

**Development of light jam as a strategy for the use and valorization of seriguela** <https://doi.org/10.47236/2594-7036.2026.v10.1987>

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Abstract – Seriguela (*Spondias purpurea* L.) is a tropical fruit with high nutritional value and limited industrial use to date, offering potential to enhance the value of extractive production systems and family farming. In this context, the present study aimed to develop and characterize light seriguela jams to evaluate their feasibility as a higher-value-added product with reduced sucrose content. The pulp was prepared without the peel, and three jam formulations (F1, F2, and F3) were developed with sugar reductions of 25%, 35%, and 45%, respectively. These formulations were evaluated for their physicochemical properties (yield, pH, titratable acidity, and soluble solids), proximate composition, vitamin C, and mineral content. The pulp exhibited characteristics favorable to preservation. Sugar reduction influenced the levels of soluble solids and carbohydrates, whereas pH and acidity remained within the recommended standards for jams. All formulations presented nutritionally relevant concentrations of essential minerals, particularly potassium and phosphorus, indicating that seriguela pulp is the main contributor to the mineral content of the product. The formulation with a 45% sugar reduction demonstrated the best nutritional balance, achieving this by combining lower sucrose addition with the retention of essential minerals. Thus, seriguela fruit demonstrates potential as a raw material for the development of light jams, adding value to the product by contributing to the valorization of native fruits and the diversification of products aligned with healthy consumption trends.

Keywords: Fruit products. *Spondias purpurea* L. Sugar reduction.

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Desenvolvimento de geleia *light* como estratégia para o uso e a valorização da seriguela

Resumo – A seriguela (*Spondias purpurea* L.) é uma fruta tropical, de elevado valor nutricional e reduzido aproveitamento industrial até o momento, com potencial para agregar valor à produção extrativista e à agricultura familiar. Nesse contexto, o presente estudo teve como objetivo desenvolver e caracterizar geleias *light* de seriguela, visando avaliar sua viabilidade como produto de maior valor agregado e com menor teor de sacarose. Foi elaborada a polpa sem a casca, sendo desenvolvidas três formulações de geleias (F1, F2 e F3), com reduções de 25%, 35% e 45% de açúcar, respectivamente, avaliadas quanto às propriedades físico-químicas (rendimento, pH, acidez titulável e sólidos solúveis), composição centesimal, vitamina C e minerais. A polpa apresentou características favoráveis à preservação. A redução de açúcar influenciou os teores de sólidos solúveis e de carboidratos, enquanto o pH e a acidez permaneceram dentro dos padrões recomendados para geleias. Todas as formulações apresentaram concentrações nutricionalmente relevantes de minerais essenciais, com destaque para o potássio e o fósforo, evidenciando que a polpa de seriguela é a principal responsável pela contribuição mineral do produto. A formulação com 45% de redução de açúcar destacou-se pelo melhor equilíbrio nutricional, aliando menor adição de sacarose à manutenção de minerais essenciais. Assim, a seriguela demonstra potencial como matéria-prima para o desenvolvimento de geleias *light*, agrega valor ao produto, contribuindo para a valorização de frutas nativas e para a diversificação de produtos alinhados às tendências de consumo saudável.

Palavras-chave: Produtos de frutas. *Spondias purpurea* L. Redução de açúcar.

Desarrollo de mermelada *light* como estrategia para el uso y la valorización de la seriguela

Resumen – La seriguela (*Spondias purpurea* L.) es una fruta tropical, de alto valor nutricional y reducido aprovechamiento industrial hasta el momento, con potencial para agregar valor a la producción extractiva y a la agricultura familiar. El presente estudio tuvo como objetivos desarrollar y caracterizar mermeladas *light* de seriguela, buscando evaluar su viabilidad como producto de mayor valor agregado y con menor contenido de sacarosa. Se elaboró la pulpa sin la cáscara, y se desarrollaron tres formulaciones de mermeladas (F1, F2 y F3), con reducciones de 25%, 35% y 45% de azúcar, respectivamente, evaluadas en cuanto a las propiedades físico-químicas (rendimiento, pH, acidez titulable y sólidos solubles), composición centesimal, vitamina C y minerales. La pulpa presentó características favorables a la preservación. La reducción de azúcar influyó en el contenido de sólidos solubles y de carboidratos, mientras que el pH y la acidez se mantuvieron dentro de los estándares recomendados para las mermeladas. Todas las formulaciones presentaron concentraciones nutricionalmente relevantes de minerales esenciales, con énfasis en el potasio y el fósforo, evidenciando que la pulpa de seriguela es la principal responsable de la contribución mineral del producto. La formulación con 45% de reducción de azúcar se destacó por el mejor equilibrio nutricional, aliando una menor adición de sacarosa al mantenimiento de minerales esenciales. Así, la seriguela demuestra potencial como materia prima para el desarrollo de mermeladas *light*, agrega valor al producto, contribuyendo a la valoración de frutas nativas y a la diversificación de productos alineados con las tendencias de consumo saludable.

Palabras clave: Productos de frutas. *Spondias purpurea* L. Reducción de azúcar.

Introduction

In agroindustrial systems, technology is most commonly associated with products and processing. In this context, there has been growing appreciation for healthy and innovative foods, especially fruit-based products, which have been gaining prominence in the market (Barroso et al., 2020), while strategies aligned with the principles of the circular economy have also been strengthened, focusing on the full use of raw materials, waste reduction, and the addition of value to production systems.

In line with this trend, there is also additionally growing demand for foods that meet the specific nutritional requirements of certain groups. As a result, light foods have been developed and are now widely available on supermarket shelves (Vieira; Soares; Carvalho, 2023). Foods with this designation have a minimum reduction of 25% in one or more of their constituents (sugars, total fats, saturated fats, sodium, or cholesterol) or in their total caloric value (Brasil, 2020a, 2020b, 2022c).

Within the context of healthy foods, fruit products have gained relevance and are prepared from whole or partial fruits or seeds, obtained through drying, dehydration, slicing, cooking, fermentation, concentration, freezing, or other safe technological processes used in food production; they may also contain a covering liquid and be covered (Brasil, 2022c).

Among fruit products, jams stand out, as they are derived from the technological processing of fruit juice free of suspended solids and, due to the balance among acid, pectin, and sugar, result in a gelled, consistent, and stable product. Jam production is widely used in food technology; however, some fruits remain underexploited for this type of processing (Alcarde; Regitano-D'arce; Spoto, 2019; Teles et al., 2017).

Among fruits with high processing potential, the genus *Spondias* deserves particular attention. This genus belongs to the Anacardiaceae family and comprises 18 species, six of which occur in Brazil. These are tropical fruit trees found in warm climate regions, notable for their nutritional value and economic potential, especially in extractivist areas. Among these species is the seriguela tree (*Spondias purpurea* L.), which is predominantly cultivated in home orchards (Silva e Lima; Meleiro, 2012).

Specifically, seriguela has been widely studied because of its nutritional value, as it contains vitamin C, is a source of dietary fiber and phenolic compounds, and presents moderate caloric and low-fat contents. It is generally sold fresh and, despite its relatively large pit, shows a pulp yield exceeding 50% (Da Silva; Agra, 2022; Neris; Loss; Guedes, 2017; Silva; Castro, 2025).

In this regard, promoting comprehensive scientific research on fruits from the Northeast region of Brazil is essential, as these fruits have high nutritional potential and allow for innovations in processing, adding value to food products. Moreover, the study of species such as seriguela contributes to the valorization of local biodiversity and to the development of products that meet market demands for healthier and more sustainable foods. The exploitation of these fruits also strengthens the regional economy, especially in communities dependent on family farming, and encourages the use of technologies that enhance the utilization of underexploited tropical fruits.

In this context, the development of processed products such as jams represents a viable alternative to increase fruit consumption, reduce post-harvest losses, and promote its economic valorization. Thus, this study proposes the development of light seriguela jam with different levels of sugar reduction, as well as the evaluation of the physicochemical and nutritional characteristics of the pulp and the jams obtained. The research aims to understand the process of producing seriguela-derived products and

to demonstrate the feasibility of this fruit as a raw material for higher-value-added products within the regional extractivist context.

Materials and methods

Type of study

The research is characterized as applied, with a quantitative approach, descriptive objectives, and an experimental design, since it involves the production of light seriguela jams and the physicochemical and nutritional characterization of the pulp and the final product based on different formulations with reduced sugar content. The study was performed in the Food Science laboratories of the Federal Institute of Education, Science, and Technology of Ceará (IFCE), Limoeiro do Norte *Campus*, Ceará, Brazil, Brazil, from April 2023 to September 2024.

Raw material acquisition and preparation of seriguela pulp

Seriguelas used for pulp processing and subsequent jam production were obtained from the rural area of the municipality of Iracema, in the state of Ceará, Brazil. The fruits were selected (removal of deteriorated, unripe, and unfit fruits), washed, and sanitized in a 200 ppm (parts per million) sodium hypochlorite solution for 15 minutes. Pulp extraction was performed manually by removing the peel and the seed; afterward, the product was passed through a sieve to obtain the pulp, which was then placed in previously sanitized containers, frozen, and stored in a freezer at $-18\text{ }^{\circ}\text{C}$ (Figure 1).

Figure 1 - Pulp preparation: fruit selection (A), sanitization (B), and seriguela pulps (C).



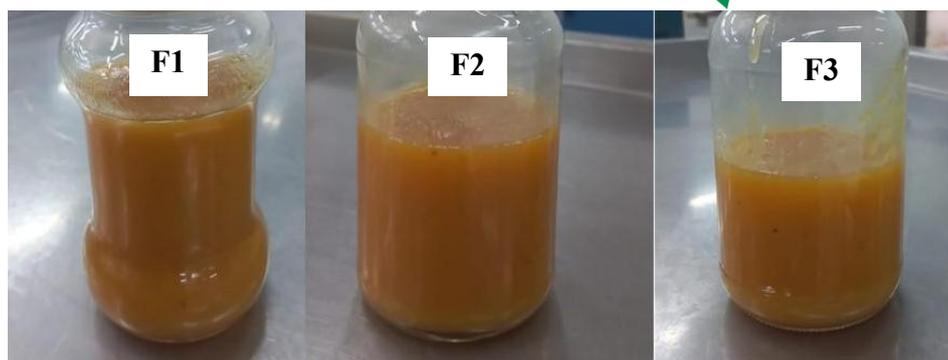
Source: Authors.

Preparation of seriguela jam

The light jams were prepared in accordance with Good Manufacturing Practices (GMP). An extra jam formulation (50 parts fruit and 50 parts sugar) was used as the basis for the three light seriguela jam formulations containing different sucrose reductions: F1 (25%), F2 (35%), and F3 (45%), all based on 50 parts of fruit. The concentrations of HM pectin (1%) and citric acid (0.2%) were kept constant for all formulations.

For jam preparation, the methodology described by Silva e Lima and Meleiro (2012) was followed, with minor adaptations. The final cooking point was determined based on achieving the desired soluble solids content, measured by refractometry, for each formulation: F1 $\leq 60\text{ }^{\circ}\text{Brix}$, F2 $\leq 55\text{ }^{\circ}\text{Brix}$, and F3 $\leq 50\text{ }^{\circ}\text{Brix}$, starting from the sucrose concentration. The jams were filled into glass containers, hermetically sealed, and cooled in ice water. Storage was carried out at room temperature until the analyses were performed between 7 and 15 days later. (Figure 2).

Figura 2 - Light seriguela jam formulations.



Source: Authors. F1, F2, and F3 correspond to light seriguela jam formulations with reductions of 25%, 35%, and 45% sucrose, respectively.

Yield of seriguela pulp and light seriguela jam

The pulp yield was determined as the ratio between pulp mass (kg) and fruit mass (kg), multiplied by 100. For jam yield, the equation used to determine the final yield in the manufacture of fruit preserves (mass sweets) and jams was applied (Vendruscolo, 1989).

$$P_G = \frac{(100 \times P_A) + (P_F \times B_F)}{B_G}$$

where P_G is the amount of jam to be obtained (kg); P_A is the weight of sugar used in the formulation (kg); P_F is the weight of fruit, pulp, or juice used in the formulation (kg); B_F is the soluble solids content of the pulp (°Brix); and B_G is the desired soluble solids concentration in the finished jam (°Brix).

Physicochemical analyses, proximate composition, and vitamin C

The pulp and the light seriguela jam formulations (F1, F2, and F3) were subjected to pH analysis by potentiometry using a Hanna Instruments® digital pH meter calibrated with pH 4.0 and 7.0 buffer solutions; titratable acidity (% citric acid) by volumetric titration with 0.1 M NaOH using 1% phenolphthalein as an endpoint indicator; soluble solids content (°Brix) using an Abbé digital benchtop refractometer (Optronic); moisture (%) by gravimetry in an oven at 105 °C; crude protein (%) by the Kjeldahl method using a conversion factor of 6.25; and ash (%) by incineration at 550 °C for 6 hr in a muffle furnace. Total carbohydrates were determined by difference (IAL, 2008).

Vitamin C was determined by titrimetry (AOAC, 2005), and the results were expressed as mg.100 g⁻¹.

Determination of macrominerals, microminerals, and metals

The samples were incinerated in a muffle furnace at 550 °C for 16 hr. The ashes were then digested with nitric chloride solution (5:1). Macrominerals Calcium (Ca) and Magnesium (Mg) and the microminerals Copper (Cu), Iron (Fe), Manganese (Mn), and Zinc (Zn) were determined by atomic absorption spectrophotometry (ICE 3300). The molybdenum blue colorimetric method was used for Phosphorus (P), and barium chloride turbidimetry was used for Sulfur (S) (Malavolta; Vitti; Oliveira, 1989). Metals were determined according to Standard Methods for the Examination of Water and Wastewater (Method 3120) (APHA, n.d.).

Determination of caloric value

The caloric value of the light seriguela jams was determined by calculating the mean amounts of carbohydrates, proteins, and lipids multiplied by 4-4-9 kcal g⁻¹, respectively, according to Atwater conversion factors (Brasil, 2020a).

Statistical analysis

Analyses of physicochemical characteristics were performed in triplicate. Data obtained from physicochemical and nutritional analyses were expressed as means and standard deviations and subjected to analysis of variance (ANOVA) and Tukey's test at a 5% significance level, using Statistica software, version 10.

Results and discussions

Seriguela pulp yield

The pulp yield of seriguela was 66.15%, which can be considered high. Neris, Loss, and Guedes (2017) reported a lower yield (47.10%) for seriguela (*Spondias purpurea* L.) harvested in Barra do Bugres, MT, Brazil. This difference may be attributed to variations in processing methods and fruit characteristics, such as extraction efficiency, moisture content, and stage of ripeness.

Physicochemical properties and nutritional characteristics of seriguela pulp

The physicochemical characterization of seriguela pulp (Table 1) indicates that it has an acidic pH (3.12), a condition favorable for microbiological stability and suitable for jam processing, since low pH values inhibit the growth of spoilage microorganisms and promote product preservation (Borges, 2023). Titratable acidity (0.72%) and the high soluble solids content (25.3 °Brix) are consistent with values reported in the literature and indicate fruit at an advanced stage of maturity, a desirable characteristic for processed products (Sobral et al., 2024; Neris, Loss; Guedes, 2017).

Table 1 - Physicochemical, proximate, and nutritional characterization of seriguela pulp.

| Parameter | Result | Parameter | Result |
|--|--------------|---|--------------|
| pH | 3.12 ± 0.00 | Proteins (%) | 0.14 ± 0.02 |
| Titratable acidity (mg citric acid.100 g ⁻¹) | 0.72 ± 0.00 | Lipids (%) | 0.43 ± 1.23 |
| Soluble solids (°Brix) | 25.3 ± 0.00 | Carbohydrates (%) * | 33.21 |
| Moisture (%) | 62.61 ± 0.27 | Caloric value (kcal.100 g ⁻¹) | 137.27 |
| Ash (%) | 3.61 ± 1.34 | Vitamin C (mg.100 g ⁻¹) | 16.47 ± 1.14 |

Source: Authors. Mean ± standard deviation (n = 3); *calculated by difference.

Regarding the proximate composition, a low protein and lipid content was observed, a typical profile for tropical fruits, as described by the TBCA (2025). The ash content (3.61%) indicates a significant presence of minerals, comparable to or higher than the values found in other tropical pulps, such as *cajá* and *umbu* (Silva et al., 2022). The high carbohydrate content (33.21%) contributes to the energy value of the pulp and is associated with the presence of natural sugars responsible for the characteristic flavor of seriguela. This is related to low moisture content, which may, in turn, be linked to the region's agronomic characteristics.

The caloric value of seriguela pulp was 137.27 kcal.100 g⁻¹, higher than that reported for other tropical pulps, such as *cajá*, which has a higher moisture content (86.78%), lower carbohydrate content (6.32%), and consequently a lower energy value (49.15 kcal.100 g⁻¹) (Silvino; Silva; Santos, 2017). This result can be attributed to the low moisture and the high carbohydrate contents observed in seriguela pulp.

Seriguela pulp showed a mean vitamin C concentration of 16.47 mg.100 g⁻¹, a value consistent with those reported for the fruit in different studies. Although lower than the value indicated by the TBCA (2025), which reports approximately 27.0 mg.100 g⁻¹, this difference may be attributed to variations in growing conditions, fruit ripeness stage, and analytical methods used.

Similar results were observed by Neris, Loss, and Guedes (2017), who reported values between 15.0 and 17.5 mg.100 g⁻¹, and by Barbosa et al. (2025), who found concentrations ranging from 14.8 to 18.3 mg.100 g⁻¹, corroborating the data of the present study and indicating the influence of the degree of ripeness on vitamin C

retention. Compared to other species of the genus *Spondias*, seriguela has a lower content than *cajá* (*Spondias mombin*), with about 26.6 mg.100 g⁻¹, and a higher content than *umbu* (*Spondias tuberosa*), with approximately 14.3 mg.100 g⁻¹ (TBCA, 2025).

From a nutritional standpoint, although seriguela is not a significant source of vitamin C, its consumption can contribute to the daily intake of this micronutrient when included in a diversified diet, helping to meet adult nutritional recommendations, considering the daily intake of 90 to 120 mg for adults (Institute of Medicine, 2000).

Overall, the results obtained confirm that seriguela pulp presents physicochemical, proximate, and nutritional characteristics suitable for processing, especially for jam production. The acidic profile, high soluble solids content, and the nutritional composition typical of tropical fruits reinforce its technological and nutritional potential, demonstrating the feasibility of its application in the development of food products.

Mineral composition of seriguela pulp

The mineral contents of seriguela pulp (Table 2) indicate relevant concentrations of Calcium, Magnesium, Potassium, Iron, and Phosphorus, which are essential minerals for the proper functioning of the human body. Calcium showed a mean concentration of 147.563 mg.kg⁻¹, higher than that reported for acerola and passion fruit pulps, indicating that seriguela stands out as an important source of this mineral (Chagas; Maradini Filho, 2020). Magnesium showed the highest concentration among the minerals evaluated (186.807 mg.kg⁻¹), although lower than the values observed in other species of the genus *Spondias*, a difference attributed to factors such as soil, cultivation environment, and stage of maturity (Freitas et al., 2024).

Table 2 - Mineral and metal characteristics of seriguela pulp determined by ICP-AES.

| Parameter (g.mg ⁻¹) | Mean ± SD | Parameter (g.mg ⁻¹) | Mean ± SD |
|---------------------------------|---------------------|---------------------------------|------------------|
| Aluminum (Al) | 0.3587 ± 0.1107 | Phosphorus (P) | 38.6697 ± 0.6239 |
| Boron (B) | 1.1777 ± 0.0095 | Potassium (K) | 2.1503 ± 0.0189 |
| Barium (Ba) | 0.3240 ± 0.0269 | Magnesium (Mg) | 18.6807 ± 0.2997 |
| Calcium (Ca) | 14.7563 ± 0.2646 | Manganese (Mn) | 0.4283 ± 0.0100 |
| Cadmium (Cd) | 0.000003 ± 0.000003 | Molybdenum (Mo) | 0.1280 ± 0.0183 |
| Lead (Pb) | 0.0036 ± 0.0040 | Nickel (Ni) | 0.3493 ± 0.2035 |
| Chromium (Cr) | 0.0297 ± 0.0006 | Selenium (Se) | 0.1143 ± 0.0150 |
| Copper (Cu) | 0.4740 ± 0.0165 | Sodium (Na) | 23.7130 ± 0.8459 |
| Strontium (Sr) | 0.2870 ± 0.0010 | Zinc (Zn) | 1.8920 ± 0.0254 |
| Iron (Fe) | 2.8790 ± 0.8648 | | |

Source: Authors. Mean ± standard deviation (n = 3). ICP-AES = Inductively Coupled Plasma - Atomic Emission Spectrometry.

Potassium was found at a concentration of 215.03 mg.kg⁻¹, a value similar to that observed in acerola pulps, indicating a relevant contribution to the intake of this mineral. The Iron content (28.790 mg.kg⁻¹) was higher than that reported for fruits such as guava and acerola, highlighting the potential of seriguela to complement the intake of this micronutrient (Silva et al., 2020; Nascimento Filho et al., 2022).

The levels of heavy metals, such as cadmium and lead, were low and below the limits established by legislation, indicating that the pulp is safe for consumption (Brasil, 2022a). Taken together, the mineral composition reinforces the nutritional value of seriguela fruit and its suitability for consumption and food processing.

General characteristics of light seriguela jam

The final soluble solids values, preparation time, and yield of light seriguela jam formulations with different sucrose reductions: F1 (25%), F2 (35%), and F3 (45%), are presented in Table 3. The measurement was performed immediately after preparation with the jam at room temperature.

Table 3 - Expected and final soluble solids content (°Brix), preparation time (min), and yield (%) of light seriguela jam formulations.

| Formulation | Expected soluble solids content (°Brix) | Final soluble solids content (°Brix) | Preparation time (min) | Yield (%) |
|-------------|---|--------------------------------------|------------------------|-----------|
| F1 | 60 | 59 | 12 | 57 |
| F2 | 55 | 54 | 10 | 62 |
| F3 | 50 | 50 | 10 | 67 |

Source: Authors. F1, F2, and F3 correspond to light seriguela jam formulations with reductions of 25%, 35%, and 45% sucrose, respectively.

The soluble solids contents obtained for the three formulations met the preestablished limits, indicating adequate control of the cooking process. This parameter is essential for the sweetness and final consistency of the jam, as it reflects the concentration of sugars, organic acids, and other solutes (Pinto et al., 2021). The seriguela pulp used had an initial content of 20 °Brix, a value considered in adjusting the formulations to achieve the desired final content, as well as the consistency and firmness of the product after cooling.

Formulation F1 showed a soluble solids content close to the established limit, a longer preparation time, and a yield of 57%, attributed to the higher solids concentration and the need for prolonged cooking. F2 reached 54 °Brix, with a higher yield (62%) and a shorter cooking time. In contrast, F3, with a lower soluble solids content (50 °Brix), reached the proposed limit, showed the highest yield (67%), and maintained the same preparation time, suggesting greater production efficiency associated with the lower sugar concentration.

Physicochemical properties and nutritional characteristics of light seriguela jam

The results of the physicochemical analyses and proximate composition of the light seriguela jam formulations are presented in Table 4. The progressive reduction of sucrose significantly influenced the evaluated parameters. Regarding pH and titratable acidity, F3 (45% reduction) did not differ from F1 (25% reduction). Formulation F2 showed the lowest pH and the highest acidity. Soluble solids contents decreased as sucrose was reduced, ranging from 58.66 °Brix (F1) to 52.00 °Brix (F3), a behavior expected for light products. Although these values are below the minimum of 65 °Brix established for conventional jams (Brazil, 1978), they are compatible with reduced-sugar formulations.

Table 4 - Physicochemical, proximate, and nutritional characterization of light seriguela jam.

| Parameter | Formulation | | |
|--|----------------------------|----------------------------|----------------------------|
| | F1 | F2 | F3 |
| pH | 3.23 ± 0.05 ^{ab} | 3.18 ± 0.01 ^b | 3.30 ± 0.00 ^a |
| Titratable acidity (mg citric acid 100 g ⁻¹) | 0.68 ± 0.01 ^{ab} | 0.72 ± 0.01 ^a | 0.67 ± 0.02 ^b |
| Soluble solids (° Brix) | 58.66 ± 0.57 ^a | 55.33 ± 0.57 ^b | 52.00 ± 1.00 ^c |
| Moisture (g 100 g ⁻¹) | 52.63 ± 1.06 ^a | 52.20 ± 1.83 ^a | 50.35 ± 1.20 ^a |
| Ash (g 100 g ⁻¹) | 0.58 ± 0.04 ^a | 0.62 ± 0.00 ^a | 0.63 ± 0.03 ^a |
| Proteins (g 100 g ⁻¹) | 0.004 ± 0.00 ^b | 0.007 ± 0.00 ^a | 0.007 ± 0.00 ^a |
| Lipids (g 100 g ⁻¹) | 0.26 ± 0.23 ^a | 0.22 ± 0.09 ^a | 0.17 ± 0.17 ^a |
| Carbohydrates (g 100 g ⁻¹) * | 46.53 ± 0.10 ^b | 46.95 ± 0.08 ^b | 48.84 ± 0.07 ^a |
| Caloric value (kcal 100 g ⁻¹) | 188.48 ± 0.43 ^c | 189.80 ± 0.25 ^b | 196.91 ± 0.15 ^c |

Source: Authors. F1, F2, and F3 light seriguela jam formulations with reductions of 25%, 35%, and 45% sucrose, respectively. * Calculated by difference. Mean ± standard deviation (n = 3). Different letters in the same line indicate that values are significantly different (p < 0.05).

The acidic pH observed (3.18-3.30) is within the typical range for jams, ensuring microbiological stability and product safety, as reported by Borges (2023) for

conventional and light tropical fruit jams. Comparatively, the soluble solids contents of light seriguela jams were higher than those reported by Sousa et al. (2020) for light *buriti* jams (30 °Brix), possibly due to the intrinsic characteristics of seriguela and the absence of alternative sweeteners in the formulation. In contrast, the soluble solids content was lower than that reported by Santos, Farinazzo and Benedetti (2024) for the prebiotic seriguela jam.

Regarding proximate composition, formulation F3 showed a lower moisture content ($50.35 \pm 1.2 \text{ g} \cdot 100 \text{ g}^{-1}$) and a higher carbohydrate concentration ($48.84 \text{ g} \cdot 100 \text{ g}^{-1}$), indicating a relative concentration of solids with sucrose reduction, as observed by Barros et al. (2019) and Pessutto and Colla (2021). Ash and protein contents increased slightly with sugar reduction, whereas lipids remained low and showed no significant variation ($p > 0.05$), a behavior similar to that described by Chen et al. (2020).

Comparatively, light seriguela jams presented lower moisture and higher carbohydrate contents than the mixed grape and passion fruit jam studied by Nascimento et al. (2020), which contributes to greater sweetness intensity and a more consistent texture. Lipid contents, although low, were higher than those observed in *mutamba* jams (Brito et al., 2023), while the low protein contents reflect the natural composition of seriguela (TBCA, 2025; Silva e Lima; Meleiro, 2012).

The energy values of formulations F1, F2, and F3 were 188.48, 189.81, and 196.92 kcal.100 g⁻¹, respectively, with the highest value observed for formulation F3 (45% sucrose reduction). This behavior is associated with the higher carbohydrate content of this formulation ($48.84 \text{ g} \cdot 100 \text{ g}^{-1}$), since carbohydrates constitute the main energy source of the product (4 kcal g⁻¹). The lower moisture observed in F3 also contributed to the relative concentration of solids and, consequently, to the increase in caloric value (Uribe-Wandurraga et al., 2021).

Similar results were reported by Sousa et al. (2020) for light *buriti* jams, although with a lower energy value (150 kcal.100 g⁻¹). Studies conducted by Jribi et al. (2021) show that sucrose reduction does not always result in a proportional decrease in caloric value, especially when there is a concentration of soluble solids or replacement with sugars of equivalent energy value.

The results demonstrate that sucrose reduction simultaneously influences the physicochemical, nutritional, and energy parameters of light seriguela jam while maintaining product stability and technological quality. In this context, the partial replacement of sucrose with low-calorie sweeteners, such as stevia, xylitol, or erythritol, emerges as a promising alternative for reducing caloric value, provided that sensory and technological properties are preserved (Nicolucia; Takehara; Bragotto, 2022). Additionally, the incorporation of functional ingredients may contribute to improving the nutritional profile of jams, expanding their technological and functional potential (Palachum; Klangbud; Chisti, 2023). Thus, the results indicate that although the formulations are classified as light, the caloric value remains influenced by the concentration of carbohydrates and total solids in the jam.

Mineral composition of light seriguela jam

The results of the macro and micromineral composition of the light seriguela jam formulations are presented in Table 5 and indicate that sucrose reduction significantly influenced the mineral concentration of the product. Statistically significant differences ($p < 0.05$) were observed for Phosphorus (P), Potassium (K), Sodium (Na), Magnesium (Mg), Iron (Fe), Zinc (Zn), and Copper (Cu) among the formulations, while Boron (B) did not show a significant variation. Formulation F3 stood out for presenting higher

concentrations of K, Na, and Cu, while F2 showed a higher Mg content, and F1 higher Fe and Zn contents.

Table 5 - Macro and micromineral composition of light seriguela jam.

| Mineral | F1 | F2 | F3 |
|-----------------------|---------------------------|----------------------------|----------------------------|
| Phosphorus (P)(g.kg) | 0.22 ± 0.010 ^b | 0.25 ± 0.005 ^a | 0.25 ± 0.010 ^a |
| Potassium (K) (g.kg) | 2.90 ± 0.000 ^c | 3.26 ± 0.050 ^b | 3.40 ± 0.000 ^a |
| Magnesium (Mg) (g.kg) | 0.11 ± 0.000 ^b | 0.12 ± 0.000 ^a | 0.80 ± 0.000 ^c |
| Sulfur (S) (g.kg) | 0.28 ± 0.005 ^a | 0.23 ± 0.000 ^b | 0.28 ± 0.005 ^a |
| Iron (Fe) (mg.kg) | 102 ± 0.000 ^a | 95 ± 0.005 ^b | 95 ± 0.010 ^b |
| Zinc (Zn) (mg.kg) | 27 ± 0.000 ^a | 25.33 ± 0.570 ^b | 17 ± 0.000 ^c |
| Copper (Cu) (mg.kg) | 2 ± 0.000 ^b | 1.33 ± 0.570 ^b | 4.00 ± 0.000 ^a |
| Boron (B) (mg.kg) | 2 ± 0.000 ^a | 2 ± 0.000 ^a | 2 ± 0.000 ^a |
| Sodium (Na) (mg.kg) | 38 ± 0.570 ^c | 45.66 ± 1.730 ^b | 48.00 ± 1.150 ^a |

Source: Authors. F1, F2, and F3 light seriguela jam formulations with reductions of 25%, 35%, and 45% sucrose, respectively. Mean ± standard deviation (n = 3). Different letters in the same line indicate that values are significantly different (p < 0.05).

The higher mineral concentration observed in F3 may be related to the lower moisture content and the resulting concentration of solids, in addition to the intrinsic characteristics of the seriguela pulp used, which is naturally rich in minerals such as Potassium and Magnesium. Although thermal processing may cause nutritional losses, some minerals tend to be relatively stable during cooking, depending on process control and interaction with sucrose, which can contribute to the retention of these nutrients (Amit et al., 2017).

Similar results have been reported in studies on reduced-sugar jams. Adetoro, Uchechi, and AmadiKwa (2022), when evaluating *Spondias mombin* jams, among other reduced-sugar formulations, identified significant variations in P, K, and Zn contents, reinforcing the impact of processing and formulation on the mineral profile.

Final considerations

Seriguela pulp showed physicochemical characteristics suitable for jam processing and relevant levels of essential minerals and vitamin C. The production of light jam with reduced sucrose proved to be technically feasible, preserving key quality parameters, such as acidity and soluble solids, although sugar reduction promoted variations in proximate composition.

The results indicate that the pulp is the main source of minerals in the jam and that, despite thermal losses, these nutrients were maintained at nutritionally significant levels. The formulation with a 45% sugar reduction stood out for presenting the best nutritional balance, combining lower sucrose addition with the retention of essential minerals.

Overall, the study highlights the potential of seriguela as a raw material for the development of light jams, contributing to the valorization of native fruits and the diversification of products aligned with healthy consumption, although further studies are needed to improve the technological aspects and sustainability of the process.

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