intent (4.02 and 4.40, respectively) (scale from 1 to 5), confirming the results previously discussed. Test 5 (1.25% NaCl, 5.00% DS), which provided a satisfactory reduction of sodium (30% compared to the control) and showed suitable sensory attributes, had an average purchase intent of 3.44.

Figure 2 shows the frequency distribution of the purchase intent scores for the French rolls.

Figure 2 - French rolls purchase intent.

Tests: 1 (0.36% NaCl, 1.45% DS); 2 (2.14% NaCl, 1.45% DS); 3 (0.36% NaCl, 8.54% DS); 4 (2.14% NaCl, 8.54% DS); 5 (1.25% NaCl, 5.00% DS); Control (1.80% NaCl, 0.00% DS). NaCl: sodium chloride; DS: dry sourdough.

In Figure 2, we can see the positive purchase intent of the control, which reached 91.7% (percentage related to “would certainly buy” and “would probably buy”). Test 2 (2.14% NaCl, 1.45% DS) was the second formulation with greatest positive purchase intent (76%). Test 5 (1.25% NaCl, 5.00% DS) presented positive purchase intent of approximately 56%, of which 41% came from “would probably buy”. This lower purchase intent can be linked to the difficulty of accepting the new, since a new ingredient (dry sourdough) was added to reduce the very well known sodium chloride, and in a product that is very specific to the Brazilian consumer.

4. CONCLUSION

In general, it was possible to observe that at higher concentrations of NaCl there was an increase of acceptance of the rolls, while the increase in dry sourdough (DS) decreased acceptance. In the purchase intent test, the control test was the most accepted (91.7%), followed by test 2 (2.14% NaCl, 1.45% DS) (76%) and test 5 (56% of positive purchase intent). Despite the higher scores amongst the tests with DS having been for test 2 (2.14% NaCl, 1.45% DS), this sample is not suitable from a nutritional point of view, due to the high level of salt it contains. It was included in our study only to ratify the importance of NaCl on taste and other sensory attributes.

Good results were obtained for test 5 (1.25% NaCl, 5.00% DS), which had desirable acceptance of its sensory attributes and satisfactory purchase intent. In this test, the sodium reduction achieved
was 30%. This reduction would reduce the contribution of French rolls in the consumption of sodium in Brazil, which is 6% (270 mg/day) (ABIA/IBGE 2013), to approximately 4.3% (190 mg/day).

5. ACKNOWLEDGEMENTS

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6. REFERENCES