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TAPEREBA FRUITS: A COMPARATIVE PHYSICAL-CHEMICAL ANALYSIS

FRUTOS DE TAPEREBA: UMA ANÁLISE FÍSICO-QUÍMICA COMPARATIVA

FRUTOS DE TAPEREBA: UN ANÁLISIS FÍSICO-QUÍMICO COMPARATIVO

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ABSTRACT
Brazil is a country rich in both animal and plant biodiversity. The Brazilian Amazon, located across a large portion of the country, especially in its northern region, is entirely contained within the Amazon. It is the most important ecosystem in terms of biodiversity, with a variety of tropical fruits. Among these fruits is the taperebá, a highly prized fruit in the region and throughout Brazil. This fruit is consumed fresh or in a variety of ways: juices, creams, cakes, among many others. This study sought to characterize fresh and frozen taperebá pulps for one year to contribute to their characterization. It also employed statistical techniques to determine whether the studied variables varied according to whether the pulp was fresh or frozen. The physicochemical variables proved to be independent of whether the samples were fresh or frozen, except for the pH of the pulps, which also demonstrated moderate acidity. On the other hand, the physical variables of the fruits were significantly different, except for pulp and seed mass, and longitudinal diameter. Statistical techniques were unable to discriminate the samples according to pulp type. Overall, all the pulps investigated were of good physical and chemical quality.

Keywords: Amazon. Alcoholic Beverages. Tropical Fruits. Chemical Properties.

RESUMO
O Brasil é um país de rico em biodiversidade, tanto animal quanto vegetal, sendo que Amazônia brasileira, situada em boa parte do território nacional principalmente na sua Região Norte, que é totalmente contida na Amazônia, o principal ecossistema em termos de riqueza em biodiversidade, com destaque para diversas frutas tropicais. Dentre essas frutas se tem o taperebá, que é uma fruta muito apreciada na região e no Brasil todo.

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Esta fruta é consumida in natura ou de diversas maneiras: sucos, cremes, bolos, dentre muitas outras formas. O presente trabalho buscou caracterizar polpas de taperebá frescas e congeladas por um ano, para contribuir com sua caracterização, além de empregas técnicas estatísticas com a intenção de averiguar a variação ou não das variáveis estudadas de acordo com o fato de ser a polpa fresca ou congelada. As variáveis físico-químicas se mostraram não depender de serem amostras frescas ou congeladas, exceto o pH das polpas, que também demonstraram serem meios de acidez moderada. Por outro lado, as variáveis físicas dos frutos eram significativamente distintas entre si, exceto a massa de polpa e de semente, e o diâmetro longitudinal. As técnicas estatísticas não foram capazes de descriminar as amostras de acordo com o tipo de polpa. De modo geral, todas as polpas investigadas se mostraram de boa qualidade físico-química.

Palavras-chave: Amazônia. Bebidas Alcóolicas. Frutas Tropicais. Propriedade Químicas.

RESUMEN
Brasil es un país rico en biodiversidad animal y vegetal. La Amazonia brasileña, que abarca gran parte del país, especialmente en su región norte, está completamente integrada en ella. Es el ecosistema más importante en términos de biodiversidad, con una gran variedad de frutas tropicales. Entre estas frutas se encuentra el taperebá, una fruta muy apreciada en la región y en todo Brasil. Esta fruta se consume fresca o en diversas presentaciones: jugos, cremas, pasteles, entre muchas otras. Este estudio buscó caracterizar pulpas de taperebá frescas y congeladas durante un año para contribuir a su caracterización. También se emplearon técnicas estadísticas para determinar si las variables estudiadas variaban según si la pulpa estaba fresca o congelada. Las variables fisicoquímicas resultaron ser independientes de si las muestras estaban frescas o congeladas, excepto el pH de las pulpas, que también presentó una acidez moderada. Por otro lado, las variables físicas de las frutas fueron significativamente diferentes, excepto la masa de pulpa y semilla, y el diámetro longitudinal. Las técnicas estadísticas no lograron discriminar las muestras según el tipo de pulpa. En general, todas las pulpas investigadas presentaron buena calidad física y química.

Palabras clave: Amazonas. Bebidas Alcohólicas. Frutas Tropicales. Propiedades Químicas.

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1 INTRODUCTION

Biodiversity is defined according to the Convention on Biological Diversity (CBD) as the diversity among beings, populations and taxonomic groups of biological individuals, who through their daily interactions adapt to ecosystems, evolving to diverse climates, reliefs, generating new species (Joly *et al*., 2011).

As for the presence of biodiversity of species of fauna and flora, Brazil is classified as the main country, both in relation to biological diversity and the number of endemic species (species that are found in strategic places of nature), because Brazilian biodiversity has an immense potential of natural and biogenetic resources, especially in the Amazon region, in addition to serving as the basis of support for the local population that has access to these resources (Campos *et al*., 2012).

The taperebá, whose scientific name is *Spondias mombin* L., is a tropical fruit species, common in the Amazon region and which belongs to the *Anacardiaceae* family, the same as cashew and mango, being known regionally as cajá, cajá-mirim, cajá verdade or taperebá. Its fruits have aromatic pulp, sweet and sour flavor and contain high nutritional value, rich in carotenoids, vitamin C and total sugars (Magalhães, 2013).

The taperebazeiro is one of the largest species of *Spondias*, which can reach up to 30 m in height (Figure 1) and trunk diameter of up to 80 cm, with rough and thick bark (2.0 to 2.5 cm), and its leaves are compound, alternate and pinnate, and the inflorescences can have more than 2000 flowers, usually pollinated by bees.

Figure 1

Taperebá tree (Spondias mombin L)

Source: The authors (2025).

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The pulp of taperebá is rich in vitamins A, B1, B2 and C, proteins, lipids, calcium, phosphorus and iron, and is widely used by the industry for the manufacture of juices, popsicles, ice cream, jellies and liqueurs, and, despite the significant potential of the species, most of the production still comes from extractivism, due to the absence of commercial plantations.

The species has socioeconomic relevance for local communities, being consumed in natura or processed in the form of juices, ice cream, jellies, liqueurs and other derivatives. However, production is extractive, with few commercial orchards, limiting the supply to agroindustries (De Quadros, 2013).

There is still scarce information on fresh pulps of taperebá (*Spondias mombin* L), especially in physical and physicochemical terms, thus, the present study focused on analyzing in physical and physicochemical terms, taperebá fruits from a locality in the State of Pará, considering fresh fruits and fruits kept frozen for one year.

2 METHODOLOGY

2.1 ACQUISITION OF TAPEREBÁ FRUITS

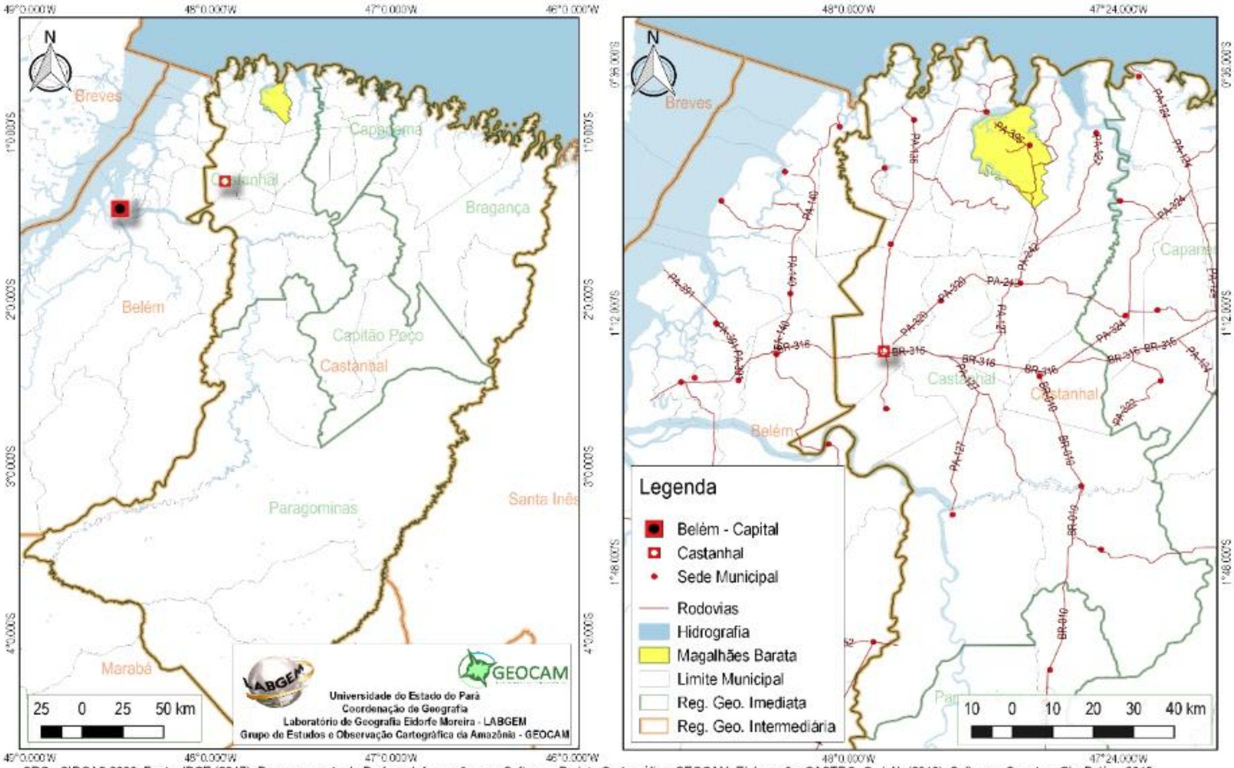
The samples were collected from a single location, during the month of May 2025, and 20 natural fruits of a tree and 20 fruits of taperebá (*Spondias mombin* L.) that had been frozen for one year and that had been collected from another taperebazeiro were collected. All 40 fruits came from Magalhães Barata, a municipality in the State of Pará (Figure 2), and were located in a site, whose geographic coordinates are 00°47'38" latitude to the South and longitude 47°35'55" to the West.

Fresh (or natural) fruits were labeled from N1 to N20, while frozen fruits were coded from C1 to C20.

After collection, the 40 fruits were taken to the Laboratory of Physics Applied to Pharmacy (LAFFA) of the Federal University of Pará (UFPA), where they were washed with distilled water and sanitized, and then dried properly and refrigerated until their analyses were carried out.

Figure 2

Location of the municipality of Magalhães Barata-PA



SRC - SIRGAS 2000; Fonte: IBGE (2017); Processamento de Dados e Informações em Software; Projeto Cartográfico: GEOCAM. Elaboração: CASTRO, C. J. N. (2018). Software: Quantum Gis. Belém: 2018.

Source: Castro, Gonçalves and Barros Filho (2020).

2.2 PHYSICAL ANALYSES OF THE FRUITS

The physical characterizations of taperebá fruits carried out were: fruit mass (pulp and peels, together), seed or stone mass; fruit dimensions (longitudinal and transverse diameter), pulp yield, and ratio between diameters, following techniques already described in the literature (Netor *et al*., 2024; Paixão *et al*., 2024).

The transverse diameters (TD), measured in the widest part of the fruit, and the longitudinal diameters (DL), were evaluated using a caliper (Figure 3), and their results were expressed in centimeters (cm), and from the results of TD and DL, the LD/TD ratio was found by dividing these values.

The total mass of the fruits and the mass of the pits were obtained by weighing on a semi-analytical scale, with results expressed in grams (g). The pulp mass (along with the peel, which is consumed together with the pulp) was determined separately after pulping the 40 fruits.

The pulp yield was obtained by equation (1), where DM is the seed mass and MT is the total fruit mass.

$$\text{Pulp Yield (\%)} = \frac{MT - MS}{MT} \, .100\% \quad (1)$$

Figure 3

Use of caliper in the determination of diameters of taperebá fruits

Source: The authors (2025).

The determination of the volume of the fruits was carried out by partially filling a 250 mL beaker with distilled water, recording the exact volume contained in the beaker, and then inserting the fruit, which displaces the volume of water inside the beaker, and then the volume of the fruit was found by subtracting the volume read after the insertion of the fruit and the volume of water.

Finally, the density of the fruit was obtained by dividing its mass by its volume, being expressed in g/mL.

2.3 PHYSICOCHEMICAL ANALYSIS OF FRUIT PULPS

The physicochemical analyses were developed following official methodologies and widely used (Adolfo Lutz, 2008; AOAC, 2016), in triplicate.

For the determinations of pH and electrical conductivity (EC), around 1.5 g of taperebá pulp were weighed and 30 mL added to a 150 mL Becker, stirring for 15 minutes. After obtaining a homogeneous solution, the pH was measured by inserting a pH meter electrode (PHTEK), previously calibrated with pH 4 and 7 buffer solutions, directly into the solution and the value read directly from the device's display. On the other hand, the EC was obtained by inserting the electrode of a portable conductivity meter, previously calibrated with a solution of 14.3 μS/cm, into the solution and directly reading on the device's display.

The pulp density was measured by filling a 10 mL vial with the pulp/bark of the taperebá and the density was calculated by dividing the mass by the volume.

To determine the moisture content of the pulp/bark of the taperebá, an amount of around 1 g was weighed (MI) on a semi-analytical scale, using a porcelain casserole of known mass (MC) that was placed to dry in an oven kept at 105º C until a constant mass (MF) was obtained. Moisture was obtained through equation (2).

$$Humidity\ (\%)\ = 100 - \left(\frac{MF - MC}{MI}\right).100 \qquad (2)$$

The total soluble solids (TSS) content was measured using a portable refractometer (Instrutherm, model ATAGO 090), previously calibrated, and the TSS values were read directly on the internal scale of the device, in degrees Brix.

To determine the acidity of the taperebá pulp/peel, 1 g of sample was weighed in a 100 mL Erlenmeyer and 30 mL of distilled water was added, followed by stirring for 15 minutes to homogenize the solution. After this time, the solution obtained was titrated with a 0.1 mol/L NaOH solution until the appearance of a pink color, then the base volume was noted, and 3 to 4 drops of phenolphthalein were used as an indicator. Acidity was found through equation (3), where f is the correction factor of the NaOH solution, C is the concentration of the NaOH solution, and V is the base volume consumed in the titration.

$$Acidity\ (\%)\ = \frac{V.C.f.100}{m} \qquad (3)$$

To determine the ratio of each sample of pulp and bark of taperebá, the TSS value was divided by the respective acidity value.

2.4 STATISTICAL TREATMENT

All tests were performed in triplicates, and the data obtained were organized in electronic spreadsheets via Excel, and basic descriptive statistical analyses (means, standard deviations, coefficients of variation, maximum and minimum values) were performed, as well as Student's t-tests for comparison between the two sample groups (fresh and frozen pulps) and box-plot graphs performed using the MINITAB 18 program. Two multivariate techniques were also performed: principal component analysis (PCA) and hierarchical cluster analysis (AHA), using MINITAB 18.

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3 RESULTS AND DISCUSSIONS

3.1 PHYSICAL CHARACTERISTICS OF TAPEREBÁ FRUITS

Table 1 shows the results for the physical tests of the taperebá (*Spondias mombin L*) samples. Mean values and standard deviation (SD), Pearson's coefficient of variation (CV), maximum and minimum values obtained for each of the investigated variables are presented, corresponding to twenty fresh (or natural) fruits, named in the present study as N1 to N20, and 20 frozen fruits, named from C1 to C20. In turn, the box-plot graphs present in Figures 4 and 5 present the variability or dispersion of the physical variables studied and visually compare the values of these variables in terms of the two groups of samples.

Table 1

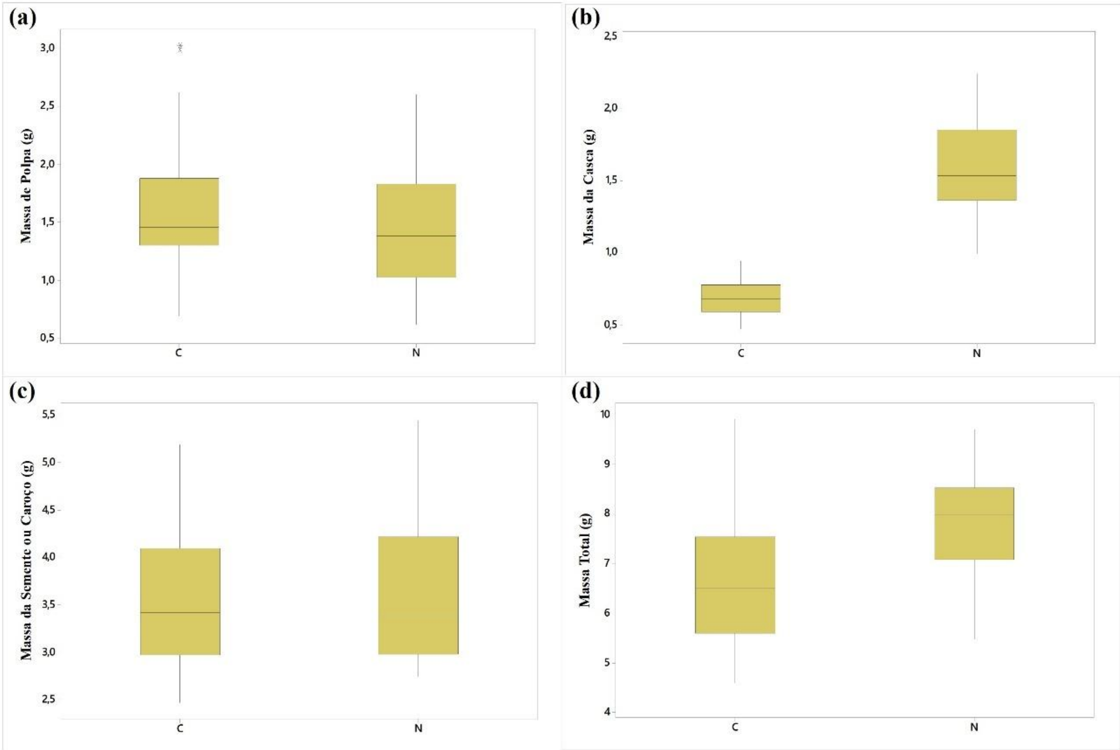
Results of the physical variables of taperebá fruits

Statistics	Mass (g)				PR (%)	Volume (mL)	Density (g/mL)	Diameter (cm)		Reason DL/DT
Samples from N1 to N20										
	Total	**Pulp**	**Seed**	**Bark**				**L**	**T**	
Average	8,05	1,44	3,63	1,59	45,44	8,00	1,001	3,10	2,31	1,34
Detour	1,47	0,48	0,76	0,32	3,84	1,37	0,138	0,26	0,22	1,15
CV	18,28	33,22	21,03	20,32	8,45	17,16	13,773	8,32	9,69	0,86
Maximum	11,28	2,608	4,901	2,241	53,52	10,00	1,341	3,43	2,96	1,16
Minimum	5,47	0,619	2,741	0,996	39,26	6,00	0,817	2,64	1,95	1,35
Samples from C1 to C20										
Statistics	**Mass (g)**				**PR (%)**	**Volume (mL)**	**Density (g/mL)**	**Diameter (cm)**		**Reason DL/DT**
	Total	**Pulp**	**Seed**	**Bark**				**L**	**T**	
Average	6,66	1,61	3,60	0,69	38,48	5,35	2,487	3,14	1,64	1,92
Detour	1,47	0,62	0,75	0,13	4,43	4,12	2,039	0,27	0,19	1,44
CV	22,24	38,83	20,91	19,17	11,51	77,01	81,974	8,57	11,42	0,75
Maximum	9,92	3,026	5,196	0,943	50,73	13,00	6,292	3,71	1,99	1,86
Minimum	4,59	0,907	2,474	0,475	32,58	1,00	0,534	2,53	1,26	2,01
p-value	**0,005**	**0,366**	**0,887**	**0,000**	**0,000**	**0,009**	**0,004**	**0,647**	**0,000**	**0,000**

Legend: PR = Pulp Yield; L = longitudinal; T = transverse. P-values < 0.05 indicate a significant difference between fresh and frozen pulps, considering a significance of 95%, according to Student's t-test.
Source: Authors (2025).

Figure 4

Box-plot plots for the variables related to fruit masses



Source: The authors (2025).

The average total mass of the fruits that were not frozen was 8.05 g and that of those that were frozen for one year was 6.66 g, and these averages were significantly different from each other, according to the p-value given in Table 1, and, in addition, there was a large oscillation of values, indicated by the auto CV (Table 1) and by the very dispersed box in Figure 4 (d). Thus, frozen fruits showed to have less mass than non-frozen fruits. According to da Silva *et al*. (2021), citing Bosco *et al*. (2000), taperebá fruits can be classified in terms of the size of their fruit, based on their total masses, and values equal to or above 15 g allow the fruits to be classified as being of the "large" type; between 12 g and 15 g as medium and less than 12 g small. And then the fruits of the present labor would be of the "small" kind.

The average pulp mass was equal to 1.44 g and 1.63 g, respectively, for fresh and frozen fruits, and these values were not significantly different from each other, according to the p-value contained in Table 1 and through the visualization of the box-plot in Figure 4 (a). These results are linked to the pulp yield results (Table 1), which were 45.44 % (fresh fruits) and 38.48 % (frozen fruits).

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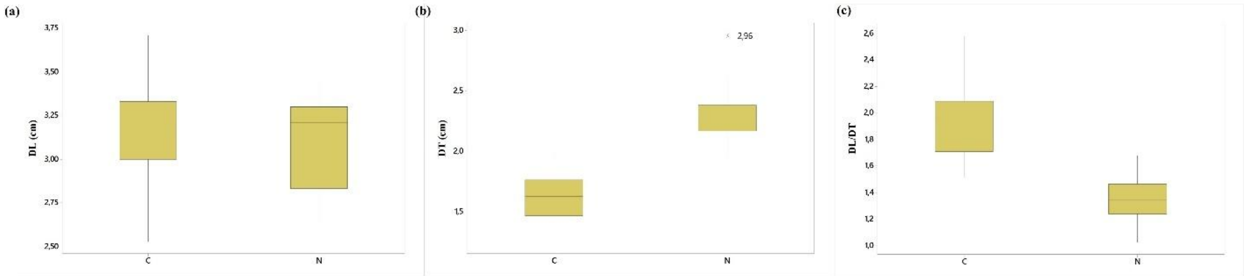
The average seed mass was equal to 3.63 g and 3.60 g, respectively, for fresh and frozen fruits, and these values were not significantly different from each other, according to the p-value contained in Table 1 and through the visualization of the box-plot in Figure 4 (c). On average, taperebá seed corresponded to 45.09 % (fresh fruits) and 54.04 % (frozen fruits), being the largest component of the fruit.

The average peel mass was equal to 1.59 g and 0.69 g, respectively, for fresh and frozen fruits, and these values were shown to be significantly different from each other, according to the p-value contained in Table 1 and through the visualization of the box-plot in Figure 4 (b). On average, taperebá peel corresponded to 19.75 % (fresh fruits) and 10.36 % (frozen fruits), being the smallest component of the fruit.

Figure 5

Box-plots for the variables related to fruit diameters



Source: The authors (2025).

The mean LD for fresh fruits was 3.10 cm and for frozen fruits it was 3.14 cm, with no significantly different values and with great dispersion of values, indicated by the wide boxes in Figure 5 (a). These values are within the range of 2.66 cm to 3.24 cm, with an average of 2.97 cm, obtained by Marques *et al*. (2017), who investigated biometric characteristics of taperebá fruits from Boa Vista, Roraima. In addition, the fruits of the present study would, on average, be categorized as "large", according to the study cited.

The mean TD for fresh fruits was 2.31 cm and for frozen fruits was 1.64 cm, with significantly different values from each other, and with less variation, according to the graph in Figure 5 (b). The values referring to non-frozen fruits are within the range of 2.09 cm to 2.54 cm, with an average of 2.30 cm, obtained by Marques *et al*. (2017), however, the values for frozen fruits are lower.

The mean LD/TD ratio was 1.34 and 1.92, respectively for fresh and frozen fruits, and these values were significantly different. These values lead to an oblong shape of the fruits.

3.2 PHYSICOCHEMICAL CHARACTERISTICS OF TAPEREBÁ PULPS

Studies on genetic diversity and the level of genetic differentiation among species populations are essential to define genetic stocks and support policies for the exploration and management of these resources, as well as to outline conservation strategies at regional and geographic scales, in addition to maintaining the natural capacity to respond to climate change and all types of biotic and abiotic stresses (Cruz *et al*., 2011). In addition, the knowledge and organization of the genetic variability of any plant species is also an important tool for extractive exploitation, genetic conservation and genetic improvement of the species (Magalhães *et al*., 2013).

Table 2 shows the results for the physicochemical analyses of the samples of taperebá pulp (*Spondias mombin L.*). Mean values and standard deviation (SD) are presented, corresponding to triplicate analyses for the 20 fresh samples and for the 20 frozen samples, in addition to Pearson's coefficient of variation (CV), maximum and minimum value found, the p-values of the Student's t-test.

The data obtained show that only the pH variable was significantly different between the two sample groups (p-value < 0.050), indicating that the freezing of taperebá pulp samples for one year does not influence the physicochemical variables investigated, except for the pH of the samples, and that the aging of the samples under freezing causes a reduction in acidity, which, in terms of pH, meant an increase from 4.03 to 4.13, or an increase of 0.10 (or 2.48% increase). The same occurred with acidity, which went from 29.14% to 28.02%, corresponding to a decrease of 1.12% in acidity (or 3.84% in relation to the acidity of fresh pulps).

Table 2

Physicochemical results of taperebá pulps

Sample from N1 to N20							
Statistics	**ph**	**EC (ms/cm)**	**Density (g/mL)**	**OSH (° Brix)**	**Acidity (%)**	**Ratio**	**Moisture (%)**
Average	4,03	1,07	1,157	9,23	29,14	0,34	90,06
Detour	0,08	0,01	0,144	0,00	1,31	0,03	1,27
CV	1,95	1,38	12,487	0,00	4,67	9,87	1,41
Maximum	4,13	1,09	1,600	10,00	29,60	0,38	91,92

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Minimum	3,94	1,05	0,970	9,00	26,20	0,30	88,37
Sample from C1 to C20							
Statistics	**ph**	**EC (ms/cm)**	**Density (g/mL)**	**OSH (° Brix)**	**Acidity (%)**	**Ratio**	**Moisture (%)**
Average	4,13	1,09	1,149	9,50	28,02	0,34	90,47
Detour	0,04	0,07	0,081	0,50	0,75	0,02	0,99
CV	1,03	5,18	7,066	5,26	2,67	7,47	1,09
Maximum	4,23	1,19	1,380	10,00	29,20	0,37	91,35
Minimum	4,09	1,04	1,030	9,00	26,90	0,31	89,26
p-value	**0,000**	**0,183**	**0,826**	**1,000**	**0,725**	**0,954**	**0,376**

Legend: CE = electrical conductivity; TSS = total soluble solids. P-values < 0.05 indicate a significant difference between fresh and frozen pulps, considering a significance of 95%, according to Student's t-test.
Source: Authors (2025).

The mean pH was 4.03 (fresh pulps) and 4.13 (frozen pulps). These averages are higher than the average value of 2.59 found for taperebá pulps from Amapá, by Bezerra, Barros Neto and da Silva (2010) and outside the range between 3.35 and 3.42 found by da Silva *et al*. (2021), in addition to being higher than the values of 2.38 and 2.53 obtained from Santos *et al*. (2024) for taperebá pulps from Cametá, Pará. The national legislation establishes a minimum of 2.2 (Brasil, 2018), so the results obtained are in accordance with the legislation.

The mean EC were 1.07 mS/cm (fresh pulps) and 1.09 mS/cm (frozen pulps). This variable is not regulated by national legislation (Brasil, 2018).

The average density of the pulps was 1.157 g/mL (fresh pulps) and 1.149 g/mL (frozen pulps). This variable is not regulated by national legislation (Brasil, 2018).

The TSS averages were 9.23º Brix (fresh pulps) and 9.50º Brix (frozen pulps). These values are close to the mean of 10.63º Brix found by Bezerra, Barros Neto and da Silva (2010) and close to the range of values obtained by da Silva *et al*. (2021), which was between 9.70º Brix and 10.54º Brix. The legislation stipulates a minimum value of 9.00o Brix (Brazil, 2018), so the TSS values of the samples are in accordance with national legislation.

The average titratable acidity was 29.14 % (fresh pulps) and 28.02 % (frozen pulps). These values are much higher than the average of 1.14% found by Bezerra, Barros Neto and da Silva (2010) and the range between 1.53% and 2.00% found by da Silva *et al*. (2021).

The mean ratios were both 0.34. This value is almost half of the average found by Bezerra, Barros Neto and da Silva (2010), which was 0.61 and higher than the range of 0.05 and 0.07 obtained by da Silva *et al*. (2021). This variable is not regulated by national legislation (Brasil, 2018). A ratio of less than 1 indicates that the acidity of the fruit predominates over the sugar content (represented by the TSS), leading to a more pronounced feeling of "sourness" than the feeling of "sweetness".

The average moisture content was 90.06 % (fresh pulps) and 90.47 % (frozen pulps), which are higher than the average of 88.20 % found by Bezerra, Barros Neto and da Silva (2010). These values are close to the range between 93.07% and 96.37% obtained by Santos *et al*. (2024). This variable is not regulated by national legislation (Brasil, 2018).

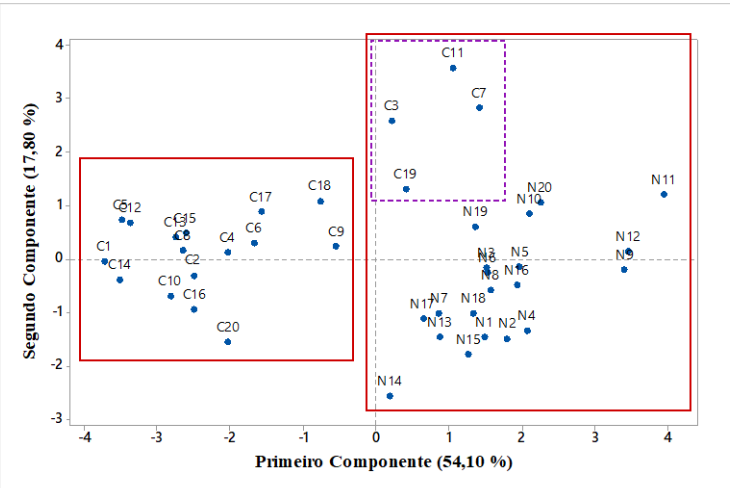
3.3 MULTIVARIATE RESULTS

The application of the principal component analysis technique generated the graph of the first two principal components given in Figure 6 and Table 3, which contains the information on the weights assigned to each variable for the formation of the principal components (PCs).

The first two major components together explain 83.90% of the variability of the data, being, therefore, sufficient for the description of the data, and the technique used was not able to separate the samples into two groups consisting of only samples from one group. There was the formation of a dispersed group, formed by samples of taperebá pulps that had been frozen for one year, on the left of the graph, but on the right the group formed contains samples of fresh taperebá pulps, but also a subgroup of samples of frozen pulps, being, therefore, a heterogeneous group in terms of the type of pulp.

Figure 6

Chart of the two main components



Source: The authors (2025).

In terms of forming variables, TD was the most important for the formation of the 1st main component, with a weight of 0.419 (Table 3), but almost all other variables, except pH and pulp mass, presented considerable and almost equal weights for the formation of the 1st main component, so all these variables are indispensable for the formation of this PC.

Table 3

Eigenvalues and eigenvectors associated with the formation of principal components

Variable	CP1	CP2	CP3	CP4	CP5	CP6	CP7	CP8	CP9
DT (cm)	0,419	-0,134	0,246	0,036	-0,152	-0,212	-0,245	-0,766	-0,173
DL/DT	-0,365	0,300	-0,226	-0,263	0,194	0,576	0,039	-0,527	-0,089
Total Mass (g)	0,342	0,369	0,188	-0,550	-0,032	0,017	-0,127	0,059	0,623
Fruit Volume (mL)	0,351	0,213	-0,492	0,041	-0,190	-0,175	0,707	-0,145	0,019
Pulp Density (g/mL)	-0,307	0,026	0,667	-0,159	0,164	-0,224	0,585	-0,113	-0,043
Pulp Mass (g)	0,156	0,717	0,078	0,036	0,234	-0,214	-0,181	0,179	-0,538
Peel Mass (g)	0,380	-0,206	0,219	-0,324	-0,275	0,531	0,167	0,256	-0,457
Pulp yield (%)	0,343	0,111	0,258	0,627	0,360	0,443	0,136	-0,014	0,256
ph	-0,263	0,376	0,212	0,319	-0,784	0,132	-0,037	-0,016	0,090

Source: The authors (2025).

In terms of the second principal component, the variable pulp density presented a low weight for the formation of the second principal component, only 0.026 (Table 3), so this variable is not very relevant for this component, with the variable Pulp Pass being the one with the highest weight (0.717), that is, this variable can be considered as the one with the greatest influence on the dispersion of samples within the right-hand grouping, and in the formation of the subgroup of frozen pulp samples.

The application of the hierarchical cluster analysis (AHA) technique to standardized data and considering Euclidean distances and simple clusters generated the dendrogram in Figure 7.

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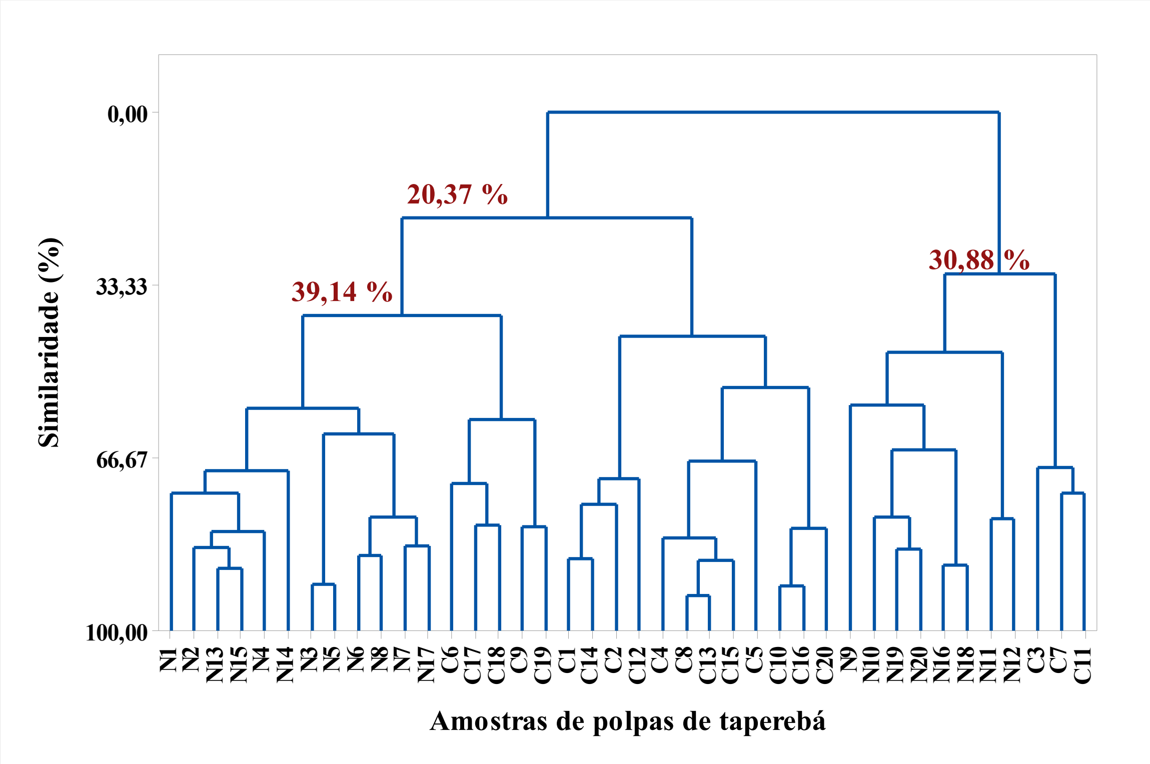
Figure 7

Dendrogram for the studied taperebá pulp samples



Source: The authors (2025).

The dendrogram in Figure 7 shows that there are similarities between fresh and frozen taperebá pulp samples, since two groups of samples with 0% similarity were not formed that were formed exclusively by fresh pulp and frozen pulp samples. Thus, the AHA technique was unable to discriminate the samples according to their type.

4 CONCLUSION

The taperebá fruits showed a good pulp yield, in addition to a reasonable peel yield, which, as this peel is edible, leads to a good use of the fruits for human consumption, but the seeds or pits make up a higher percentage of the fruits, indicating that it would be good to study the use of this part of the fruits.

The relationship between longitudinal and transverse diameters, DL/DT, showed that taperebá fruits can be classified as oblong.

The aging process of taperebá pulps under freezing leads to a small reduction in its acidity, evidenced by the increase in pH and reduction of titratable acidity, which leads to a weakening of the medium to microbiological attack, making the pulps more susceptible to the development of microorganisms such as fungi and bacteria.

The physicochemical properties studied were in accordance with the legal recommendations and in line with the results of other studies, although there are few articles on such variables in fruits and pulp of taperebá.

The multivariate techniques, associated with the data obtained, were not able to perform a separation or discrimination of samples according to the type of pulp (fresh and frozen), indicating, perhaps, that the freezing process does not appreciably alter the variables investigated,

REFERENCES

Adolfo Lutz. (2008). Métodos físico-químicos para análise de alimentos (4th ed.). São Paulo, Brazil: Instituto Adolfo Lutz.

Aniceto, A. (2017). Desenvolvimento e caracterização físico-química e sensorial de bebidas à base de murici e taperebá [Master's dissertation, Universidade Estadual Paulista "Júlio de Mesquita Filho"]. Repositorio Institucional UNESP.

AOAC. (2016). Official methods of analysis of the Association of Official Analytical Chemists (20th ed.). Gaithersburg, MD: AOAC International.

Bezerra, V. S., Barros Neto, E. L., & da Silva, R. A. (2010). Características físico-químicas de frutos de taperebá (Spondias mombin L.) coletados em área de ocorrência de mosca-das-frutas. In IV Jornada Nacional da Agroindústria, Bananeiras, Brazil.

Brasil, Ministério da Agricultura e do Abastecimento. (2018). Regulamento técnico geral para fixação dos padrões de identidade e qualidade para sucos e polpas de frutas (Instrução Normativa nº 37). Diário Oficial da União, Brasília, Brazil.

Campos, W. H., Miranda Neto, A., Peixoto, H. J. C., Godinho, L. B., & Silva, E. (2012). Contribuição da fauna silvestre em projetos de restauração ecológica no Brasil. Pesquisa Florestal Brasileira, 32(70), 429–440. https://doi.org/10.4336/2012.pfb.32.70.111

Castro, C. J. N., Gonçalves, N. S., & Barros Filho, J. de S. (2020). Magalhães Barata (PA): Da fragmentação territorial às dinâmicas e conflitos da pesca artesanal na Reserva Extrativista Marinha Cuianarana. Sociedade e Território, 32(1), 30–50. https://doi.org/10.21680/2177-8396.2020v32n1ID17005

Cruz, A. G., Cadena, R. S., Faria, J. A. F., Oliveira, C. A. F., Cavalcanti, R. N., Bona, E., Bolini, H. M. A., & Silva, M. A. A. P. (2013). Consumer perception of probiotic yogurt: Performance of check all that apply (CATA), projective mapping, sorting and intensity scale. Food Research International, 54(1), 601–610. https://doi.org/10.1016/j.foodres.2013.07.036

Cruz, C. D., Ferreira, F. M., & Pessoni, L. A. (2011). Biometria aplicada ao estudo da diversidade genética. Visconde do Rio Branco, Brazil: Suprema.

da Silva, J. G., Santos, R. M. dos, Lima, A. B. de, & Silveira, T. S. (2021). Caracterização físico-química de taperebá (Spondias mombin L.) pertencente a matrizes nativas do município de Santarém – Pará. In Desafios e impactos das ciências agrárias no Brasil e no mundo 2 (pp. 14–24). Ponta Grossa, Brazil: Atena. https://doi.org/10.22533/at.ed.5792102062

de Quadros, B. R. (2013). Conservação de sementes de taperebá [Doctoral dissertation, Universidade Estadual Paulista “Júlio de Mesquita Filho”]. Repositorio Institucional UNESP.

de Sá, R. J. da S., Santos, R. M. dos, Lima, A. B. de, & Silveira, T. S. (2019). A importância da biodiversidade amazônica. Multidisciplinary Reviews, 2, e2019011. https://doi.org/10.29327/multiscience.2019011

Joly, C. A., Haddad, C. F. B., Verdade, L. M., Oliveira, M. C., Bolzani, V. S., & Berlinck, R. G. S. (2011). Diagnóstico da pesquisa em biodiversidade no Brasil. Revista USP, (89), 114–133. https://doi.org/10.11606/issn.2316-9036.v0i89p114-133

Magalhães, M. A., Santos, R. M. dos, Lima, A. B. de, & Silveira, T. S. (2013). Genetic diversity within and among populations of Cajazeira. Revista de Ciências Agrárias/Amazonian Journal of Agricultural and Environmental Sciences, 56(Suple), 61–67.

Marques, C. S., Santos, R. M. dos, Lima, A. B. de, & Silveira, T. S. (2017). Caracterização física e rendimento de frutos e endocarpos de taperebá (Spondias mombin L.) coletados em área urbana de Boa Vista-RR. In XXX Congresso Brasileiro de Agronomia, Fortaleza, Brazil.

Netor, L. de L. P., Lima, G. C. de, Negrão, C. A. B., Amorim, L. M., Pantoja, S. S., Souza, E. C. de, & Silva, A. dos S. (2024). Análises físicas e físico-químicas de polpa de jambo vermelho (Syzygium malaccense L.). Revista Foco, 17(8), e5218. https://doi.org/10.54751/revistafoco.v17n8-007

Paixão, A. de O., Prudente, E. C., Negrão, C. A. B., Pinheiro, H. V. A., Souza, E. C. de, Pantoja, S. S., Pantoja Neto, L. de L., & Silva, A. dos S. (2025). Avaliação física e físico-química de frutos e polpas de uxi (Endopleura uchi). Revista Foco, 18(1), e5812. https://doi.org/10.54751/revistafoco.v18n1-075

Santos, R. M. dos, Andrade, J. J. A. de, Silva, E. B. da, Lima, A. B. de, Silveira, T. S., Cardoso, A. S., Chinelate, G. C. B., & Araújo, L. de A. (2024). Estudo microbiológico e físico-químico da polpa de taperebá (Spondias mombin L.) comercializada em Cametá - PA. Observatorio de la Economía Latinoamericana, 22(12), e8439. https://doi.org/10.55905/oelv22n12-280