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ELABORATION AND SENSORY ACCEPTABILITY OF SUBPRODUCTS PRODUCED WITH JATOBÁ FLOUR IN MARANHÃO

ELABORAÇÃO E ACEITABILIDADE SENSORIAL DE SUBPRODUTOS PRODUZIDOS COM FARINHA DE JATOBÁ NO MARANHÃO

ELABORACIÓN Y ACEPTABILIDAD SENSORIAL DE SUBPRODUCTOS ELABORADOS CON HARINA DE JATOBÁ EN MARANHÃO

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ABSTRACT

Jatobá is a fruit with a farinaceous, white or yellowish pulp, rich in dietary fiber, whose nutritional and sensory properties make it a promising ingredient for food production. This study aimed to analyze the development and sensory acceptability of subproducts produced with jatobá flour in Barreirinhas, Maranhão, Brazil. The flour was produced from the fruit pulp and used to partially replace wheat flour in bread (15%) and cakes (35%), and to totally replace it in pasta formulations (100%). Sensory acceptability (appearance, color, aroma, texture, flavor, and overall quality) and purchase intention were evaluated by adolescents and adults, considering acceptance levels above 70%. Data were analyzed using Stata® 14.0 ($p < 0.05$). Cake showed the best sensory evaluations (7.16 ± 1.50 to 7.96 ± 1.77), with a global acceptance index of 85.49% and the highest purchase intention ("would certainly buy," 48.98%). Bread presented intermediate evaluations (6.50 ± 1.79 to 7.32 ± 1.54), overall acceptance of 78.58%, and purchase intention of 44% ("would probably buy"). Pasta showed the lowest mean scores (3.84 ± 2.55 to 5.76 ± 2.25), lower overall acceptance (54.93%), and purchase intention of 36% ("would probably not buy"). Significant differences were observed between cakes and bread compared to pasta ($p < 0.05$). Thus, cake and bread showed higher acceptance and purchase intention, proving to be promising products, whereas pasta showed low acceptability and requires formulation adjustments. The use of this regional ingredient strengthens local producers and promotes healthy and sustainable food systems.

KEYWORDS: Jatobá. Flour. Bakery. Sensory Acceptability. Food Products.

RESUMO

O jatobá é um fruto de polpa farinácea, branca ou amarelada, rico em fibras alimentares, cujas propriedades nutricionais e sensoriais o tornam um ingrediente promissor para a produção de

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alimentos. Esta pesquisa teve como objetivo analisar a elaboração e a aceitabilidade sensorial de produtos elaborados com farinha de jatobá em Barreirinhas, Maranhão, Brasil. A farinha foi produzida a partir da polpa do fruto e utilizada para substituir parcialmente a farinha de trigo em pães (15%) e bolos (35%) e totalmente nas formulações de massa alimentícia (100%). A aceitabilidade sensorial (aparência, cor, aroma, textura, sabor e qualidade global) e a intenção de compra foram avaliadas por adolescentes e adultos, considerando-se como satisfatórios níveis de aceitação acima de 70%. Os dados foram analisados no Stata® 14.0 ($p < 0,05$). O bolo apresentou as melhores avaliações sensoriais (7,16 ± 1,50 a 7,96 ± 1,77), com índice de aceitação global de 85,49% e maior intenção de compra (“certamente compraria”, 48,98%). O pão apresentou avaliações intermediárias (6,50 ± 1,79 a 7,32 ± 1,54), aceitação global de 78,58% e intenção de compra de 44% (“provavelmente compraria”). A massa alimentícia apresentou as menores médias (3,84 ± 2,55 a 5,76 ± 2,25), menor aceitação global (54,93%) e intenção de compra de 36% (“provavelmente não compraria”). Foram observadas diferenças significativas entre bolos e pães em comparação com a massa ($p < 0,05$). Assim, bolo e pão apresentaram maior aceitação e intenção de compra, mostrando-se promissores, enquanto a massa apresentou baixa aceitabilidade e requer ajustes. O uso desse ingrediente regional fortalece os produtores locais e promove uma alimentação saudável e sustentável.

PALAVRAS-CHAVE: Jatobá. Farinha. Panificação. Aceitabilidade Sensorial. Produtos Alimentícios.

RESUMEN
El jatobá es un fruto de pulpa farinácea, blanca o amarillenta, rico en fibra dietética, cuyas propiedades nutricionales y sensoriales lo convierten en un ingrediente prometedor para la producción de alimentos. Este estudio tuvo como objetivo analizar la elaboración y la aceptabilidad sensorial de subproductos producidos con harina de jatobá en Barreirinhas, Maranhão, Brasil. La harina se obtuvo a partir de la pulpa del fruto y se utilizó para sustituir parcialmente la harina de trigo en pan (15%) y en pasteles (35%), y totalmente en formulaciones de pasta alimenticia (100%). La aceptabilidad sensorial (apariencia, color, aroma, textura, sabor y calidad global) y la intención de compra fueron evaluadas por adolescentes y adultos, considerando niveles de aceptación superiores al 70%. Los datos se analizaron mediante Stata® 14.0 ($p<0,05$). El pastel presentó las mejores evaluaciones sensoriales (7,16±1,50 a 7,96±1,77), con un índice de aceptación global de 85,49% y la mayor intención de compra (“ciertamente compraría”, 48,98%). El pan mostró evaluaciones intermedias (6,50±1,79 a 7,32±1,54), aceptación global de 78,58% e intención de compra del 44% (“probablemente compraría”). La pasta alimenticia presentó los promedios más bajos (3,84±2,55 a 5,76±2,25), menor aceptación global (54,93%) e intención de compra del 36% (“probablemente no compraría”). Se observaron diferencias significativas entre pasteles y pan en comparación con la pasta ($p<0,05$). Así, el pastel y el pan presentaron mayor aceptación e intención de compra, destacándose como productos prometedores, mientras que la pasta mostró baja aceptabilidad y requiere ajustes en la formulación. El uso de este ingrediente regional fortalece a los productores locales y promueve una alimentación saludable y sostenible.

PALABRAS CLAVE: Jatobá. Harina. Panadería. Aceptabilidad sensorial. Productos alimenticios.

INTRODUCTION

Jatobá (*Hymenaea stigonocarpa* Mart.) is a fruit known by various popular names, such as Jutaí, jutaí-açu, jataíba, jatobá-mirim, quebra-facão, and farinheira in Brazil, jatay'va in Argentina and Paraguay, cuapinol, and algarrobo in Mexico. The term "jatobá" originates from Tupi va-atã-yba, meaning "tree of hard fruit." In addition to occurring in the Amazon region, this species is

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present in the Atlantic Forest, Pantanal, and Cerrado (Ramos *et al.,* 2018; Padilha *et al.,* 2024).

In addition to its wide geographical distribution, jatobá-do-cerrado stands out for its traditional medicinal and functional use. Various parts of the plant, such as the bark, leaves, and fruits, are used by local communities in the preparation of teas, infusions, and syrups due to their antimicrobial and antioxidant properties. These characteristics give jatobá a relevant role in health promotion and expand its application possibilities in culinary preparations, preserves, and regional crafts, reinforcing its cultural and multifunctional importance (Paiva *et al.,* 2025).

Jatobá produces fruits annually in pod format, utilized by local wildlife and rural communities. Its fruits have a mildly sweet taste and aroma, with yellow pulp rich in fibers and minerals such as potassium, magnesium, zinc, and calcium. The pulp has a flour-like texture, facilitating its application in bakery products such as bread, cakes, and cookies. This characteristic has been confirmed in studies that used jatobá flour in the production of cookie-type biscuits (Ramos *et al.,* 2018; Dias *et al.,* 2020; Padilha *et al.,* 2024), hard candies (Carvalho *et al.,* 2020), and breads enriched with papaya and banana (Borges *et al.,* 2023), all with good sensory acceptance.

Similar studies with alternative flours rich in fiber and protein have reported satisfactory sensory results in baked products, indicating that non-traditional flours can be successfully used to improve both nutrition and consumer acceptance (Irigoytia *et al.,* 2023; Mendes *et al.,* 2024).

Nutritionally, jatobá stands out for its high fiber content, with 11.01% soluble fibers and 42.86% insoluble fibers, in addition to minerals, proteins, B-complex vitamins, and phenolic compounds that confer antioxidant, anti-inflammatory, and antimicrobial properties. This composition expands its potential in the food industry, offering health benefits when incorporated into the diet. Additionally, its extract and essential oil can act as natural preservatives due to their antioxidant and antimicrobial properties, enabling the reduction of chemical additives in foods. Studies indicate the effectiveness of jatobá extract in extending the shelf life of perishable products, reinforcing its importance in developing food preservation solutions (Filho *et al.,* 2019; Pimentel *et al.,* 2024; Padilha *et al.,* 2024).

Despite the various benefits associated with jatobá consumption and its subproducts, the fruit is still little explored in national and local gastronomy. In some regions, the flour is mainly used for its nutritional and sensory characteristics, either for enriching preparations or for the sustainable use of regional foods (Borges *et al.,* 2023). The interest in exploring natural resources sustainably, such as jatobá, reflects the need to produce nutritious, sustainable foods relevant to human health. In this context, jatobá emerges as a promising ingredient for innovation in the food sector, such as school feeding, which demands low-cost, nutritious foods with good yield.

However, for jatobá's potential to be fully exploited, research exploring its properties and applications is necessary. Expanding knowledge about processing techniques and optimizing

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extraction and conservation methods can drive new usage possibilities for this species. Additionally, it is essential that jatobá valorization strategies and other natural resources consider bioeconomy principles, ensuring that their exploitation contributes to the sustainable development of producing regions, promoting biodiversity and maintaining local communities.

For such strategies to result in innovative, sustainable products accepted by the public, it is indispensable to understand how consumers perceive foods made with jatobá. In this sense, sensory analysis plays a fundamental role in developing new foods, allowing evaluation of attributes determinant for consumer acceptance, such as taste, texture, aroma, and appearance (Dutcosky, 2019).

These findings are consistent with reports from international studies, which demonstrate that alternative flours significantly influence sensory attributes and overall consumer acceptability in bakery products (Irigoytia *et al.,* 2023; Mendes *et al.,* 2024).

Although previous studies have investigated the incorporation of jatobá flour into bakery products, there is still a lack of research evaluating different food matrices simultaneously, especially including dough formulations with total wheat flour replacement. It is worth noting that existing studies are predominantly descriptive and lack critical analysis of the results.

Studies focusing on the regional application in Barreirinhas, Maranhão, and its potential inclusion in school feeding programs are also limited. Thus, this study seeks to fill this scientific gap by comparatively analyzing the sensory acceptability and purchase intention of different formulations developed with jatobá flour. Thus, the present research aimed to analyze the development and sensory acceptability of subproducts produced with jatobá flour in Barreirinhas, Maranhão, Brazil, seeking to expand consumption possibilities of this fruit and offer nutritious, sustainable, low-cost food options, especially for local school feeding.

METHODS

Experimental study with quantitative approach and cross-sectional nature, developed at the Kitchen Laboratory of the Federal Institute of Education, Science and Technology of Maranhão (IFMA) – Barreirinhas Campus, over 12 months (2024–2025).

Jatobá fruit was collected in the urban area of the municipality of Barreirinhas, Maranhão, during the fruit harvest season. The fruits were transported by the researchers themselves in an institutional vehicle to the IFMA – Barreirinhas Campus laboratory. Only healthy fruits free from shells and impurities were selected for jatobá flour production.

For jatobá flour production, fruits underwent selection, sanitization, washing, and separation of shell, pulp, and seed processes. The shell and seed were discarded for possible external uses, and the pulp was used for flour production. The pulp was removed and disintegrated in a food multiprocessor (Philips Walita Powerchop ri7303®); then submitted to drying in a fruit

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dehydrator (Slow Juicer Brasil, 700W / Teflon®) for 24 hours and ground in a domestic blender (Philips Walita Powerchop ri7303®) until complete homogenization. Then, the flour was sieved through a domestic sieve and packaged in polyethylene bags, divided into 200g portions, sealed, and stored at room temperature for food product elaboration.

Cake, bread, and pasta formulations were developed, replacing wheat flour with jatobá flour in different proportions. The cake was made with 35% jatobá flour; the bread with 15%, and the pasta with 100% jatobá flour. In addition to jatobá flour, other ingredients were used in product elaboration, purchased from the local market, namely: a) cake: extra-type chicken eggs; crystal white sugar; non-yeasted wheat flour; salted margarine; soybean oil; whole liquid cow's milk and chemical baking powder; b) breads: table salt; crystal white sugar; non-yeasted wheat flour; salted margarine; soybean oil; whole milk powder and chemical baking powder and water; c) pasta: only extra-type chicken eggs. The preparations were cooled to room temperature and packaged in polyethylene packaging and stored in a dry and airy place.

For cake preparation, 300 g of crystal white sugar, 50 g of salted margarine, 20 g of soybean oil, two extra-type eggs (approximately 90 g each) and 120 mL of whole liquid cow's milk were used. These ingredients were homogenized in a blender for three minutes. Then, 140 g of non-yeasted wheat flour and 66 g of jatobá flour were added, mixing until complete incorporation. Finally, 10 g of chemical baking powder was added, with light homogenization for proper distribution. The obtained dough was transferred to a previously greased baking pan with margarine and wheat flour and placed in an electric fryer-type oven (Mullller®), previously preheated to 175 °C. The cake was baked covered with aluminum foil for 45 minutes, then the foil was removed for process continuation until obtaining the characteristic golden color (approximately 15 additional minutes). After baking, the cake was unmolded and cooled on a rack until reaching room temperature.

For bread preparation, 2 g of salt, 15 g of white sugar, 250 g of non-yeasted wheat flour, 50 g of jatobá flour, 5 g of milk powder and 5 g of chemical baking powder were used. These dry ingredients were initially homogenized, to which approximately 150 mL of water was added, mixing until obtaining uniform dough. Then, 40 g of salted margarine and 20 g of soybean oil were incorporated, proceeding with manual kneading for 15 minutes. The dough was then left to rest, covered with a damp cloth, for 30 minutes, then subjected to new kneading for 15 minutes. After this process, the dough was shaped into two loaf units and placed in a baking pan previously greased with soybean oil and wheat flour, remaining covered with a damp cloth until reaching double the initial volume. Baking was performed in an electric fryer-type oven (Mullller®), previously preheated, initially at 180 °C for 15 minutes and then at 200 °C for another 15 minutes. The baked breads were cooled on a rack until reaching room temperature.

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For pasta preparation, 100 g of jatobá flour and two extra-type eggs (approximately 90 g each) were used. The ingredients were homogenized until forming uniform dough, which was shaped into a spherical format, wrapped in plastic film, and left to rest for 30 minutes at room temperature. Then, the dough was rolled out to approximately 1 mm thickness and cut into strips of 4 mm width by 20 cm length. Cooking was performed in boiling water previously salted, for about 18 minutes, or until reaching the desired cooking point. After cooking, the pasta was drained and considered ready for consumption or application in subsequent analyses.

Figure 1 shows some stages of the food product elaboration process with jatobá flour.

Figure 1. Food product elaboration process with jatobá flour



Source: Authors (2025).

The sensory analysis of breads, cakes, and pasta developed with jatobá flour was conducted through sensory acceptability testing, with high school adolescent students and adults. Two sensory tests were performed using affective methods (acceptance test and purchase intention). The inclusion criterion for sensory judges' participation in the research was not having intolerance, allergy, or aversion to the tested product's ingredients, meaning that if a person had limitations in consuming any formulation component, they could not participate in the tests.

Research participants had their doubts about study execution clarified and accepted to participate; their signatures were collected through the Free and Informed Consent Term (TCLE). For participants under 18 years of age, consent from parents or guardians was obtained through TCLE signature, followed by the minor's signature and agreement through the Free and Informed Assent Term (TALE).

During sensory analysis, samples were presented on white disposable plastic plates, accompanied by a glass of water for palate cleansing (white), along with an evaluation form containing a nine-point hedonic scale ranging from 1 (disliked extremely) to 9 (liked extremely). The following attributes were evaluated: appearance, color, aroma, texture, flavor, and overall quality. Each evaluator also indicated their purchase intention regarding each product. Scores equal to or greater than six points were considered acceptable (Dutcosky, 2019).

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Judges received instructions from researchers on how to fill out the form, without influencing responses. Product formulations were offered sequentially and individually to evaluators.

Additionally, the percentage acceptance index (AI) of sensory attributes was calculated using Equation 1:

$$AI(\%) = \frac{A \times 100}{B} \quad (1)$$

Where *A* represents the average score among the attributes and *B* the maximum score (9 points). Products were considered acceptable if the AI showed a percentage above seventy (>70%) (Dutcosky, 2019).

The sample size was calculated a priori according to the procedures described by Dutcosky (2019) for affective sensory tests using hedonic scales. Considering a minimum detectable difference of 1.0 point on the 9-point hedonic scale, a standard deviation of 1.5 (based on previous sensory studies with similar products), a significance level of 5% ($\alpha = 0.05$), statistical power of 80% ($1 - \beta = 0.80$), and a two-tailed test, the minimum required sample size was estimated at 49 evaluators per formulation.

The sensory study followed a completely randomized design, in which each evaluator assessed the samples independently under standardized serving conditions. Prior to inferential analyses, data normality was assessed using the Shapiro–Wilk test. As the normality assumptions were met, hedonic scores - treated as continuous interval-level data, as recommended for parametric analyses in sensory studies - were compared using Student's t-test for independent samples. For categorical variables, differences between formulations were evaluated using the z-test for independent proportions.

Descriptive statistics included absolute and relative frequencies for categorical variables and means with standard deviations for numerical variables. The significance level adopted was 5% ($p < 0.05$). All analyses were performed using Stata® version 14.0 (StataCorp, College Station, TX, USA). Data were initially entered into Microsoft Excel® and subsequently exported for statistical analysis.

This research project belongs to a matrix research titled "Jatobá Project: nutritional, technological, microbiological profile, elaboration and sensory acceptability of products made with jatobá flour from the municipality of Barreirinhas, Maranhão", which was submitted and approved by the Research Ethics Committee of Hospital Carlos Macieira, complying with Resolution No. 466 of 12/12/2012, of the National Health Council and its complements, for research involving human beings, under opinion No. 5.897.801, on February 15, 2023. Furthermore, the research has Registry No. ABFB56B, in the National System for Management of Genetic Heritage and Associated Traditional Knowledge (SISGEN).

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RESULTS AND DISCUSSION

In the sensory acceptability evaluation of subproducts made with jatobá flour, 49 cake evaluators, 50 bread evaluators, and 50 pasta evaluators participated, with a predominance of females and age range between 15 and 55 years. The means of the evaluated sensory attributes (appearance, color, aroma, texture, flavor), as well as overall impression and acceptance and global acceptance index (%) of the products, are presented in Table 1.

Cakes formulated with 35% jatobá flour showed the highest means for all evaluated sensory attributes, with values between 7.16 ± 1.50 and 7.96 ± 1.77, corresponding to the "liked moderately" category. These results reflected a global acceptance index of 85.49%, indicating high sensory acceptability. The good acceptance of the cake suggests that jatobá flour adapts adequately to this food matrix, since cake-type products depend less on gluten network formation and show greater tolerance to incorporation of alternative flours, without prejudice to sensory characteristics. In addition to sensory acceptance, jatobá flour stands out for the increase in fibers and minerals (Borges; Romão; Zandonadi, 2022) strengthening the potential of cakes and breads as functional foods attractive to health-conscious consumers.

Table 1. Sensory evaluation of cake, bread, and pasta made with jatobá flour

Items	Jatobá Flour Subproducts			
	Cake (n=49)	Bread (n=50)	Pasta (n=50)	p-value*
	Mean ± Standard Deviation			
Appearance	7.84 ± 1.28	7.32 ± 1.54	5.60 ± 2.21	<0.001[a,b]
Color	7.61 ± 1.44	7.00 ± 1.71	5.76 ± 2.25	<0.001[a,b]
Aroma	7.16 ± 1.50	6.50 ± 1.79	4.60 ± 2.61	0.049 [c] <0.001[a,b] <0.001[a,b]
Texture	7.90 ± 1.33	7.30 ± 1.62	4.92 ± 2.49	0.047 [c] <0.001[a,b]
Flavor	7.96 ± 1.77	7.24 ± 1.80	3.84 ± 2.55	<0.001[a,b]
Impression / Overall Quality	7.84 ± 1.43	6.96 ± 1.68	4.76 ± 2.54	0.006[c] <0.001[a,b]

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Overall Acceptance	7.69 ± 1.07	7.07 ± 1.26	4.94 ± 2.05	0.009 [c] <0.001[a,b]
Overall Acceptance Index (%)	85.49%	78.58%	54.93%	0.0009 [a,b]

**Student's t-test or z-test for two independent proportions.*
[a] difference between cake and pasta; [b] difference between bread and pasta; [c] difference between cake and bread.
Source: Authors (2025).

Similar findings have been reported by Ramos *et al.,* (2018) and Dias *et al.,* (2020), who observed acceptance indices above 80% for cookies formulated with jatobá flour. Padilha *et al.,* (2024), evaluating products developed in the same geographical region, also reported acceptance levels exceeding 80%. Collectively, these studies suggest that jatobá flour performs favorably in bakery matrices with lower structural dependence on gluten network formation. This pattern supports the hypothesis that the technological functionality of jatobá flour is matrix-dependent, with better sensory outcomes in products where structural integrity relies more on starch gelatinization and sugar–fat interactions than on gluten elasticity.

In the present study, bread formulated with 15% jatobá flour achieved intermediate mean hedonic scores (6.50 ± 1.79 to 7.32 ± 1.54), corresponding to “liked slightly” to “liked moderately,” and a global acceptance index of 78.58%. Although slightly lower than values reported for cookies, these results remain within the threshold, commonly considered indicative of good consumer acceptability (>70%). The moderate reduction in scores compared to sweet baked goods may be attributed to partial gluten dilution, which can affect crumb structure, volume, and texture perception.

Borges *et al.,* (2023) similarly reported good acceptance of bread enriched with 16% jatobá flour, highlighting texture as one of the most positively evaluated attributes. The convergence of these findings strengthens the evidence that substitution levels around 15–16% represent a technologically and sensorially viable range for bread applications. Importantly, the consistency across studies reinforces that partial replacement of wheat flour with jatobá flour can be achieved without compromising consumer acceptance, provided that formulation and matrix characteristics are adequately considered.

In contrast, pasta made entirely with jatobá flour showed the lowest sensory evaluation means, ranging between 3.84 ± 2.55 and 5.76 ± 2.25, corresponding to the categories "disliked moderately" and "neither liked nor disliked." The global acceptance index of 54.93% was below the minimum value recommended for sensory acceptance, evidencing low acceptance of this product.

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Statistical analyses demonstrated significant differences between pasta and the other evaluated subproducts ($p < 0.05$), as presented in Table 1.

The lower acceptance of pasta can be mainly explained by the absence of gluten, the protein responsible for the elasticity, firmness, and cohesion characteristic of this type of product. The exclusive use of jatobá flour compromised fundamental sensory attributes, especially texture and flavor. The literature points out that alternative flours, when used as the sole farinaceous source in pasta, tend to show technological limitations, requiring combination with other flours or addition of structuring agents to improve sensory and technological quality (Arora *et al.,* 2023).

Overall, the results indicate that jatobá flour shows better sensory performance when applied in baked products, such as cakes and breads, where structural requirements are lower. These findings corroborate previous studies that highlight the potential of jatobá flour as an alternative, functional, and regionally valued ingredient for the food industry, especially in bakery products (Ramos et al., 2018; Dias *et al.,* 2020; Borges *et al.,* 2023; Padilha *et al.,* 2024).

Figure 2 presents the results regarding purchase intention of subproducts made with regional flour from Barreirinhas, Maranhão. It was observed that cake showed the highest purchase intention, with predominance of the response "would certainly buy" (48.98%; n = 24), followed by bread, for which most evaluators indicated "would probably buy" (44%; n = 22). In contrast, pasta showed lower purchase intention, with higher frequency of the response "would probably not buy" (36%; n = 18).

These results directly reflect the sensory acceptability data previously discussed, evidencing the relationship between positive sensory attributes (flavor, aroma, texture, and appearance) and consumer purchase predisposition. According to Dutcosky (2019), purchase intention is strongly influenced by the food's overall sensory perception, with flavor being one of the main determinants of consumer decision. In this sense, products that show sensory balance tend to be better accepted and consumed more frequently.

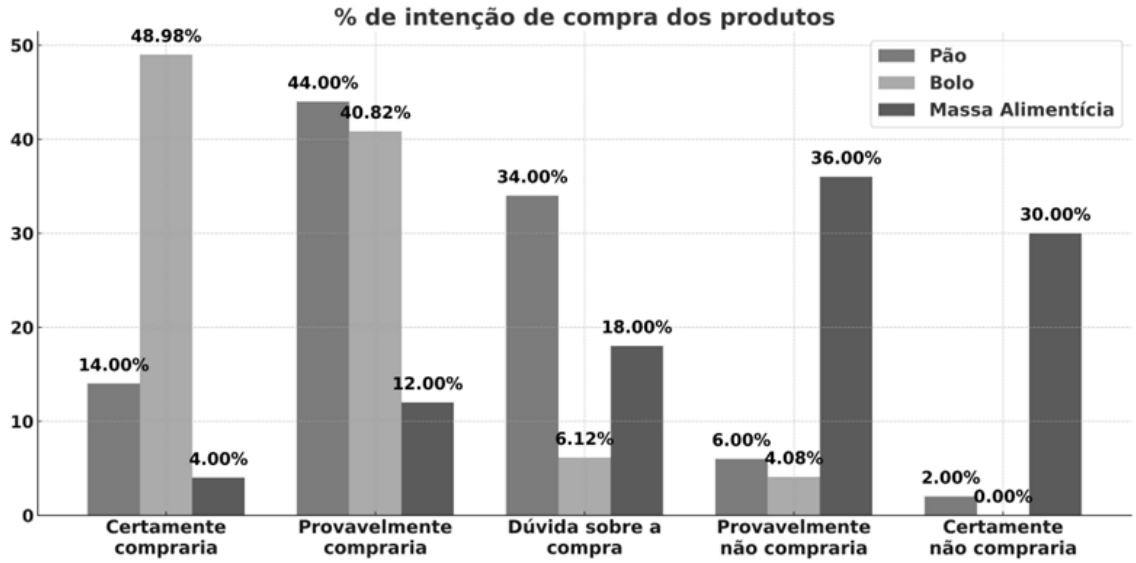
The high purchase intention observed for cake and, to a lesser degree, for bread, is associated with the good sensory evaluations of these products, especially in flavor and texture attributes. Similar results were reported by Dias *et al.,* (2020), when developing cookies with jatobá flour in Maranhão, which obtained high flavor scores and good public acceptance. As observed in cookies, the cakes and breads evaluated in this study demonstrated that jatobá flour can be successfully incorporated into different food matrices, without compromising sensory acceptance and purchase intention.

These findings reinforce that small variations in formulation and wheat flour substitution level can positively impact sensory perception and consumer preference, expanding the potential use of jatobá flour in producing attractive and commercially viable foods. Thus, bakery products

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made with this regional ingredient show promising prospects for insertion into the local market and institutional programs, such as school feeding.

Figure 2. Purchase intention of cake, bread, and pasta with jatobá flour



Source: Authors (2025).

In contrast to bakery products, the pasta formulation exhibited lower sensory scores, which were directly reflected in reduced purchase intention. This outcome suggests that the technological functionality of jatobá flour may be less compatible with matrices that rely heavily on structural cohesion, firmness, and elasticity. Pasta quality is strongly dependent on protein network formation and starch–protein interactions that confer resistance to cooking and desirable texture. Partial replacement of wheat flour with jatobá flour, characterized by higher fiber content and absence of gluten-forming proteins, likely interfered with matrix continuity, resulting in denser texture and less appealing appearance.

Borges, Romão and Zandonadi (2022) similarly reported that higher concentrations of jatobá flour were associated with increased product density and darker coloration, factors that may negatively influence consumer perception, particularly in products where visual and textural attributes are critical to quality evaluation. Therefore, the reduced purchase intention observed in this study is not merely a sensory outcome but reflects structural and technological limitations inherent to the formulation.

From a formulation perspective, these findings indicate that successful incorporation of jatobá flour into pasta may require technological optimization strategies, such as blending with protein-rich flours, incorporation of hydrocolloids or structuring agents, particle size standardization,

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or process adjustments to improve dough cohesion and cooking stability. Such approaches would aim to compensate for gluten dilution and enhance structural integrity.

Although previous studies (Borges *et al.,* 2023; Padilha *et al.,* 2024) have demonstrated satisfactory sensory performance of jatobá flour in baked goods, evidence regarding its application in products demanding higher structural strength remains limited. Thus, rather than contradicting existing literature, the present findings refine the understanding of matrix-dependent functionality and highlight a relevant technological gap. This reinforces the central hypothesis that the performance of jatobá flour is strongly influenced by the structural requirements of the target product, underscoring the need for matrix-specific formulation strategies in future research.

Among the study limitations, the subjective nature of sensory analyses stands out, since individual and cultural preferences of evaluators can influence results. Additionally, storage effects on subproducts were not evaluated, nor the stability of jatobá flour over time, which limits understanding of possible future sensory changes. It was also not possible to make adjustments to pasta formulation or expand sensory evaluation to elementary school children, which could provide additional information on product acceptance in different age groups.

Despite these limitations, the study stands out for being pioneering in the Barreirinhas, Maranhão region, in developing and sensorially evaluating cakes, breads, and pasta made with jatobá flour. The number of participants and use of standardized methodology conferred reliability to the results. The joint analysis of sensory acceptability and purchase intention allowed a broader understanding of the market potential of developed subproducts, evidencing that cakes and breads show greater commercial viability, while pasta still requires technological improvements to achieve greater acceptance.

CONCLUSION

In conclusion, products formulated with jatobá flour demonstrated differentiated sensory performance depending on the food matrix. The cake formulation achieved the highest acceptance across all evaluated attributes, indicating greater compatibility between the physicochemical characteristics of jatobá flour and the cake structure. Bread showed satisfactory acceptance, whereas the pasta formulation received limited consumer approval.

These findings reinforce the technological feasibility of incorporating jatobá flour into selected bakery products, particularly those less dependent on gluten structure. From a practical standpoint, the results support the use of jatobá flour in cake and bread formulations at the tested substitution level, with potential application in institutional food services, school feeding programs, and small-scale commercial bakeries. Such incorporation may contribute to adding value to native Brazilian species, diversifying raw materials in the bakery sector, and strengthening local production chains within a circular economy perspective.

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However, successful market implementation requires complementary technological validation. Future studies should advance toward detailed physicochemical characterization of dough rheology and structural properties; comprehensive nutritional profiling, including dietary fiber fractions and bioactive compounds; shelf-life assessment and storage stability under real distribution conditions; consumer segmentation analysis to identify target markets; and economic feasibility modeling considering production scale, supply chain logistics, and cost–benefit analysis.

Collectively, these approaches will enable a more robust assessment of the industrial scalability and functional positioning of jatobá flour in bakery applications, consolidating its role as a sustainable ingredient with technological and socioeconomic relevance.

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