Effect of the rice bran over chemical, physical and sensorial parameters of arepas

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Abstract

In Venezuela the daily diet includes the «arepas» (corn bread), so that the objective of this study was the evaluation of the nutritional effect of the stabilized bran rice over the pre-cooked «arepas» with 5%, 10% and 15% of rice bran and stored at –18°C. The results (P<0.05) point out increases in fat (0.69% to 1.9%), total dietetic fiber (1.62% to 4.6%), ashes and available lysine (1.8 to 2.2g/100g of protein). The amylgraphic curves were affected possibly by the increase of dietetic fiber from rice bran that produced smoother «arepas». The sensorial evaluation was applied the 1st 15th and 30th days of freezing by a non trained panel of 24 young people of both sexes (20-24 years) the parameters were odor, flavor, texture and global preference results did not show differences between regular «arepas» and those containing 5% and 10% rice of bran. In conclusion, rice bran enhanced nutritional and sensorial quality of the «arepas» freezing contributed to maintain the sensorial characteristics of the «arepas» during thirty days of storage.

Key words: rice bran; dietetic fiber; corn bread, freezing.

Introduction

Arepa is a food of massive consumption in Venezuela, which preparation is made of pre-cooked corn flour, which is obtained through a partial cooking process of the peeled and germinated corn grain. The nutritive value of corn is relatively poor, since the nitrogen content in most cereals is low (6). Researches have been done to increase the nutritive value of the arepa substituting partially the corn by amaranth achieving an increment of PER (ratio of protean efficiency) and the available lysine (16). The addition of rice flour to the pre-cooked corn flour for the elaboration of arepas produce a relative improvement in the protein quality in the resultant mixes of the snack of INN (Nutrition National Institute) with 18% to 20% of rice and commercial mix with 8% to 10% of rice (6).
Stabilized rice bran is a source of dietary fiber, protein and unsaturated acid fats (15, 9). However, if rice bran is stored without inactivating the lipase, the bran’s fat hydrolyzes rapidly and oxidizes, going rancid rice bran and being disgusting for the palate, therefore lipases must be inactivated with heat. Proteins of rice bran are rich in albumins and globulins, and reflect a PER that oscillates from 2.18 to 2.03. Lysine contents available oscillate from 5.3 to 5.8 g/100g proteins. Since in rice bran predominate the insoluble fiber, it is known by its absorption capacity of water, improving the intestinal function (3). This gluten free ingredient is a good source of fiber for people allergic to gluten (4, 3). The application of the stabilized rice bran as ingredient in baking products has been successfully incorporated in levels of even 20% as maximum. Rice bran helps keeping the humidity and freshness and consequently improves the useful life of the product (4).

The most notable quality of rice bran is the presence of natural antioxidants such as oryzanol, tocopherols and tocotrienols which are capable of reducing the plasmatic cholesterol (11, 9).

It is important to appoint that the preservation of food is related to refrigeration, freezing and canned. Nowadays, freezing of diverse products before cooking is being used, such as croissants. Frozen croissants and without being baked are distributed to bakeries before baking the same day of their consumption, so the client gets a fresh product, just prepared with all the best characteristics such as textures, smoothness, humidity content, color and aroma (13).

Arepa is eaten hot, once it is taken out from the oven or from the fryer pan, since once cool the dough turns rigid. So, it must be kneaded, cooked and eaten in a continuous process, which means time for homemakers, who nowadays must of them work out of their homes, so the objectives of this research were to study the effect of rice bran flour (HAS) on some physic and chemical parameters and sensorial attributes of pre-cooked and frozen arepas, and to study the stability during the frozen of arepas with rice bran.

Materials and methods

For elaborating corn arepas with rice bran, were employed as raw matter the commercial white corn pre-cooked flour (Harina Pan), obtained in local stores and rice bran flour, donated by PROMASA c.a, and stabilized in a double drum in the Biochemical laboratory of Food of the Agronomy Faculty U.C.V.

Rice bran was diluted with distilled water in a 1:2.5 proportion and was mixed. Lately, the mix was taken to a double roller dehydrator of direct contact Dryer Flaker Model 01-1010 GF, used with vapor to transmit hot by conduction to the material at 560 Kpa of pressure and 126°C at a velocity of 5 r.p.m, with a separation.
between rollers of 0.2 mm. The obtained flakes were dried on a dryer with ventilation Bertuzzi c.a brand, for a tie period of 1 hour at 75°C, and then were let cool at an environment temperature. These were stored frozen in hermetic containers in an icebox at -18°C until the moment of use. Rice bran flakes that were previously stabilized by process mentioned before were homogenized with pre-cooked corn flour in a grinder Oster brand model 14081 and were refined in a sieve (0.1 mm) to obtain particles with the same size and thus facilitating their handle in the elaboration of arepas. Corn-rice bran mixtures were 95:5, 90:10, 85:15 and the pattern arepa was 100% of commercial white pre-cooked corn flour.

Elaboration of pre-cooked arepas:
For 100g of pre-cooked corn flour and mixtures of rice bran was added approximately 170 ml ± 8 ml of water according to the retention capacity of water showed by the different arepas with their respective proportion of rice bran. The kneading time was of 20 minutes and the rest time was of 3 minutes. Approximately 120 g of dough were taken, a rounded shape was given and was cooked in a "Tosty" arepas Oster brand, for 7 minutes and lately, were put in the oven at 350°C for 10 minutes. Then, were sailed in foiled bags and stored at -18°C for a week.

Chemical analysis
Chemical analysis were done by triplicate to the arepas and to the rice bran, according to the official methods of AOAC (1990), corresponding to the determinations of humidity, ashes, proteins (Nx6.25), raw fat, total dietary fiber and starch. The available lysine was analyzed following the methodology employed by Kakade and Liener (10). It was detected resistant starch using the method of Goñi et al. (7)

Physical analysis
The color determination was done employing a digital colorimeter Hunterlab model color Quest II. L values were measured, that correspond to luminosity or whitening of samples, that is, the total reflection of light. pH as measured in a pH meter, Radiometer brand, model PH M 61, Nº 272843.

The viscosity analysis was measured in a fast viscoamilograph (RVA) Thomas Magne brand, 12 Matic model, following the methodology of AACC (1).

Statistical analysis
A completely randomized design was applied in order to determine if there was or not significant differences among the different proportions established for the results obtained during the physical-chemical characteristics of arepas with rice bran. For the analysis a variance analysis was done in those variables that fulfilled the statistics supposed, those that dif not fulfill with the supposed were evaluated through the non parametric via. For establishing if there are significant differences among the results obtained for each of the formulations done during the physical-chemical analysis , it was applied a multiple rank test of Duncan and Kruskall – Wallis, the latter for those variables that did not fulfill the
Sensorial evaluation:

For the sensorial evaluation was proceeded to establish a Friedman test with the purpose of verifying if there are significant differences among the selected formulations.

The sensorial evaluation of frozen arepas with different proportions of rice bran were evaluated through the acceptability test on a interval of time in storage under frozen temperatures of -18ºC from the 1st day to 15 and 30 days. This evaluation was carried out on the sensorial evaluation area of the Agronomy Faculty, of the Central University of Venezuela, Maracay campus; for this a non trained panel was selected at random formed by 24 persons on each evaluation, following the methodology of Predero and Pangborn (17). For this purpose, a hedonic scale from 1 to 5 was used, going from the less preferred to the more preferred, and regarding the texture, from the smoothest to the hardest. Frozen arepas were defrosted for 10 minutes and were then baked on a «Tosty» arepas for 7 minutes, to serve them hot.

Results and discussion

Table 1 shows the results of the chemical composition of arepas and rice bran. Humidity of the different arepas tends to increase slightly at the time that increases the substitution level of corn flour by rice bran, but statistically all arepas were similar. The protein percentage increases slightly. The fat also experiments an increment at the time that increases the quantity of rice bran in the different formulations. Arepas with the highest content of rice bran exhibited the lowest values of starch, showing an inversely proportional tendency to the quantity of rice bran, since when increases this reduces significantly the starch content.

For the case of the dietary fiber and ashes, a significant statistical increment can be observed at the time that increases the quantity of rice bran in the formulation of the studied arepas.

The available lysine increases with the increment of rice bran in the arepas. The proteins of rice bran are of good quality since are rich in essential amino acids, especially in lysine and would compensate the known deficiency of corn of the referred essential amino acid (16).

The gradual increment of components of each of the studied arepas would be related to the chemical composition of stabilized rice bran, since it has 27% of dietary fiber, 13% of proteins, 18% of fats and 8.5% of ashes, similar values to those reported in the literature (18, 4). Meanwhile, the nutritional contribution of the commercial corn flour is low compare to the provided by rice bran. Prior publications (6, 16) indicate that the commercial corn flour has a contribution of 7.8% of proteins, 1.2% of fat, 1.2 of dietary fiber, 0.3% of ashes. With this can be proved that rice bran improves the
Table 1. Nutritional chemical composition of frozen arepas for 2 days with stabilized rice bran.

<table>
<thead>
<tr>
<th>Component g/100g</th>
<th>SA</th>
<th>AM:SA 100:0</th>
<th>AM:SA 95:5</th>
<th>AM:SA 90:10</th>
<th>AM:SA 85:15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humidity</td>
<td>8.82±0.20</td>
<td>60.48±0.49a</td>
<td>60.52±0.12a</td>
<td>60.55±0.19a</td>
<td>61.00±0.20a</td>
</tr>
<tr>
<td>Protein</td>
<td>13.71±0.33</td>
<td>3.00±0.04a</td>
<td>3.20±0.045a</td>
<td>3.31±0.015a</td>
<td>3.60±0.02a</td>
</tr>
<tr>
<td>Fat</td>
<td>17.90±0.50</td>
<td>0.64±0.02c</td>
<td>1.00±0.02b</td>
<td>1.45±0.03a</td>
<td>1.9±0.005a</td>
</tr>
<tr>
<td>Starch</td>
<td>17.00±0.80</td>
<td>35.3±0.79a</td>
<td>33.97±0.058b</td>
<td>32.96±0.25c</td>
<td>31.52±0.30</td>
</tr>
<tr>
<td>Resistant starch</td>
<td>2.20±0.01</td>
<td>0.28±0.01c</td>
<td>0.55±0.02b</td>
<td>0.65±0.02a</td>
<td>0.74±0.02a</td>
</tr>
<tr>
<td>Total dietary fiber</td>
<td>27.00±0.20</td>
<td>1.68±0.11c</td>
<td>2.79±0.21c</td>
<td>3.55±0.58b</td>
<td>4.43±0.60a</td>
</tr>
<tr>
<td>ashes</td>
<td>8.52±0.20</td>
<td>0.43±0.021c</td>
<td>0.66±0.056b</td>
<td>0.87±0.025a</td>
<td>0.95±0.03</td>
</tr>
<tr>
<td>Available lysine g/100g of proteins</td>
<td>4.80±0.10</td>
<td>1.6±0.02</td>
<td>2.1±0.02</td>
<td>2.30±0.00</td>
<td>2.40±0.02</td>
</tr>
</tbody>
</table>

SA: Rice bran flour
AM:SA 100:0 Corn arepa 100% or pattern
AM:SA 95:5 Corn arepa 95% with rice bran 5%
AM:SA 90:10 Corn arepa 90% with rice bran 10%
AM:SA 85:15 Corn arepa 85% with rice bran 15%

Note: Different letters in a same row indicate that there are significant differences P≤0.05
nutritional value of the studied arepas. It is important to mention that the increment of dietary fiber in the food may have advantages in the organism as for example, risk reduction of heart diseases and of the intestinal tract (3).

Figure 1 indicates the viscosity changes that corn flour has when it is substituted part of the rice bran. The peak indicates the maximum viscosity that the granule produces during the gel process when substituting corn flour by rice bran. A material rich in starch is substituted by other rich in fiber and fat, so the concentration of starch lowers in the dough and the viscosity reduces. Additionally, fat has a tenderizing effect of the formed dough and reduces the strength done by the heat paddles of the equipment. On the viscosity case, it is registered a lost in the consistency of the dough according to the substitution percentage of rice bran. Commercial white corn flour was pre-cooked and rice bran once of being submitted to dehydration in a double drum, the starch that it has is also pre-cooked, consequence of this process, starches suffer a couple of modifications by being progressively comprised and transformed in a solid and compact material. Elevated temperatures in the dehydration process cause a thermal decomposition of starches,

![Figure 1. Viscosity of white corn flour (HM) y mixtures with rice bran (SA).](image)

STD 30  
8g/25 ml  
Total sample
thus producing some reactions. The amilographic behavior of starches of arepas show that during heat a gel peak is not observed; instead a high initial viscosity is observed that declines continuously.

It can be observed that the resistant starch increases in the arepas at the time that increases the percentage of rice bran (table 1); logical results since it contains SA 2.2% of the resistant starch and corn arepas 0.2%. It is possible that the dehydration in the double drum that was applied to the bran had produced the formation of new links per condensation and trans-glycosidation, which produces atypical links resistant to the attack of amylases (5).

In table 2 can be seen the information of color in luminosity terms, measured by the "L" parameter. According to the non parametric mean comparison tests that was applied, significant differences were detected (P≤0.05), for color in arepas with 15% of rice bran. With this can be proved that rice bran has an influence on the color of the studied arepas and this is attributed to its composition. However, significant differences were not detected (P≤0.05) for the time effect, which indicates that freezing is an excellent method to maintain the stability of color during the storage. The color of the food and other aspects of the appearance give the first opinion and help the consumer to decide about the acceptance or not of the product. Most of the food have an own characteristic color, when the color or appearance deviates too much of what it is expected, the consumer rejects it (14). It is important to appoint that this characteristic predisposes people to expect some appropriate taste, especially in arepas which is a food

<table>
<thead>
<tr>
<th>Arepas</th>
<th>Time</th>
<th>10 days</th>
<th>15 days</th>
<th>30 days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>AM:SA 100:0</td>
<td>10 days</td>
<td>75.84±0.03&lt;sup&gt;a&lt;/sup&gt;</td>
<td>75.44±0.07&lt;sup&gt;a&lt;/sup&gt;</td>
<td>74.92±0.08&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>AM:SA 95:5</td>
<td>10 days</td>
<td>71.31±0.44&lt;sup&gt;a&lt;/sup&gt;</td>
<td>70.77±0.113&lt;sup&gt;a&lt;/sup&gt;</td>
<td>70.43±0.12&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>AM:SA 90:10</td>
<td>10 days</td>
<td>68.31±0.16&lt;sup&gt;a&lt;/sup&gt;</td>
<td>67.95±0.13&lt;sup&gt;a&lt;/sup&gt;</td>
<td>67.12±0.06&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>AM:SA 85:15</td>
<td>10 days</td>
<td>66.98±0.050&lt;sup&gt;b&lt;/sup&gt;</td>
<td>65.86±0.15&lt;sup&gt;b&lt;/sup&gt;</td>
<td>65.36±0.49&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

AM:SA 100:0 Corn arepa 100% or pattern
AM:SA 95:5 Corn arepa 95% with rice bran 5%
AM:SA 90:10 Corn arepa 90% with rice bran 10%
AM:SA 85:15 Corn arepa 85% with rice bran 15%
Note: different letters in a same row and column indicate that there are significant differences (P≤0.05).
eaten by Venezuelan since their childhood and are daily consumed for almost everybody.

The behavior of the pH during the storage is indicated in figure 2, where it can be observed a very stable uniform tendency in both the time and treatments. According to the statistical analysis, significant differences were not detected ($P \leq 0.05$), which indicated that the pH kept stable and it may be inferred that there was not any microbial growth, again, the frozen effectiveness is shown. On wheat breads, it is even more frequent to freeze dough, since low temperatures generate an inadequate media for the bacterial growth and it keeps the color, smell and nutritional value at temperatures of -18°C of lowers (8).

One selected the formulations and elaborated the respective arepas, it was proceeded to make the sensorial evaluation to detect the affability level of the tester panel, done in the following way: First evaluation, which consisted on detecting the preference grade of just prepared arepas, 1st day (table 3). Te other evaluations were applied to frozen arepas enriches with stabilized rice bran and stored at -18°C for a time period from 15 to 30 days respectively, with the aim of proving that frozen is a good method that allows to keep stable the sensorial attributes; acceptability, texture, taste, smell and color in arepas.

For effects of the first sensorial evaluation, the four selected formulations were taken into account. In the first evaluation was detected that on the acceptability grade, corn arepas 100% with 5% of rice bran were the most accepted and the arepa with the highest proportion of rice bran (15%) was the one with the less preference, specially due to the color, being this the first reason of rejection in the following evaluation, it seems that the excess of rice bran in the formulation gives the arepa a darker dolor, though it gives more smoothness, this confirms the results

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Figure 2. pH analysis in arepas with rice bran during storage at -18°C
Sensorial evaluations revealed that enriched breads with 5% and 10% of fiber coming from rice bran are compared to the bread with the highest fiber in the market, showing to be more acceptable for the panelist (3). Likewise, formulations have been done with a huge variety of products enriched with stabilized rice bran, among these are: breads, peanut butter cookies and oat flour cookies, being successfully incorporated inside these baking products in almost 20% (4).

To conclude, it can be mentioned that rice bran stabilized by double drum may be employed to enrich the

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**Table 3. Mean ranks of the sensorial evaluation applied to frozen arepas in the first day.**

<table>
<thead>
<tr>
<th>Trat./Attribute</th>
<th>Color</th>
<th>Smell</th>
<th>Taste</th>
<th>Texture</th>
<th>Acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM:SA 100:0</td>
<td>70.08a</td>
<td>68.08a</td>
<td>68.00a</td>
<td>61.96b</td>
<td>68.00a</td>
</tr>
<tr>
<td>AM:SA 95:5</td>
<td>69.60a</td>
<td>65.52a</td>
<td>65.44a</td>
<td>62.56b</td>
<td>65.00a</td>
</tr>
<tr>
<td>AM:SA 90:10</td>
<td>65.04a</td>
<td>67.44a</td>
<td>62.12a</td>
<td>63.40b</td>
<td>66.00a</td>
</tr>
<tr>
<td>AM:SA 85:15</td>
<td>47.52b</td>
<td>48.96b</td>
<td>54.96b</td>
<td>58.40b</td>
<td>64.00b</td>
</tr>
</tbody>
</table>

AM:SA 100:0 Corn arepa 100% or pattern
AM:SA 95:5 Corn arepa 95% with rice bran 5%
AM:SA 90:10 Corn arepa 90% with rice bran 10%
AM:SA 85:15 Corn arepa 85% with rice bran 15%

a, b: different levels in a column indicate statistically significant differences at a P ≤ 0.05 level.

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**Table 4. Mean ranks of the sensorial evaluation applied to frozen arepas within 15 days.**

<table>
<thead>
<tr>
<th>Trat./Attribute</th>
<th>Color</th>
<th>Smell</th>
<th>Taste</th>
<th>Texture</th>
<th>Acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM:SA 95:5</td>
<td>56.00a</td>
<td>48.00a</td>
<td>50.00a</td>
<td>50.00a</td>
<td>52.00a</td>
</tr>
<tr>
<td>AM:SA 100:0</td>
<td>56.00a</td>
<td>46.00a</td>
<td>45.00a</td>
<td>48.00a</td>
<td>49.00a</td>
</tr>
<tr>
<td>AM:SA 90:10</td>
<td>54.00a</td>
<td>47.00a</td>
<td>48.00a</td>
<td>51.00a</td>
<td>50.00a</td>
</tr>
</tbody>
</table>

AM:SA 100:0 Corn arepa 100% or pattern
AM:SA 95:5 Corn arepa 95% with rice bran 5%
AM:SA 90:10 Corn arepa 90% with rice bran 10%
Table 5. Mean ranks of the sensorial evaluation applied to frozen arepas within 30 days.

<table>
<thead>
<tr>
<th>Trat./Attribute</th>
<th>Color</th>
<th>Smell</th>
<th>Taste</th>
<th>Texture</th>
<th>Aceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM:SA 95:5</td>
<td>52.96^a</td>
<td>48.96^a</td>
<td>50.60^a</td>
<td>49.92^a</td>
<td>51.00^a</td>
</tr>
<tr>
<td>AM:SA 100:0</td>
<td>55.48^a</td>
<td>48.00^a</td>
<td>44.40^a</td>
<td>45.92^a</td>
<td>48.00^a</td>
</tr>
<tr>
<td>AM:SA 90:10</td>
<td>51.56^a</td>
<td>47.04^a</td>
<td>48.00^a</td>
<td>49.92^a</td>
<td>49.00^a</td>
</tr>
</tbody>
</table>

AM:SA 100:0 Corn arepa 100% or pattern  
AM:SA 95:5 Corn arepa 95% with rice bran 5%  
AM:SA 90:10 Corn arepa 90% with rice bran 10%

The nutritional value of arepas, since it increases the values of the total dietary fiber and available lysine, and it was proved that pre-cooked and frozen arepas can be kept for 30 days, which are ready to eat after heat them.

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Literature cited


