Onion bread with barbados gooseberry leaf flour

Pão de cebola com farinha de folhas de ora-pro-nóbis

DOI:10.34117/bjdv7n8-006

Received: 02/07/2021
Accepted for publication: 02/08/2021

Rejane de Oliveira Ramos
Mestranda em Engenharia de Alimentos pela UFU
Universidade Federal de Uberlândia, Patos de Minas - MG, Brasil.
Endereço: Av. Getúlio Vargas, 230 - Centro, Patos de Minas – MG.
E-mail: oliverjane4324@gmail.com

Andressa de Sousa Luz
Mestra em Ciência e Tecnologia de Alimentos pelo Ital
Endereço: Rua Adelino Sousa Lira, 3510, Cristino Cortes, Barra do Garças, MT.
E-mail: dressynha_luzz@hotmail.com

Carla Regina Amorim dos Anjos Queiroz
Doutora em Agronomia pela UNESP
Professora no Instituto Federal do Triângulo Mineiro
Endereço: Fazenda Sobradinho s/n. Rodovia Municipal Joaquim Rezende, Zona Rural,
Uberlândia, MG, Brasil.
Caixa Postal 1020. CEP: 38400-970.
E-mail: carlaregina@iftm.edu.br

ABSTRACT
The Barbados Gooseberry (Pereskia aculeata Miller) is an unconventional vegetable with edible leaves and high nutritional value. The research was carried out aiming to develop onion breads with partial substitution of wheat flour for dehydrated leaf flour of Barbados Gooseberry with percentages of 0% (standard), 2.5% and 5%, in order to experimentally determine the viability of the processing, sensory acceptance and chemical analysis. Moisture, ash, protein, lipids, crude fiber, carbohydrates and caloric value were determined. For the acceptance test, a nine-point hedonic scale with thirty-eight non trained consumers was conducted. All data were subjected to variance analysis, followed by Tukey’s test. There was no significant difference among formulations, regarding lipid and moisture content. Breads with 2.5% and 5% Barbados Gooseberry had increased protein, crude fiber and ash, and reduced carbohydrate content and caloric value compared to bread without it. By the analysis of sensory acceptance, there was no difference between the formulations for the tested attributes. The products were considered accepted by the tasters (acceptability index > 70%). The chemical and sensory tests showed promising and satisfactory results in the replacement of wheat flour with Barbados Gooseberry leaf flour, promoting improvements in the product’s nutritional quality and acceptability.

Keywords: Pereskia Aculeata Miller, Sensory Analysis, Chemical Composition, Unconventional Food Plant.
RESUMO
A ora-pro-nóbis é uma hortaliça não convencional com folhas comestíveis e alto valor nutricional. Objetivou-se desenvolver pães de cebola com substituição parcial da farinha de trigo por farinha de folhas desidratadas de ora-pro-nóbis com porcentagens de 0% (padrão), 2,5% e 5%, a fim de determinar experimentalmente a viabilidade do processamento, aceitação sensorial e características químicas. Foram realizadas análises de umidade, cinzas, proteínas, lipídios, fibra bruta, carboidratos e valor calórico. Para o teste de aceitação foi utilizada escala hedônica de nove pontos com trinta e oito consumidores. Não houve diferença significativa entre as formulações de pães para umidade e lipídios. Os pães com 2,5% e 5% de ora-pro-nóbis tiveram incremento de proteínas, fibra bruta e cinzas, e redução do teor de carboidratos e valor calórico em relação ao pão sem ora-pro-nóbis. Pela análise de aceitação sensorial, não houve diferença significativa entre as formulações para os atributos testados. Os produtos foram considerados aceitos pelos provadores (índice de aceitabilidade>70%). Os testes químicos e sensoriais mostram resultados promissores e satisfatórios na substituição de farinha de trigo por farinha de folhas de ora-pro-nóbis, promovendo melhorias significativas na qualidade nutricional do produto e aceitabilidade.

Palavras-Chave: Pereskia Aculeata Miller, Análise Sensorial, Composição Química, Planta Alimentícia Não Convencional (PANC).

1 INTRODUCTION
The varieties of non-conventional vegetables existing in the Brazilian territory can contribute to the promotion and maintenance of the population’s health. Pereskia aculeata Miller, popularly known as ora-pro-nóbis in Brazil and as Barbados Gooseberry in English language countries (Figure 1), according to the Ministry of Agriculture, Livestock and Supply is classified as unconventional vegetable (Anvisa 2010).

It is found in the American regions in the south of the United States (Florida) and southeastern Brazil, easy to grow in places with temperatures above 25 °C and intense sunlight. It is also considered a shrub or weed, which has important nutritional value, especially high-quality proteins, and minerals, such as iron and calcium (Maciel et al. 2020). When non-conventional vegetables are used, greater nutritional value is added to the diet, bringing greater benefits to people who consume them, especially related to vitamins and minerals (Romano et al. 2017).
Figure 1. Barbados Gooseberry leaves (Pereskia aculeata Miller).

Source: Carla Queiroz (2015)

In Pereskia aculeata Miller's branches, small and succulent leaves are inserted (Figure 1) with the presence of mucilage, which has no toxicity, and which makes it important in human and animal food due to the richness in nutrients. Because of its characteristics, it can be source of fibers, proteins and minerals that improve the nutritional quality of products made with their inclusion. As a result of its nutritional value, it is highlighted in preparations such as flour, salads, stews, pies and pasta such as macaroni (Almeida et al. 2014).

Bread, in its multiple varieties, is a staple food in several parts of the world, over thousands of years. It is a popular food present in the Brazilian diet and is an important vehicle for the introduction of dietary fibers. The exchange of ingredients that are less nutritious for others of greater nutritional value is a practice that can reach exceptional magnitude, transforming ordinary diets into healthier options, without compromising the taste of food (Coelho 2014).

The prediction of acceptance of a new product by consumers must be carried out before production or dissemination steps are initiated, since they involve high costs (Brazil et al. 2015). Thus, if a new product is not successful in forecasting expectations, there is no justification for expenditures for preparation of any subsequent stages of production. In this way, applying forecasting sensory methodologies can optimize and save the development process. Among the consumer study methodologies, the sensory ones intrinsic to the product, such as taste, color, aroma, texture, and odor, can guarantee the decision to purchase a product (Minim 2018).

Research was carried out in relation to sensory perception in products added from the Barbados Gooseberry leaves. Queiroz et al. (2015) when studying traditional products (cheese biscuit, lemon cake, chocolate cake, bonbon, pumpkin jam, banana jam, onion
bread and vegetable pie), with addition of Barbados Gooseberry leaves, realized that they were accepted in tasting tests. Jesus & Reges (2019), sensorially evaluating ten Barbados Gooseberry based products (rice, pasta, chicken, bread, polenta, chocolate cake, brigadeiro, traditional cake, pudding and ice cream), found that of these, only bread did not reach the acceptance level of 70%. In products such as cookies, vegetable pie, cake and pasta, the addition of Barbados Gooseberry was accepted, mainly in relation to flavor attribute, with scores above 6 (I slightly liked it); in some cases, lower grades were reported only for general impression and color (Hitz et al. 2019; Baroni et al. 2017; Paula et al. 2016; Rocha et al. 2008).

In view of the above, the objective of the present work was to prepare onion breads with partial replacement of wheat flour for Barbados Gooseberry flour, to chemically characterize and to evaluate the sensory acceptability of the products.

2 MATERIAL AND METHODS

The breads were prepared in the vegetable laboratory in the Federal Institute of Triângulo Mineiro - IFTM campus Uberlândia.

Leaves of Barbados Gooseberry plants grown in the Uberlândia campus nursery were harvested in April 2018. Then, they were washed in running water, sanitized with 100 ppm sodium hypochlorite, and placed in a 24-hour air-dried food dehydrator, in constant temperature (35 ºC). After drying, they were crushed in a blender, sieved, and stored in a glass container in a cool, ventilated place at room temperature, as shown in Figure 2.

Figure 2. Kiln drying process to produce Barbados Gooseberry flour.

The breads were made by replacing part of the wheat flour with Barbados Gooseberry flour (0%, 2.5% and 5%) (Table 1), with three repetitions per formulation.
and each repetition analyzed in triplicate, totalizing 27 onion breads. In a blender, onion, egg and milk were processed at a temperature of 30 °C (warm), which were mixed with yeast, salt and Barbados Gooseberry flour, and then wheat flour. The mixture was kneaded and left to stand for 20 minutes at room temperature. After that time, the dough was again kneaded and shaped into the shape of round breads, with 50g each, then placed to rise for another 60 minutes. The breads were baked in an electric oven for 15 minutes at a temperature of 170 °C. After cooling, they were packed in plastic bags, identified, and stored in a common horizontal freezer at -20 °C for one day, then sent for chemical analysis.

Table 1. Formulation of onion breads with partial substitution of wheat flour for Barbados Gooseberry flour in concentrations of 0%, 2.5% e 5%.

<table>
<thead>
<tr>
<th>Onion bread formulations</th>
<th>Ingredients (g)</th>
<th>0%</th>
<th>2.5%</th>
<th>5%</th>
<th>Ingredients</th>
<th>0%</th>
<th>2.5%</th>
<th>5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onion in natura</td>
<td>67.5</td>
<td>67.5</td>
<td>67.5</td>
<td></td>
<td>Salt (g)</td>
<td>3.8</td>
<td>3.8</td>
<td>3.8</td>
</tr>
<tr>
<td>Dry yeast</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td></td>
<td>Eggs (unit)</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Cristal sugar</td>
<td>3.4</td>
<td>3.4</td>
<td>3.4</td>
<td></td>
<td>Soybean oil (mL)</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Wheat flour</td>
<td>310</td>
<td>302.25</td>
<td>294.50</td>
<td></td>
<td>Plain milk (mL)</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Dryed Barbados Gooseberry</td>
<td>-</td>
<td>7.75</td>
<td>15.50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The design in the manufacture of the onion breads followed the preparation of three repetitions per formulation and each repetition was analyzed in triplicate (lipids, proteins, moisture, ash and crude fiber).

The humidity was determined in an oven at 105 °C, until constant weight. The ashes were obtained after complete carbonization by muffle incineration at 550 °C. For the lipid content, the Soxhlet method was used, and for proteins the micro Kjeldhal method, using the conversion factor of 6.25 (Instituto Adolfo Lutz 2008). Crude fiber was evaluated using the Weende method, described by Campos et al. (2004). The total carbohydrate content was determined by difference, and the caloric value calculated by adding the results of the multiplication of the conversion factors, for lipids (9.0) and for carbohydrates and proteins (4.0) (Brazil 2001).
The acceptance test, of the formulations at 2.5% and 5% substitution of wheat flour for Barbados Gooseberry flour, was carried out using a hedonic scale of nine points (being given a score of 9 for very much liked to 1 for very disgusted) (Minim 2018). The tests were applied at the Sensory Analysis Laboratory of the IFMT, campus Uberlândia. The samples, duly randomly coded with three digits, were served randomly to untrained tasters, in individual booths, and in a single session. Along with the samples, a glass of filtered water was served at room temperature so that the tasters could rinse their mouths between evaluations.

The results were submitted to statistical analysis after being plotted on an electronic spreadsheet, using the free program Past (Hammer et al. 2001), through analysis of variance (ANOVA) and Tukey's test for comparison of means (p < 0.05 and p < 0.10).

3 RESULTS E DISCUSSION

Onion breads with 0% substitution of Barbados Gooseberry, and those produced with the substitution of wheat flour for 2.5% and 5% of dry Barbados Gooseberry leaf flour resulted in technologically suitable products.

The feasibility of the formulation is simple and can be repeated at home without difficulty. They showed excellent visual appearance, both of the shell and the crumb, without the appearance of a blunted mass (Figure 3). Regarding the sensory aspect, the onion breads had a characteristic onion smell, pleasant taste and pleasant texture.

Figure 3. Appearance of onion breads with partial replacement of wheat flour with Barbados Gooseberry flour, after being baked. Replacement percentage: 0% (no substitution), 2.50% and 5% of Barbados Gooseberry flour.

Source: Rejane de Oliveira Ramos
Chemical analysis of the composition of the breads (Table 2) showed that the replacement of wheat flour with OPN leaf flour changed the chemical characteristics of the product, except for moisture and lipids. For these two parameters, there was no difference between the formulations (p>0.05), which presented an average result equal to 30.2% and 9.3% respectively.

Table 2. Mean values ± standard deviation of the results of the composition of onion breads with partial replacement of wheat flour with Barbados Gooseberry flour (0%, 2.5% e 5%).

<table>
<thead>
<tr>
<th>Parameters (%)</th>
<th>Onion bread formulations</th>
<th>Barbados Gooseberry percent substitution</th>
<th>Barbados Gooseberry%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0%</td>
<td>2.5%</td>
<td>5%</td>
</tr>
<tr>
<td>Moisture**</td>
<td>31.3 ± 0.20a</td>
<td>30.4 ± 0.06a</td>
<td>28.9 ± 1.84a</td>
</tr>
<tr>
<td>Ash (minerals)**</td>
<td>1.3 ± 0.20c</td>
<td>1.6 ± 0.01b</td>
<td>1.7 ± 0.05a</td>
</tr>
<tr>
<td>Protein**</td>
<td>6.8 ± 0.35b</td>
<td>8.7 ± 0.69a</td>
<td>9.6 ± 0.22a</td>
</tr>
<tr>
<td>Lipids**</td>
<td>9.3 ± 0.33a</td>
<td>9.1 ± 0.09a</td>
<td>9.6 ± 0.20a</td>
</tr>
<tr>
<td>Crude Fiber**</td>
<td>1.6 ± 0.24b</td>
<td>3.8 ± 0.16a</td>
<td>4.5 ± 0.64a</td>
</tr>
<tr>
<td>Carbohydrate(1)**</td>
<td>49.7 ± 0.53a</td>
<td>46.5 ± 0.79b</td>
<td>45.7 ± 1.20b</td>
</tr>
<tr>
<td>Caloric value*</td>
<td>309.6 ± 1.66a</td>
<td>302.4 ± 0.60b</td>
<td>308.0 ± 4.08ab</td>
</tr>
</tbody>
</table>

**significant at the level of 1% probability (p<0.01); *significant at the level of 5% probability (p<0.05); ns: not significant (p>0.05). Different letters on the line mean significant difference in the Tukey means comparison test at 95% probability. &values obtained from samples pre-dried at 35 °C. 6Kcal values / 100g of food. (1)Total carbohydrates, obtained by difference (100 - proteins - lipids - ash)

The results obtained for humidity are in accordance with the Technical Regulation for Fixing Identity and Quality (Anvisa 2000), which is a maximum of 38% water in breads. The dried leaves of Barbados Gooseberry used as flour in this work, presented 9% residual moisture, after pre-drying at a temperature of 35 °C. Silva et al. (2013), in research on the moisture content of various non-conventional vegetable flours such as taioba, milkweed, mustard and Barbados Gooseberry, obtained values between 10.5% and 11.4%, close to the value found in this work. Regarding lipids, the flour had a content equal to 3.4%. Martinevski et al. (2013) reported a 2.07% lipid content in dry Barbados Gooseberry leaves used in bread making, lower than that obtained in this study.
The ashes, proteins, crude fiber, carbohydrates, and caloric value parameters were influenced ($p<0.05$) by the replacement of wheat flour with Barbados Gooseberry flour (Table 2).

Barbados Gooseberry flour had a mineral content equal to $14.7\%$, and in breads, the lowest ash content was $1.3\%$ for bread without it ($p<0.05$). In general, white bread contains low mineral content and must be supplemented to meet the daily requirements of a good diet (Coelho 2014). The gradual increase in the Barbados Gooseberry flour content in breads resulted in a significant increase in the ash content, $1.6\%$ and $1.7\%$, respectively for breads with $2.5\%$ and $5\%$ substitution, which is in agreement with the insertion of a greater quantity of inorganic residues due to the presence of Barbados Gooseberry.

Bread with $0\%$ Barbados Gooseberry showed $6.8\%$ protein, lower than the $8.7\%$ and $9.6\%$ obtained in breads with $2.5\%$ and $5\%$ Barbados Gooseberry in the formulation, respectively. The Barbados Gooseberry flour presented $21.6\%$ protein. In the work of Almeida et al. (2014) higher protein contents in Barbados Gooseberry were reported than those obtained in this study of $28.99\%$. Possibly this difference is related to the management, climate, and age of the plants, among others. Regarding added breads, the result is according to expectations, since the replacement of wheat flour with Barbados Gooseberry flour increased the protein quality of the bread.

According to the Brazilian National Health Surveillance Agency, by resolution n° 54 of 12 November 2012 (ANVISA 2012), which concerns the Technical Regulation on Complementary Nutritional Information, discussing the conditions for declaring complementary nutritional information, with levels and / or quantities of one or more nutrients and / or energy value contained in the food, characterizes the breads with the addition of Barbados Gooseberry source of protein, since it presents an average of $9.2\ g$ of protein per 100 grams of food, indicating an increase of $35\%$ in relation to the reference bread (with $0\%$ Barbados Gooseberry).

Barbados Gooseberry flour contains about $34.0\%$ crude fiber, a result close to that reported by Romano et al. (2017) of $39.27\%$ for dry Barbados Gooseberry leaves. These fiber contents suggest the existence of high added value in the incorporation of fibers from Barbados Gooseberry into breads, considered expressive values for fibers in foods. The average found for breads of $2.5$ and $5\%$ was $4.15$ crude fiber, and if we compare it with bread ($0\%$ OPN), an increase of $160\%$ crude fiber was obtained, resulting from the addition of OPN, making the percentage found relevant for considering the insoluble part,
in which it brings several benefits to the organism. Insoluble fibers give the firm texture of some foods, such as wheat bran and vegetables, retain a larger amount of water, producing softer and more volume stools, thus helping the intestine to function better.

Silva et al. (2014), in research of crude fiber in the evaluation of breads produced with partial substitution of wheat flour for green banana flour, obtained a higher fiber content in the formulations with the addition of green banana flour, similarly to what happened with onion breads with Barbados Gooseberry. According to Romano et al. (2017), unconventional fruits and vegetables have advantages compared to domesticated plants, both for their different nutritional values and for being rich in fibers and compounds with antioxidant functions.

There was a higher carbohydrate content in bread without Barbados Gooseberry than in bread with substitution for Barbados Gooseberry flour. The decrease in carbohydrates in bread with Barbados Gooseberry (about 7%) can be interpreted as a reduction in starch content. The same happened in working with bread enriched with chia (Coelho 2014).

The average caloric value of onion breads with 2.5% Barbados Gooseberry was lower than that obtained for bread without it, while bread with 5% Barbados Gooseberry did not differ from the breads. The percentage reduction was 2.3% in the caloric content in relation to breads with 2.5% substitution. The demand for products with reduced caloric content is not only due to consumer interest in products related to weight control diets, but also due to the growing concern about the health benefits brought by them (Benassi et al. 2001).

The sensory analysis of onion breads with partial substitution of wheat flour for Barbados Gooseberry flour counted on the participation of 38 untrained consumers of both genders. The average age of the tasters was 28 years old.

The averages in relation to consumer acceptance for the evaluated attributes of the product developed, namely: color, aroma, texture, flavor and general impression are shown in Table 3.

Table 3. Average results of the sensory analysis of onion breads in different contents of wheat flour substitution for Barbados Gooseberry flour (2.5 and 5%) for the parameters color, flavor, aroma, texture and overall impression.

<table>
<thead>
<tr>
<th>Formulated breads with Barbados Gooseberry flour</th>
<th>Color (a)</th>
<th>Flavor (a)</th>
<th>Aroma (a)</th>
<th>Texture (a)</th>
<th>Overall Impression (a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5%</td>
<td>7.3</td>
<td>7.2</td>
<td>7.5</td>
<td>7.7</td>
<td>7.5</td>
</tr>
<tr>
<td>5.0%</td>
<td>6.9</td>
<td>7.2</td>
<td>6.9</td>
<td>7.8</td>
<td>7.4</td>
</tr>
</tbody>
</table>
The scores for all attributes in the formulations were statistically equal (p>0.05). The average scores of the attributes varied between 7.1 and 7.8, so the evaluation of consumers varied between “I liked it moderately” and “I liked it a lot”. The level of acceptance was higher when compared to a survey carried out by Martinevski et al. (2013) in bread formulations with bertalha and Barbados Gooseberry, with average values between 5.31-7.19 and 6.09-7.05 respectively, for the attributes of color, flavor, texture and global acceptance. A similar result was found by Magalhães et al. (2019) when performing acceptance test also using a hedonic scale of nine points with traditional bread and added Barbados Gooseberry, they obtained scores for the attributes flavor, odor, texture, and overall impression above 7, equivalent on the acceptance scale as “I liked it moderately”. Comparing with another study in which wheat flour is substituted for green banana flour in breads, the average grades of the attributes color, aroma, texture and flavor for 8% and 12% of substitution were respectively 6.35 and 6.42 (slightly liked), less than the average range of 7.1-7.8 (“moderately liked” and “liked a lot”) found in this study (Silva et al. 2014). This result may be due to the peculiar flavor of the bread incorporated by the presence of onion in the formulation, since Barbados Gooseberry itself has no pronounced flavor, on the contrary, the flavor is mild and barely noticeable.

The acceptability index (AI) of onion breads with partial replacement of wheat flour with Barbados Gooseberry flour with 2.50% was 83.1% and with 5% was 81.9%. In other words, there was an indication of strong acceptance for both products offered since the AI was higher than 80%. According to Spehar& Santos (2002) and Oliveira et al. (2013), for a product to be considered accepted, in terms of its sensory attributes, it is necessary to obtain an acceptability index of at least 70%. This result is relevant when in contrast, Jesus & Reges (2019) did not reach the 70% acceptance level for Barbados Gooseberry based bread.

Overall, 84.21% of consumers appreciate bread, with only 5.26% do not like it and 10.53% did not respond. For the group whose frequency of consumption of bread is daily, there was a lower consumption intention, around 23.68%, which may be due to the bread offered having a peculiar onion flavor. This hypothesis can be reinforced by the responses obtained by people who consume bread more sporadically, as rarely or monthly, as they point to a possible consumption of the new product in a higher
percentage than the product of regular habit. It was also observed that there was an equal percentage of intention to consume by those who make weekly or biweekly consumption of common bread and the new product being tasted.

Queiroz et al. (2015), studying Barbados Gooseberry in human food use in face of sensory perception, obtained an acceptability index for onion bread with the addition of Barbados Gooseberry of 91%. Hitz et al. (2019) seeking optimization of the chocolate flavored cookie formulation added with Barbados Gooseberry, obtained an average of 6.57 (I liked it a lot) for the lowest percentage of Barbados Gooseberry added to the product, because as its percentage increased, decreased the scores of the attributes, indicating lower acceptability. Vegetable pie, cake and pasta with the addition of Barbados Gooseberry were also accepted, with scores higher than 6 (slightly liked) (Baroni et al. 2017; Paula et al. 2016; Rocha et al. 2008).

These results indicate, in general, the sensory preference of the global characteristics of onion breads made with 2.5% and 5% Barbados Gooseberry flour, being able to perceive that the increase in the quantity of dried vegetables in the products did not negatively affect its acceptance, making it promising as a source of nutrients.

4 CONCLUSION

The onion breads with Barbados Gooseberry leaf flour showed a higher protein, mineral and crude fiber content and lower carbohydrate and caloric content, leading to increased nutritional quality and considered a protein source product. There was a high level of acceptability for breads formulated with Barbados Gooseberry leaf flour, indicating that it is a potential food item for consumption by the population.
REFERENCES


SILVA, J. P.; NETTO-OLIVEIRA, E.; PEREIRA, S. C. M.; MONTEIRO, R. G. Avaliação Físico-Química e sensorial de pães produzidos com substituição parcial de
