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Acceptance of culinary preparations with ora-pro-nobis by schoolchildren under the National School Feeding Program

Aceitabilidade de preparações culinárias com ora-pro-nóbis por escolares atendidos pelo Programa Nacional de Alimentação Escolar

Abstract

Introduction: Supporting the sustainable development of agrifood systems through the acquisition of diversified and regional foods is one of the aims of the National School Feeding Program. Ora-pro-nobis, a plant of great culinary application, is an unconventional food plant with high nutritional density that can contribute to the valorization of Brazilian biodiversity, nutritional enrichment of the diet, and family farming. **Objective:** The main objective of this study was to evaluate the benefit of introducing culinary recipes from the Biodiversity for Food and Nutrition Project using ora-pro-nobis in the menus of The National School Feeding Program, based on the acceptance levels of the students. **Method:** A controlled experimental cross-sectional study was conducted with schoolchildren aged 8–10 years enrolled in two municipal schools in Santos-SP, located in regions with different sociodemographic indicators. The hedonic facial scale was used to evaluate the acceptability of ora-pro-nobis bread and pie and their respective control preparations made with kale. **Results:** Ora-pro-nobis preparations have high densities of micronutrients and dietary fiber. The ora-pro-nobis bread was accepted by students of lower socioeconomic status. Sensorial analysis of the new preparations showed an acceptance range of 46–72%, which is insufficient for their incorporation in the school menu. **Conclusion:** Repeated exposure can be used as a strategy to familiarize students with this food item and improve acceptance. Foods from Brazilian biodiversity should be studied and explored, as they have high nutritional value, contribute to the valorization of native species, disrupt the food monopoly, promote agrifood systems, and increase food and nutrition security.

Keywords: Plants, Edible. School Feeding. Food Analysis. Biodiversity. Nutritive Value.

Resumo

Introdução: O apoio ao desenvolvimento sustentável por meio da aquisição de alimentos diversificados e regionais é uma das diretrizes do Programa Nacional de Alimentação Escolar. De grande aplicação culinária, a ora-pro-nóbis é uma planta alimentícia não convencional com elevada densidade nutricional, que pode contribuir para a valorização da biodiversidade brasileira, enriquecimento nutricional da dieta e incentivo à agricultura familiar. **Objetivo:** O principal objetivo deste estudo foi avaliar o potencial de introdução de receitas culinárias do projeto Biodiversidade para Alimentação e Nutrição com ora-pro-nóbis em cardápios do Programa Nacional de Alimentação Escolar, a partir da medida da aceitação de escolares atendidos. **Método:** Estudo transversal experimental controlado conduzido com escolares de 8-10 anos matriculados em duas escolas municipais de Santos-SP, localizadas em regiões com

indicadores sociodemográficos distintos. A escala hedônica facial foi utilizada para avaliar a aceitabilidade do pão e torta de ora-pro-nóbis, e suas respectivas preparações-controladas elaboradas com a couve-manteiga. **Resultado:** As preparações com ora-pro-nóbis melhoraram a densidade de micronutrientes e fibra alimentar. O pão de ora-pro-nóbis foi aceito pelos escolares de menor nível socioeconômico ($p < 0,05$). A análise sensorial das preparações resultou em percentuais de aceitação de 46-72%, insuficientes para sua incorporação no cardápio escolar. **Conclusão:** A exposição repetida pode ser uma estratégia adotada para a familiarização e melhora da aceitação pelos escolares. Os alimentos da biodiversidade brasileira devem continuar sendo estudados e explorados, pois possuem grande potencial nutricional, contribuem para a valorização de espécies nativas, rompimento da monotonia alimentar, transformação dos sistemas agroalimentares e promoção da segurança alimentar e nutricional.

Palavras-chave: Plantas comestíveis. Alimentação escolar. Análise de alimentos. Biodiversidade. Valor nutritivo.

INTRODUCTION

Around the world, approximately 12,500 species of plants with food potential have already been documented.¹ However, approximately 90% of the world's diet is based on only 20 species, and more than half of the energy consumed comes from rice, wheat, and corn, leaving aside numerous species with high nutritional potential.^{1,2}

The Biodiversity for Food and Nutrition Project (BFN) is an international initiative that, with the support of the Ministry of the Environment, aims to promote the sustainable use of biodiversity through the valorization of native species, strengthening of cultural identity, increasing the number of species currently used in human nutrition, and lowering of demand for natural resources for the production of exotic species.³ The BFN Project is composed of three axes: 1. Knowledge base, 2. Political and regulatory structures, 3. Awareness and scale. The third axis includes actions taken to popularize knowledge, such as those in the present study, which also contribute to the first axis when evaluating the sensorial acceptance of culinary recipes in which the fruits of biodiversity are used. One of the products of the BFN Project is the book *Brazilian Biodiversity: tastes and flavours* that aims to rescue species of native flora; enhance cultural links; and popularize the use of Brazilian biodiversity through the proposition of more than 300 culinary recipes for a nutritious, pleasant, and sustainable diet.⁴

The National School Feeding Program (PNAE) is a public policy of the Food and Nutritional Security (SAN), in force since 1979. It aims to provide healthy and adequate food to students for promoting growth, development, and school performance.⁵ Its guidelines include support for sustainable development, through the purchase of diversified and regional foods, in addition to the purchase of at least 30% of food from family farming. Therefore, the PNAE is an important link between the consumption and acquisition of food and sustainable food development.⁶

Ora-pro-nobis (OPN), *Pereskia aculeata* Mill, is an unconventional food plant (UFP) of the perennial *Cactaceae* species native to the south, southeast, and northeast regions of Brazil.^{1,7} It has wide culinary application, and its succulent leaves have high content of essential amino acids, dietary fibers, iron, and carotenoids.^{7,8}

Interministerial Ordinance No. 284/2018 established a list of native species from Brazilian socio-biodiversity with nutritive value for the purpose of marketing through natural or derived products, within the scope of the operations of the Food Acquisition Program (PAA), which cites OPN, highlighting its importance in the current food scenario.⁹

UFPs are socially and economically viable food alternatives that, in addition to enhancing Brazilian biodiversity and nutritional enrichment of the diet, promote agricultural activity, especially family farming in low-income rural and urban populations.¹⁰

The acquisition of food from family farming has significant advantages both for cities (e.g., increasing the supply of vegetables and improving the quality of the ingredients and nutritional status of schoolchildren) and for small farmers (e.g., financial stability, technical and organizational improvements, diversification of production, and expansion of the markets of commercialization).¹¹ The use of food from local biodiversity in the school menu should be prioritized, since it helps in the consolidation and development of local agriculture, expands the supply of essential nutrients and micronutrients, helps strengthen the cultural identity, and demands few natural resources from the environment. In addition, it enables the dissemination of traditional eating habits to the families of students and extends the promotion of food and nutrition education.

The present study aimed to evaluate the benefit of introducing culinary recipes containing OPN from the BFN Project in the PNAE menus, based on the results of analysis of the acceptance of these preparations by schoolchildren, as a means for promoting the SAN.

METHODS

Study design and subjects

This cross-sectional experimental and controlled study involved students of both sexes, aged 8–10 years, and enrolled in municipal schools in Santos, São Paulo (SP). The exclusion criteria were food restrictions with regard to any of the ingredients included in the preparations. There is no information on the schoolchildren's eating habits and practices, but all are served the menus prepared according to the PNAE guidelines. The students were invited to participate in the study, whilst ensuring that the ethical requirements and the terms of informed consent were met.

Data collection location

Two Municipal Education Units (UMEs) located in the municipality of Santos were selected, one in the “Morros” (Hills) region (UME Therezinha de Jesus Siqueira Pimentel) and one in the “Orla” (Seafront) region (UME Prof^a Maria Luiza Alonso Silva), in order to include students with diverse sociodemographic characteristics.

Preparations under study

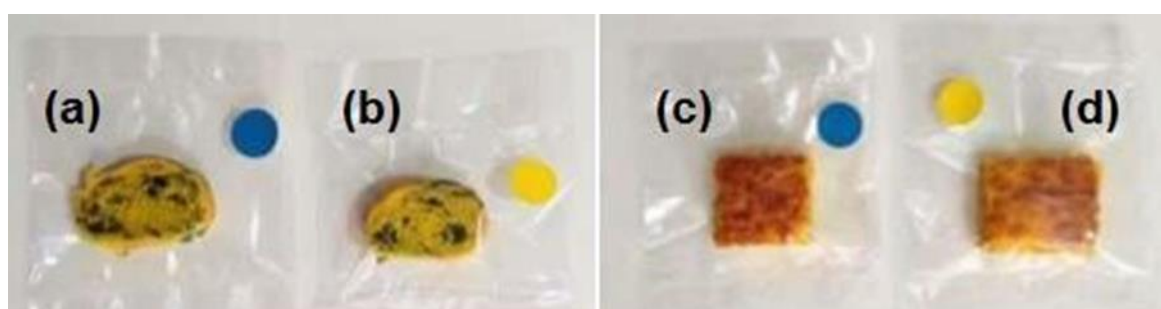
The foods used in this study were prepared within the scope of “Biodiversity for Food and Nutrition Project - Culinary Recipes with Fruits from the Southeast Region (Atlantic Forest and Cerrado)”, as published in the book *Brazilian Biodiversity: tastes and flavours*.¹²

The test preparations used in this study were turmeric bread and pumpkin pie both made with OPN. As the control, identical food items were prepared using kale. The nutritional composition of OPN leaves was extracted from the Brazilian Biodiversity Information System (SiBBR)¹³ and that of the other ingredients was extracted from the Brazilian Food Composition Table (TACO)¹⁴ and the National Nutrient Database for Standard Reference of the United States Department of Agriculture (USDA).¹⁵

Samples preparation

The samples for the sensory test were produced at the Dietetics Laboratory of the Federal University of São Paulo, *Campus Baixada Santista*, on the eve of the application of the test. After cooling, the food was portioned (15 g bread and 50 g pie), packed, individually coded (Figure 1), stored under refrigeration, and transported to the School Units in an isothermal container.

Figure 1. Samples served in the sensory test to the participants of the study: (a) OPN bread; (b) Kale Bread; (c) OPN pie; (d) Kale pie. Codification: Blue dot = test; Yellow dot = control.



Sensory analysis

Sensory acceptance tests were conducted with students from the third and fourth grades in the school units, during the school year, under similar conditions for both culinary preparations: test and control. The test preparations with OPN were coded with blue labels and the control preparations with yellow labels for blind analysis.

The samples were delivered in a monadic, randomized, and balanced manner and were evaluated using the five-point structured facial hedonic scale used for schoolchildren from the first to the fifth school year, in which 1 point corresponds to the “I detested it” judgment and 5 points, to the “I loved it” judgment. The criterion for the approval of the preparation was at least 85% prevalence of “I liked” and “I loved it” judgments (points 4 and 5).¹⁶

Data analysis

The data were processed using the STATA program. The normality of the data distribution was verified by kurtosis and symmetry measures. The Wilcoxon test was applied to the dependent variable (acceptance) and the Mann-Whitney test was used to determine any differences between treatments (culinary preparations) according to the independent variables (sex and school unit), with $p < 0.05$ (95% confidence).

Ethical aspects

The study was submitted and approved by the Research Ethics Committee of UNIFESP under the CAAE number 94100518.8.0000.5505 and authorized by the Municipal Secretary of Education of the City of Santos.

RESULTS AND DISCUSSION

The nutritional density of the test and control preparations for the variables of dietary fibers, iron, zinc, and retinol equivalent are described in table 1. OPN preparations showed higher nutritional density for all variables than the control preparations, reinforcing their value for human consumption..

Table 1. Nutritional density of the test (T) and control (C) preparations. Santos-SP, 2020

Preparation	Nutritional density per 100 Kcal (Portion of 43g bread; 70g pie)			
	Dietary fiber (g)	Iron (mg)	Zinc (mg)	RAE (mcg)
OPN bread (T)	1.09	0.90	1.08	22.12
Kale bread (C)	1.00	0.46	0.23	16.07
OPN pie (T)	1.04	0.70	1.04	67.58
Kale pie (C)	0.98	0.41	0.46	63.58

RAE = Retinol Activity Equivalent.

The sensory analysis was carried out with 50 schoolchildren (25 girls and 25 boys), distributed as follows: UME Therezinha Pimentel (n = 29) and UME Prof^a Maria Luiza Alonso Silva (n = 21) in Santos-SP. The results for the test and control breads did not differ, although the median value for the test preparation was 4.5, and for the control, 4.0. The test pie with OPN had worse acceptance than the control pie (table 2).

Table 2. Results of the sensory analysis of the preparations with OPN (T) or kale (C). Medians and interquartile ranges (n = 50). Santos-SP, 2020

OPN bread (T)		Kale bread (C)		<i>p-value</i>	OPN pie (T)		Kale pie (C)		<i>p-value</i>
Median	IQR	Median	IQR		Median	IQR	Median	IQR	
4.5	3-5	4.0	3-5	0.324	3.0	3-5	4.0	3-5	0.032*

*Values with a statistically significant difference ($p < 0.05$). (T)= Test preparation and (C)= Control preparation

According to the criteria established by Scarparo and Bratkowski¹⁶ and in agreement with the criteria proposed by the PNAE, OPN bread can be considered accepted by the schoolchildren of UME Therezinha Pimentel, as their responses showed 85% prevalence of "I liked" and "I loved it" judgments (points 4 and 5) in the facial hedonic scale (table 3). When considering approval in both school units, most of the studied culinary preparations, test or control, did not meet the acceptance percentage of the PNAE.

Table 3. Percentage of approval for test (T) and control (C) preparations, according to school unit. Santos-SP, 2020.

School unit	OPN bread (T)	Kale bread (C)	OPN pie (T)	Kale pie (C)
Approval UME Therezinha (%)	93.1	79.3	51.7	58.6
Approval UME Prof ^a Maria Luiza (%)	42.9	28.6	38.1	71.4
Total approval (%)	72	58	46	64

Sato et al.¹⁷ and Martinevski et al.¹⁸ found good global acceptance of pasta and bread, respectively, made with OPN. These results are consistent with those of this study, since OPN bread showed greater acceptance than the control foods among students, without statistical difference, demonstrating the potential of OPN from a sensory and nutritional point of view.

The differences between the preparations according to sex and the school unit are described in table 4. None of the preparations showed a statistically significant difference in acceptance according to the sex of the schoolchildren. The data also revealed the non-similarity of acceptance between culinary preparations: bread and pie. When comparing the results of the sensory analysis, there was a difference in acceptance between the breads according to the school unit. At UME Therezinha Pimentel, both preparations (test and control) received maximum scores, while at UME Profa Maria Luiza Alonso, they were not well accepted. The acceptance results for pies did not differ between schools. The UME Therezinha Pimentel, located in the "Morros" (Hills) region and whose students have a low socioeconomic profile, was the school with the best evaluations for OPN bread, kale bread, and OPN pie.

Table 4. Results of the Mann-Whitney analysis of variance, according to sex and school unit. Medians and interquartile ranges (n = 50). Santos-SP, 2020

Preparation	Female		Male		<i>p-value</i>	UME Therezinha		UME Maria Luiza		<i>p-value</i>
	Median	IQR	Median	IQR		Median	IQR	Median	IQR	
OPN bread (T)	4	4-5	5	3-5	0.950	5	5-5	3	2-4	0.000*
Kale bread (C)	5	3-5	3	3-5	0.055	5	4-5	3	3-5	0.003*
OPN pie (T)	4	2-5	3	3-5	0.725	4	3-5	3	2-5	0.176
Kale pie (C)	4	3-5	4	3-5	0.879	4	3-5	4	3-5	0.975

* Values with a statistically significant difference ($p < 0.05$). IQR = interquartile range. (T)= Test preparation and (C)= Control preparation.

A study carried out in Mexico with schoolchildren aged 5–11 years showed that dietary patterns are strongly associated with socioeconomic factors and found that children with medium and high socioeconomic status tend to have an increased amount of processed foods in their diet.¹⁹ The same study also found no significant difference between sexes and the dietary patterns analyzed. Schindler et al.²⁰ assessed the effectiveness of food exposure in the consumption of fruits and vegetables by children and reported that children from low-income families were more willing to try healthy foods than those from higher socioeconomic families. In addition, in their study involving children aged 9–12 years from low-income families from diverse racial and ethnic groups, Overcash et al.²¹ concluded that the population liked a wide variety of vegetables.

A review article by Nekitsing et al.²² summarized recent findings that investigated the impact of some interventions to promote the consumption of vegetables among preschoolers. Repeated exposure to taste has been identified as the most effective strategy for promoting the consumption of new foods by children, as it allows familiarization and positive acceptance in the long term. Sensory learning and nutritional education also demonstrated positive results in the acceptance of children, emphasizing the importance of using different strategies for the introduction and acceptance of new foods.²² Studies also point out to a positive association between the most frequently tried and most highly appreciated vegetables, suggesting that, once children try a new food, they are willing to eat it at subsequent instances.²¹

The high nutritional density of preparations with the addition of OPN, a traditional plant of Brazilian biodiversity, is related to the findings of Kasimba et al.,²³ who demonstrated a higher intake of vitamin A in children and women who consumed traditional foods than in those who consumed non-traditional foods. Another study pointed out a relationship between the adoption of a diet rich in traditional foods and high intake of vitamins A, D, iron, magnesium, and zinc in preschoolers in Canada's Arctic regions, indicating the need to promote a dietary pattern including fruits, vegetables, and native foods, mainly plants, in order to reduce the risks of obesity and dental caries in this population.²⁴ When investigating the levels of carotenoids in native leaves from Brazilian biodiversity, Kobori and Amaya²⁵ concluded that these are richer sources of carotenoids than the leafy vegetables produced commercially.

Hunter et al.²⁶ showed that neglected and underutilized plant species have a high nutritional content and can help transform current food systems, especially in developing countries, in order to combat malnutrition and achieve the 2nd Sustainable Development Goal (SDG-2), which aims to end hunger, achieve food security and improve nutrition, and promote sustainable agriculture by 2030. On the other hand, Lachat et al.,²⁷ observed a positive association between the richness of species in the diet and the nutritional adequacy of micronutrients in women and children in rural areas, showing the contribution of food biodiversity to the increase in diet quality. These results are in line with the principles of the *Dietary Guidelines for the Brazilian Population*, which encourage the consumption of regional and diversified species for a healthy diet.²⁸ Such findings in the literature show the importance of introducing foods from biodiversity in the nutritional enrichment of the diet, mainly for the adequate intake of micronutrients, sustainable food development, and promotion of SAN.

CONCLUSION

The inclusion of OPN contributed to the improvement of the nutritional quality of the culinary preparations, mainly in relation to micronutrients and dietary fiber.

Sensory analysis results indicated good acceptance of the test and control preparations, indicating that OPN bread was approved by students of lower socioeconomic level in accordance with the criteria proposed by the PNAE for preparations to be included in the school menu. However, most of the culinary preparations in this study achieved an acceptance percentage lower than the recommended cut-off for inclusion in the school menu. Repeated exposure can be an effective strategy to familiarize students with these foods and improve their acceptance.

Thus, foods from the local biodiversity should be explored, as they have great nutritional potential, contribute to the valorization of regional species, disrupt the food monopoly, transform the agrifood systems, and promote the SAN. Further studies are necessary for the development and evaluation of the acceptability of other preparations with OPN in order to guarantee a scientific basis for the inclusion of the species in the school feeding menu.

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Contributors

Izzo and Domene participated in conceptualizing the study design; data collection, analysis, and interpretation; drafting of the manuscript; and final review and approval of the manuscript for submission.

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