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PHYSICOCHEMICAL EVALUATION OF INDUSTRIALIZED *BYRSONIMA CRASSIFOLIA* PULPS MARKETED IN SUPERMARKETS OF BELÉM, PARÁ

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ABSTRACT

Objective: This study aimed to analyze the physicochemical parameters of industrialized muruci (*Byrsonima crassifolia*) pulps marketed in supermarkets in Belém, Pará, to evaluate the quality of products available in the market.

Theoretical Framework: The research is based on the growing demand for processed foods derived from native Amazonian fruits, highlighting the importance of standardization and quality control of these products. Literature emphasizes the relevance of physicochemical parameters as indicators of fruit pulp quality.

Method: Twenty samples from four different commercial brands were analyzed in a completely randomized design with five replications per treatment. Evaluated parameters included pH, electrical conductivity (EC), total soluble solids (TSS), titratable acidity, and total solids (TS). Data were subjected to analysis of variance, and means were compared using Tukey's test at 5% significance.

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Results and Discussion: Results showed significant variation among brands. Sample T2 presented the highest values for EC (0.412 mS/cm), TSS (4.0 °Brix), acidity (11.874 g/100 g), and TS (11.495%), indicating a more concentrated pulp. Sample T1 showed the lowest values and highest pH (3.516), suggesting lower concentration. Other samples had intermediate values.

Research Implications: The data reinforce the importance of physicochemical characterization for quality control and suggest the need for greater standardization in the production of native fruit derivatives.

Originality/Value: This study contributes by demonstrating variability among commercial brands and highlighting the importance of regulation to ensure quality in processed native fruit products.

Keywords: Amazonian Fruits, Physicochemical Parameters, Quality Control, Processed Foods, Muruci, Industrialized Pulps.

AVALIAÇÃO FÍSICO-QUÍMICA DE POLPAS INDUSTRIALIZADAS DE *BYRSONIMA CRASSIFOLIA* COMERCIALIZADAS EM SUPERMERCADOS DE BELÉM DO PARÁ

RESUMO

Objetivo: O objetivo deste estudo foi analisar os parâmetros físico-químicos de polpas industrializadas de muruci (*Byrsonima crassifolia*) comercializadas em supermercados da cidade de Belém do Pará, visando avaliar a qualidade dos produtos disponíveis no mercado.

Referencial Teórico: A pesquisa fundamenta-se na crescente demanda por alimentos processados à base de frutas nativas da Amazônia, destacando a importância da padronização e controle de qualidade desses produtos. A literatura enfatiza a relevância de parâmetros físico-químicos como indicadores de qualidade em polpas de frutas.

Método: Foram analisadas vinte amostras de quatro marcas comerciais diferentes, em delineamento inteiramente casualizado, com cinco repetições por tratamento. Avaliaram-se pH, condutividade elétrica (CE), sólidos solúveis totais (SST), acidez titulável e sólidos totais (ST). Os dados foram submetidos à análise de variância e as médias comparadas pelo teste de Tukey (5%).

Resultados e Discussão: Os resultados mostraram variações significativas entre as marcas. A amostra T2 apresentou maiores valores de CE (0,412 mS/cm), SST (4,0 °Brix), acidez (11,874 g/100g) e ST (11,495%), indicando maior concentração. A amostra T1 apresentou menores valores e maior pH (3,516), sugerindo menor qualidade. As demais amostras mostraram valores intermediários.

Implicações da Pesquisa: Os dados reforçam a importância da caracterização físico-química para o controle de qualidade e sugerem a necessidade de padronização na produção de derivados de frutas amazônicas.

Originalidade/Valor: Esta pesquisa contribui ao evidenciar a variabilidade entre marcas comerciais e a importância da regulamentação na garantia de qualidade dos produtos processados à base de frutas nativas.

Palavras-chave: Frutas Amazônicas, Parâmetros Físico-Químicos, Controle de Qualidade, Alimentos Processados, Muruci, Polpas Industrializadas.

EVALUACIÓN FÍSICO-QUÍMICA DE PULPAS INDUSTRIALIZADAS DE *BYRSONIMA CRASSIFOLIA* COMERCIALIZADAS EN SUPERMERCADOS DE BELÉM, PARÁ

RESUMEN

Objetivo: Este estudio tuvo como objetivo analizar los parámetros físico-químicos de pulpas industrializadas de muruci (*Byrsonima crassifolia*) comercializadas en supermercados de Belém, Pará, con el fin de evaluar la calidad de los productos disponibles en el mercado.

Marco Teórico: La investigación se basa en la creciente demanda por alimentos procesados a partir de frutas nativas amazónicas, destacando la importancia de la estandarización y el control de calidad de estos productos. La literatura resalta la relevancia de los parámetros físico-químicos como indicadores de calidad en pulpas de frutas.

Método: Se analizaron veinte muestras de cuatro marcas comerciales diferentes, en un diseño completamente aleatorizado con cinco repeticiones por tratamiento. Se evaluaron pH, conductividad eléctrica (CE), sólidos solubles totales (SST), acidez titulable y sólidos totales (ST). Los datos fueron sometidos a análisis de varianza y las medias comparadas mediante la prueba de Tukey al 5% de significancia.

Resultados y Discusión: Los resultados mostraron variaciones significativas entre las marcas. La muestra T2 presentó los mayores valores de CE (0,412 mS/cm), SST (4,0 °Brix), acidez (11,874 g/100 g) y ST (11,495%), indicando una pulpa más concentrada. La muestra T1 presentó los menores valores y mayor pH (3,516), sugiriendo menor concentración. Las demás muestras mostraron valores intermedios.

Implicaciones de la Investigación: Los datos refuerzan la importancia de la caracterización físico-química para el control de calidad y sugieren la necesidad de mayor estandarización en la producción de derivados de frutas nativas.

Originalidad/Valor: Este estudio contribuye al evidenciar la variabilidad entre marcas comerciales y resaltar la importancia de la regulación para garantizar la calidad de los productos procesados a base de frutas nativas.

Palabras clave: Frutas Amazónicas, Parámetros Físico-Químicos, Control de Calidad, Alimentos Procesados, Muruci, Pulpas Industrializadas.

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1 INTRODUCTION

Muruci (Byrsonima crassifolia (L.) Kunth) is a typical fruit from the Amazon region, known for its intense aroma, acidic taste, and high nutritional value. Traditionally consumed fresh, this fruit has gained prominence in the processed food market, especially in the form of frozen pulps, jams, and juices, as an alternative to extend its availability throughout the year and add value to the production chain (Lima et al., 2016).

Several studies indicate that muruci pulp exhibits relevant physicochemical characteristics, such as low pH, high soluble solids content, and significant levels of bioactive compounds, including vitamin C, total phenols, and carotenoids (Oliveira et al., 2015; Embrapa, 2017). These properties give the fruit functional potential and favor its use in the healthy food industry.

However, the physicochemical composition of the pulp may vary substantially due to factors such as the origin of the raw material, fruit ripeness, cultivation conditions, and especially industrial processing and preservation methods (Silva et al., 2016). Such variations directly influence the sensory, nutritional, and microbiological quality of the final product, impacting consumer perception and market value.

Physicochemical analysis of industrialized pulps is an essential tool for quality control, allowing verification of compliance with standards established by regulatory agencies such as the Ministry of Agriculture, Livestock and Supply (MAPA) and ensuring product safety and acceptability (MAPA, 2000). Parameters such as pH, total soluble solids (°Brix), titratable acidity, electrical conductivity, and total solids are commonly used to assess food integrity and detect possible dilution, adulteration, or degradation.

In this context, the present study aims to perform a physicochemical analysis of industrialized muruci pulp samples marketed in supermarkets in the city of Belém, Pará. The research seeks to identify variations in composition among different brands and evaluate product compliance with expected quality standards, providing relevant data for consumers, researchers, and regulatory agencies.

2 THEORETICAL FRAMEWORK

Byrsonima crassifolia, commonly known as muruci, is a fruit native to the Amazon region that has attracted considerable scientific interest due to its distinctive organoleptic properties and nutritional profile. Several studies have documented the fruit's intense aroma and acidic flavor, attributes that contribute to its consumer appeal and potential for diverse applications in food products (Lima et al., 2016). Traditionally consumed fresh, muruci's commercialization in processed forms such as frozen pulps, jams, and juices has increased, aiming to extend shelf life and availability beyond the harvest season (Lima et al., 2016).

From a compositional standpoint, muruci pulp is characterized by low pH values, which contribute to its acidic taste and enhance microbiological stability (Oliveira et al., 2015; Embrapa, 2017). The pulp is also rich in total soluble solids (TSS), reflecting high sugar and organic acid content, which are key determinants of flavor and consumer acceptance (Chitarra & Chitarra, 2005). Moreover, muruci contains significant levels of bioactive compounds such as vitamin C, phenolic compounds, and carotenoids, which confer antioxidant properties and functional benefits, making the fruit a promising ingredient in the health food sector (Oliveira et al., 2015; Embrapa, 2017).

However, physicochemical parameters of muruci pulps are influenced by multiple factors, including geographic origin, fruit maturity at harvest, agronomic practices, and particularly industrial processing techniques (Silva et al., 2016). Variability in these factors can affect pulp quality by altering sensory attributes, nutrient retention, and shelf life, which in turn impact consumer satisfaction and market competitiveness. Silva et al. (2016) emphasize that

processing methods such as freezing, pasteurization, and storage conditions play a pivotal role in preserving or degrading key quality indicators.

Quality control of fruit pulps, including muruci, relies heavily on physicochemical analyses that assess parameters such as pH, electrical conductivity (EC), TSS (°Brix), titratable acidity, and total solids. These measurements serve not only to ensure compliance with regulatory standards set by authorities like Brazil's Ministry of Agriculture, Livestock and Supply (MAPA, 2000) but also to detect adulterations, dilutions, or spoilage (MAPA, 2000). Medeiros et al. (2018) highlight electrical conductivity as an indirect measure of mineral content and a marker of potential industrial additives.

Despite the availability of such analytical tools, there is limited literature focusing specifically on the physicochemical characterization of commercial muruci pulps, especially in the context of the Pará region's market. This gap underscores the importance of further studies to support regulatory oversight, guide producers in quality enhancement, and inform consumers about product standards and authenticity.

3 METHODOLOGY

Four samples of industrialized muruci (Byrsonima crassifolia) pulps from different brands were purchased in supermarkets in the city of Belém, Pará, with the aim of performing a physicochemical characterization of the product marketed in the region.

The samples were transported in a thermal box to the Analytical Chemistry Laboratory at the Federal Rural University of the Amazon (UFRA), where they were stored under refrigeration at approximately 4 °C until analysis.

Analyses were carried out with the pulps at room temperature, using a completely randomized design in a 4 × 5 factorial scheme, consisting of four treatments (T1 to T4), corresponding to the different pulp brands evaluated, with five replications per treatment. The physicochemical variables analyzed were: pH, electrical conductivity (EC), total soluble solids (TSS), titratable acidity, and total solids (TS).

pH was determined using a bench pH meter (model AT-315), previously calibrated with standard buffer solutions at pH 4.0 and 7.0. Total soluble solids were obtained by direct refractometry using a portable refractometer (model ATC-080), with results expressed in degrees Brix (°Brix), as described by Chitarra and Chitarra (2005). Titratable acidity was determined by volumetric neutralization using a 0.1 mol/L sodium hydroxide (NaOH) solution

as titrant, previously standardized, with results expressed as grams of citric acid per 100 grams of sample, according to the methodology of Instituto Adolfo Lutz (2008).

Electrical conductivity was measured using a portable conductivimeter (model CD 850), calibrated with a standard solution of 146.9 µS/cm, and values expressed in mS/cm. Total solids were determined by drying the samples in an oven at 105 °C until constant weight, with results expressed as a percentage, following the methodology described by Silva et al. (2021).

The obtained data were subjected to analysis of variance (ANOVA), and means were compared by Tukey's test at a 5% probability level when significant.

4 RESULTS AND DISCUSSIONS

The physicochemical analysis of industrialized muruci (Byrsonima crassifolia) pulp samples marketed in supermarkets in the city of Belém, Pará, revealed significant differences among the treatments evaluated regarding pH, electrical conductivity (EC), total soluble solids (TSS), titratable acidity, and total solids (TS).

Table 1

Average values of pH, electrical conductivity (EC), total soluble solids (TSS), titratable acidity, and total solids (TS) of industrialized muruci (Byrsonima crassifolia) pulps from four brands marketed in Belém, Pará.

Treatment	Average pH	Average EC (mS/cm)	Average TSS (ºBrix)	Average Acidity	Average TS (%)
T1	3.516a	0.351d	3.100c	10,662c	10,560c
T2	3.428c	0.412a	4.000a	11,874a	11,495a
T3	3.474b	0.399b	3.500b	10,604d	10,604b
T4	3.470b	0.395c	3.500b	10,796b	10,566c

Equal letters in the column indicate no significant difference between the means according to Tukey's test at 5% probability.

Treatment T2 stood out by presenting the highest values of electrical conductivity (EC) (0.412 mS/cm), total soluble solids (TSS) (4.000 °Brix), titratable acidity (11.874 g/100 g), and total solids (TS) (11.495%). The high content of total soluble solids (°Brix) indicates a greater concentration of natural sugars such as fructose, glucose, and sucrose, as well as soluble organic acids, which are directly related to fruit ripeness and the absence of dilution in the pulp formulation (CHITARRA & CHITARRA, 2005). Values above 3.5 °Brix are considered indicative of a more concentrated pulp with a more attractive sensory and nutritional potential (SILVA et al., 2021).

The higher electrical conductivity recorded in T2 suggests a greater presence of soluble ions, such as potassium, calcium, and magnesium, which are common in tropical fruits, especially those grown in acidic tropical soils like those found in the Amazon region (OLIVEIRA et al., 2020). According to Medeiros et al. (2018), EC can be an indirect indicator of the mineral density of the pulp, as well as reflect industrial practices such as the addition of stabilizers and preservatives.

Titratable acidity was also significantly higher in T2, reinforcing the idea that this sample comes from riper fruits or maintained greater fidelity to the natural composition of muruci, known for its pronounced acidic profile, with a marked presence of malic, citric, and ascorbic acids (LOPES et al., 2019). Acidity influences the microbiological stability of the product and its sensory perception, being desirable when balanced with sweetness.

In contrast, treatment T1 presented the lowest values of TSS (3.100 °Brix), EC (0.351 mS/cm), and TS (10.560%), in addition to exhibiting the highest pH value (3.516). This profile may indicate greater dilution of the pulp, which compromises the concentration of bioactive compounds and natural nutrients in the fruit. According to the Normative Instruction No. 1/2000 of MAPA, fruit pulps must contain at least 10% total solids; although T1 meets the legal requirement, it presents a borderline value, which may indicate a lower quality standard and a possible attempt to reduce costs by adding more water during the industrial process (BRASIL, 2000).

Treatments T3 and T4 presented intermediate values, with TSS of 3.500 °Brix, EC around 0.395 mS/cm, and acidity between 10.604 and 10.796 g/100 g. These results suggest a certain balance between concentration and acidity, reflecting more standardized formulations. The higher pH value in T3 (3.474), combined with lower acidity, may favor the sensory acceptability of the product, since excessively acidic flavors tend to reduce consumer acceptance (RAMOS et al., 2021).

The variation observed among treatments can be attributed to different industrial practices, the quality of the raw material used (variety, ripeness level, harvest conditions), and the addition of ingredients during processing, such as water, sugar, and acidulants. Additionally, it is important to highlight that Brazilian legislation does not establish minimum values for pH, TSS, or EC in fruit pulps, which may allow for significant discrepancies between products from different brands, as observed in this study.

From a technological standpoint, products with low TSS and TS values tend to have lower viscosity, color, and flavor, as well as reduced energy value, which may compromise their use in food formulations or as substitutes for the fresh fruit (PINTO et al., 2017).

Furthermore, pulps with high acidity and low pH, as observed in this study, have greater microbiological stability, which can reduce the need for preservative additives.

5 CONCLUSION

The results of the physicochemical analyses demonstrated significant variations among the industrialized muruci pulps marketed in Belém, Pará. Treatment T2 showed the best quality indices, with higher levels of soluble solids, acidity, and electrical conductivity, indicating a more concentrated pulp closely resembling the natural composition of the fruit. On the other hand, treatment T1 presented the lowest values, suggesting possible dilution or a lower quality standard.

Although all samples met the minimum total solids requirement established by legislation, the lack of standardization among the products highlights the need for improved production control and stricter regulatory oversight. This also underscores the importance of specific regulations for native fruits such as muruci, aiming to ensure the quality, safety, and valorization of these products in the market.

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