Freeze-Dried Cambuí Fruit (*Myrciaria tenella* O. Berg): Physicochemical Characterization, Bioactive Potential, and Technological Prospecting

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This study investigated the physicochemical properties, bioactive potential, and technological prospects of freeze-dried cambuí fruit (*Myrciaria tenella* O. Berg), a little-explored native Brazilian species. Analyses of pH, titratable acidity, moisture, lipids, total phenolic compounds, flavonoids, and antioxidant activity were performed on different methanolic and ethanolic extracts. The results revealed high levels of phenolic compounds and flavonoids, particularly in 60% solvent extracts, along with significant antioxidant activity, highlighting the fruit's functional potential. Low pH and intermediate moisture contributed to the stability of bioactive compounds, while the high lipid content favored efficient extraction. Technological prospection indicated that cambuí remains underexplored in patents and scientific research, revealing opportunities for innovation in food, pharmaceutical, and nutraceutical products. These findings underscore the importance of sustainably utilizing Brazilian biodiversity and provide a foundation for the development of new technologies based on cambuí.

Keywords: Freeze-Dried Cambuí. Flavonoids. Antioxidants. Phenolic Compounds. Technological Prospection.

The cambuí is the fruit of the cambuí tree, whose scientific name is *Myrciaria tenella* O. Berg, a frutiferous plant belonging to the Myrtaceae family [1]. The cambuí fruit is a glossy berry found in colors from red to purple [2]. This fruit is little known despite being a native plant of Brazil [3] and belonging to the same genus as *Myrciaria cauliflora* (Mart.) Berg, known as jabuticaba, which is a widely consumed fruit for juices, jams, and liquors in Brazil [4].

The Myrtaceae family species are consumed by the Brazilian population for their adstringent, anti-inflammatory, and anti-hypertensive properties [5]. Those plants are naturally distributed throughout the southern hemisphere countries [6]. In Brazil, plants of the *Myrciaria* genus can be found in several Brazilian biomes, e.g, the Amazon Rainforest, Caatinga, Cerrado, and Pampa. Antonelo and colleagues (2023) [5] found that essential oils extracted from plants of the Myrtaceae family, including the *M. tenella*, present antioxidant, antimicrobial, and *in vitro* cytotoxic activity against adrenocortical carcinoma.

As for the berries of *Myrciaria* genus plants, they stand out for their high yield of an antioxidant-rich pulp [4]. Those fruits also present high quantities of the functional pigment anthocyanin, which provides them with their red, blue, or violet coloration [4]. Ferreira and colleagues (2024) [7] studied the essential oils of *Myrciaria tenella* (DC.) O. Berg and identified their main components as being (*E*)-caryophilen, δ-cadinen, caryophilen, and viridifloren. They also found that those essential oils have antioxidant activity and are potential agents that can be used against oral diseases. In addition, Almeida and Silva (2011) [8] noted the outstanding vitamin C source potential of the cambuí fruit, particularly its purple berries.

Despite its bioactive and biotechnological potential, the cambuí remains underexplored and underinvestigated when compared to other fruits of the Myrtaceae family. The studies regarding the cambuí are scarce. There are only 12 papers, published between 2006 and 2021, related to "*Myrciaria tenella* O. Berg" in the research platform managed by the Brazilian federal agency CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior), which gathers research papers from several databases and provides

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free access to them for students, teachers, and researchers.

Thus, this work provides a characterization of the cambuí berries (*Myrciaria tenella* O. Berg) and the technological prospects of related studies. The purpose of this work is to produce scientific knowledge on the properties of cambuí to guide the development of cambuí-based technologies and products, such as drinks and pharmaceutical drugs.

Materials and Methods

Experimental Technological Prospection

The search for technological prior art related to the 'cambuí' fruit was conducted in national and international patent databases, including the National Institute of Industrial Property (INPI), Espacenet, World Intellectual Property Organization (WIPO), The Lens, and Japan Patent Office. At the same time, research was carried out in scientific journal databases through the journal portal of the "Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)", accessed via the Federal University of Sergipe (UFS).

The search strategies employed Boolean logical operators applied to specific fields (keywords, title, abstract, and author) using the following descriptors: "*Myrciaria cuspidata*" OR "cambuí" OR "*Myrciaria tenella* O. Berg" OR "*Myrciaria floribunda* (West ex Willd.) O. Berg".

Additionally, the analysis of the scientific impact was conducted on the Web of Science® indexing database (https://www.webofknowledge.com), using the same descriptors and search criteria.The results were organized to generate graphical representations related to the publication period, document types, prominent authors, and thematic categories of the platform, to understand the scientific production associated with the fruit 'cambuí'.

Sampling

The cambuí berries sampled for this study were collected directly from the cambuí tree in Morro do Chapéu, BA, Brazil. The samples were sieved to remove solid impurities (e.g, sticks and leaves), washed, dried, and frozen. The frozen samples were transported to the lab in cool boxes and kept in the Ultra-low temperature freezer (Liotop UFR30) for 2 h at -80 ºC.

Lyophilization of the Fruit Sample

The fruits were kept in the lyophilizer (Liotop L101) for 48 h, at -62 ºC and under <100 mmHg. As the fruits had not yet fully dehydrated, they were frozen in the Ultra-low temperature freezer for 2 hours and then kept in the lyophilizer for 48 hours.

Extracts Preparation

The extracts were obtained using a method adapted from Lima and colleagues (2012) [9]. Ethanol-water and methanol-water solutions containing 20%, 40%, and 60% organic solvent were used for the extraction. The ground lyophilized fruits were mixed with the extraction solvents in a 5:100 (g/mL) ratio in triplicate. The mixture was stirred for 1 h on an orbital shaker (Quimis). The liquid was collected on Falcon tubes and centrifuged at 400 rpm for 45 min, and the supernatant was transferred to amber flasks.

Antioxidant Activity Analyses

The antioxidant activity was analyzed by the DPPH radical scavenging method described by Lima and colleagues (2012) [9]. For the analyses, 3.750 mL of DPPH 0.62 $g.L^{-1}$ and 0.750 mL of extract were mixed; the extracts were replaced with the extraction solvents for the blank preparation. The samples were homogenized by vortex agitation for 1 min twice, with a 5-minute break in between. The triplicates were analyzed at 517 nm using a Shimadzu UV-1800 UV Spectrophotometer.

Total Flavonoids Determination

The determination of flavonoid compounds was carried out using the method described by Woisky and Salatino (1998) and modified by Lima and colleagues (2012) [9]. For the analyses, 10 mL of $AlCl_3$ 20 $g.L^{-1}$ and 1 mL of extract were mixed; the extracts were replaced with the extraction solvents for the blank preparation. The samples were homogenized by vortex agitation for 1 min. The triplicates were analyzed at 425 nm on a Shimadzu UV-1800 UV Spectrophotometer.

Total Phenolics Determination

The determination of flavonoid compounds was carried out using the Swain and Hills (1959) method, as described by Lima and colleagues (2012) [9]. For the analyses, 1 mL of ethanol, 5 mL of distilled water, 0.5 mL of Folin Ciocalteau, 1 mL of Na_2CO_3 20 $g.L^{-1}$, and 0.250 mL of extract were mixed; the extracts were replaced with the extraction solvents for the blank preparation. The samples were homogenized by vortex agitation for 1 min. The triplicates were analyzed at 725 nm on a Shimadzu UV-1800 UV Spectrophotometer.

Moisture

The moisture analyses were carried out by the Instituto Adolfo Lutz (2008) [10]method. In triplicate, 5 g of the lyophilized samples in pre-calibrated aluminum capsules were placed in the oven at 105 °C for 2 h and then in the desiccator for 30 min. The mass of the samples was measured before and after the heating process, and the % of moisture was determined by the relative variation of the sample mass due to the evaporation process.

Lipids determination

The determination of lipids was performed using the method described by Bligh and Dyer (1959) [11]. In triplicate, 2.5 g of the lyophilized samples, 10 mL of chloroform, 20 mL of methanol, and 8 mL of distilled water were mixed. After 30 minutes of stirring on an orbital shaker (Quimis), 10 mL of chloroform and 10 mL of 1.5% Na_2SO_4 were added, and the mixture was stirred for 2 minutes. The mixture was transferred to a separatory funnel.

Once the phases were visually separated, the lipidic phase was collected and filtered. The lipidic phase was maintained at 90 °C in the oven for 30 minutes to remove moisture. After cooling down, the mass of the lipidic phase was measured. The % of lipids was calculated by Equation 1, where m_1 is the mass of the empty beaker, m_2 is the mass of the beaker containing the lipidic phase, and m is the initial mass of the lyophilized cambuí.

$$Lipids\ (\%) = \frac{(m_2 - m_1) \times 4 \times 100}{m} \qquad \textbf{Equation 1}$$

Analyses of pH

The pH analyses were carried out by the Instituto Adolfo Lutz (2008)10 method. For the determination of the pH, 5 g of lyophilized cambuí and 50 mL of distilled water were mixed. The pH was measured using the DIGIMED DM-22 pH Meter.

Titratable Acidity Analyses

The titratable acidity analyses were carried out by the Instituto Adolfo Lutz (2008) [10] method. In triplicate, 5 g of lyophilized cambuí and 50 mL of distilled water were mixed. The samples were titrated with 0.1 M NaOH, using phenolphthalein as an indicator. The titratable acidity was calculated by Equation 2, where V corresponds to the volume (mL) of NaOH 0,1 M used for the titration, f to the solution factor of 0,1 M, m to the mass of lyophilized cambuí, and C to the correction factor for the NaOH 1 M (which equals 10).

$$Acidity\ (\%) = \frac{(V \times f \times 100)}{C \times m} \qquad \textbf{Equation 2}$$

Results and Discussion

Technological Prospection

The prior art search was conducted in the INPI, Espacenet, WIPO, The Lens, and Japan Patent databases, as well as in CAPES journals through access provided by the Federal University of Sergipe. The search strategy employed Boolean logical operators applied to keywords, titles, abstracts, and authors, using the following descriptors: "*Myrciaria cuspidata*" OR "CAMBUÍ" OR "*Myrciaria tenella* O. Berg" OR "*Myrciaria floribunda* (West ex Willd.) O. Berg".

On the INPI (National Institute of Intellectual Property) website, only 1 patent was found with the application number (BR 10 2021 021304 3 A2) and title: Fumigating formulation in microemulsion for controlling *Sitophilus zeamais* using *Myrciaria floribunda* and *Pothomorphe umbellata*. This invention describes an insecticidal fumigating formulation composed of essential oils from *Myrciaria floribunda*, with major constituents (*E*)-caryophyllene (26.81%) and viridiflorol (6.64%), and *Pothomorphe umbellata*, with β-pinene (27.33%) and α-pinene (14.55%), effective in controlling *Sitophilus zeamais* in corn grains. The formulation, prepared in emulsion with Tween 80 at 120 ppm, and applied to filter paper discs in containers with 20 insects, demonstrated fumigant activity, resulting in a significant reduction in population after 7 days. The technology demonstrates agro-industrial potential for application during harvest and/or storage, distinguishing itself for its practicality, safety, and effectiveness in pest management.

In the WIPO database, only patent no. BR102021019690 was identified, specifically regarding the preparation process of a tea that affects the growth of multidrug-resistant bacteria. The inventors described the process of obtaining an antibacterial tea from the fruit of *Myrciaria floribunda* (cambuí), which is rich in flavonoids and phenolic compounds and is effective against Gram-positive bacteria, particularly multidrug-resistant *Enterococcus faecium*. The process involves drying, grinding, and extraction using pressurized hot water, resulting in a bioactive plant extract. The preparation can be applied in food, pharmaceutical, and veterinary formulations, acting as an active agent against bacterial infections.This is an industrial process designed to produce plant substances with pharmacological activity.

In the Japan office patent sites, Espacenet, and The Lens, no studies involving applications of the "cambuí" fruit were found. As for the Web of Science search results, Figure 1 shows the scientific production related to the fruit that was examined. The available related papers on cambuí were published between 1997 and 2025, reaching their peak in 2021. However, this research topic remains relatively underexplored, considering the results and the number of publications up to 2025. A total of 27 publications were identified.

For the analysis of the fruit "cambuí", the scientific impact was assessed using the Web of Science® indexing database (https://www.webofknowledge.com), based on keywords, titles, abstracts, and authors (Topic), applying the same Boolean logical operators. This search yielded graphical outputs, including publication periods, document types, manuscript authors, and Web of Science categories associated with the fruit "cambuí".

Other than that, it was observed that 26 out of 27 scientific publications found are of the common article type; only one article is classified as a review, and one as early access. This division is expected because, to produce review articles, the topic should theoretically be well-explored in the literature, allowing researchers to gather a sufficient number of articles to discuss the desired subject.

The principal authors who have written about the fruit 'cambuí', as reported by Web of Science, are: Alvares-Carvalho, Antonelo; Amaral; Alves-Aquila; Andrade-Silva; Apel; Andrino; Aragão; Augusti; and Baldo. Knowing that each of the authors contributed only one manuscript each, this contribution is considered small compared to scientific publications on other native fruits of Brazil.

As shown in Figure 2, the platform categorizes articles into various fields, including molecular biochemistry, biotechnology applications, cell biology, applied chemistry, medicinal chemistry, multidisciplinary chemistry, food science and technology, medical research, pharmacological and pharmaceutical sciences, and plant sciences. It is

Figure 1. Number of publications over time for the search of "*Myrciaria cuspidata*" OR "CAMBUÍ" OR "*Myrciaria tenella* O. Berg" OR "*Myrciaria floribunda* (West ex Willd.) O. Berg" in keywords, titles, abstracts, and authors on the Web of Science® platform.

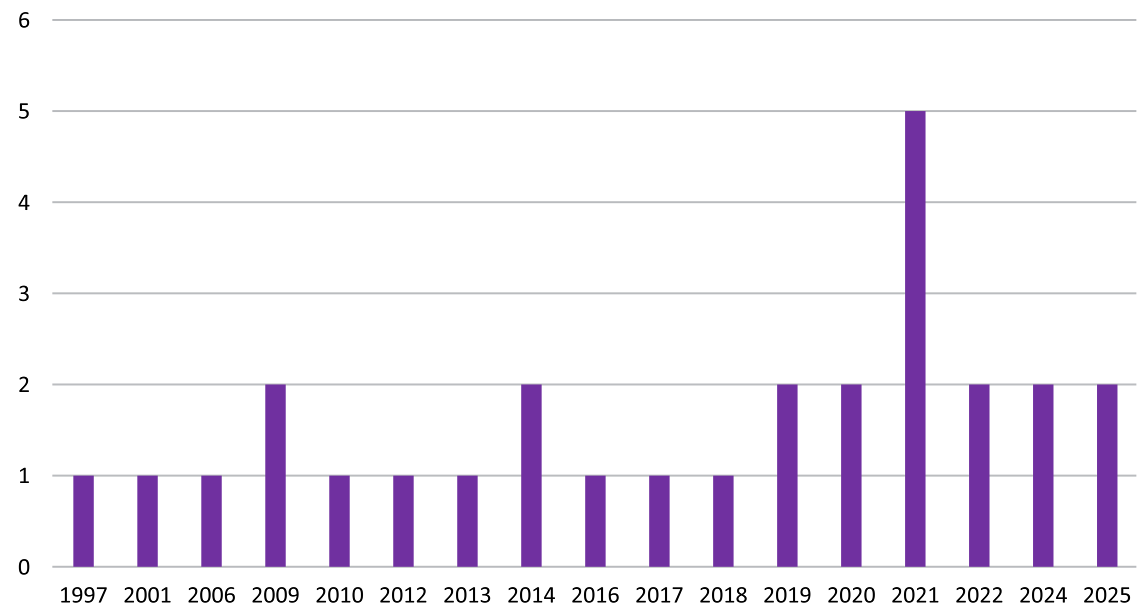
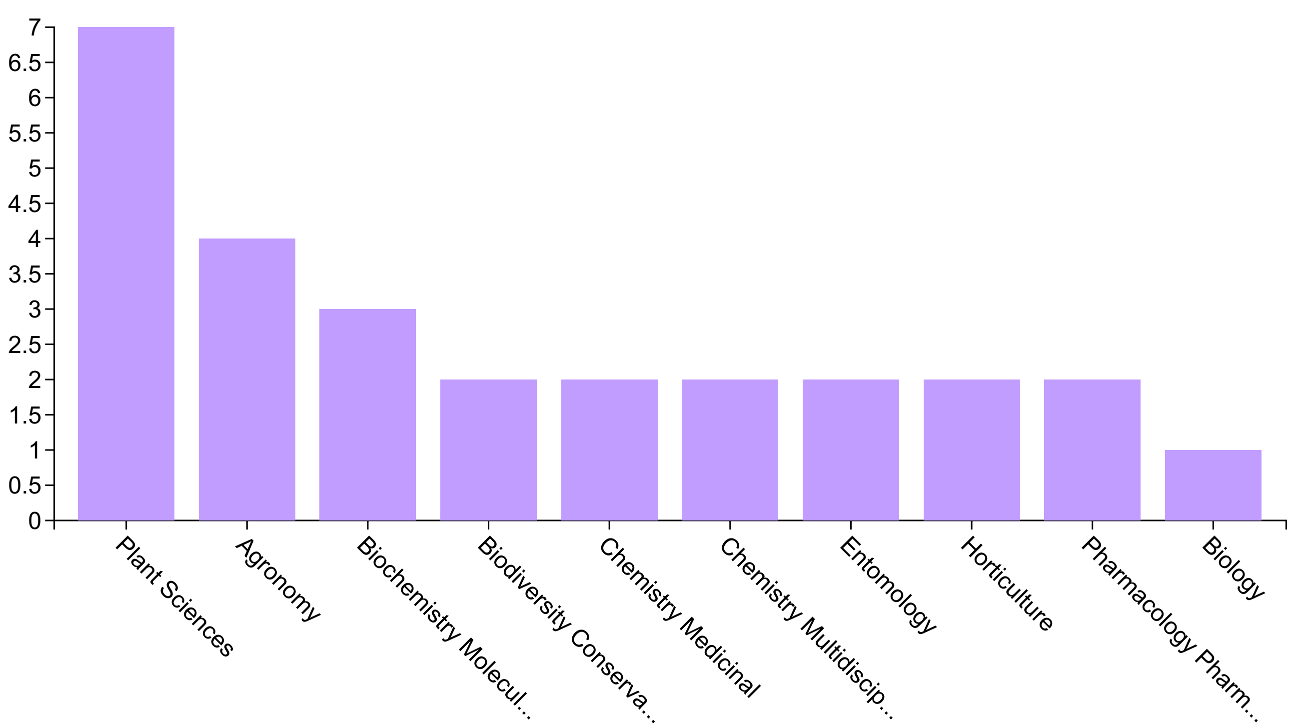


Figure 2. Categories of the Web of Science® platform for the search of "*Myrciaria cuspidata*" OR "CAMBUÍ" OR "*Myrciaria tenella* O. Berg" OR "*Myrciaria floribunda* (West ex Willd.) O. Berg" in keywords, titles, abstracts, and authors (Topic) on the Web of Science® platform.



noted that the most relevant categories in Cambuí-related papers were molecular biochemistry, medicinal chemistry, food science and technology, and plant science.

The increasing appreciation of species of the Myrtaceae family in the scientific literature is intrinsically related to their phytochemical diversity, therapeutic potential, and broad applicability in the pharmaceutical, food, cosmetic, and agricultural industries. The integrative analysis of the selected studies highlights complementary approaches that reinforce the relevance of this botanical family, especially in the context of Brazilian biodiversity. One of the points of convergence among the studies is the rich composition of flavonoids and phenolic compounds identified in several species, such as *Myrciaria floribunda*, *Myrciaria tenella*, and Cambuí. Correia and colleagues (2022) [12] synthesized this information by highlighting the main flavonoids — anthocyanins (cyanidin, petunidin, malvidin, and delphinidin), catechin, quercetin, and rutin — in native fruits, associating them with antioxidant, anti-inflammatory, antidiabetic, and cardioprotective properties. This perspective is corroborated by Ribeiro and colleagues (2019) [13], who demonstrated the bioactive potential of *Myrciaria tenella* leaves, particularly rutin, in both *in vitro* and *in vivo* assays, thereby broadening the nutraceutical applicability of these species.

In a more in-depth manner, Santos and colleagues (2020) [14] reveal that extracts from the bark of *Myrciaria floribunda* not only concentrate phenols and anthocyanins but also express vigorous antinociceptive activity, mediated by the opioid system, with low toxicity. The association between chemical composition and pharmacological effects reinforces the importance of integrative studies that correlate phytochemical data with pharmacological tests.

Complementarily, through physicochemical analyses and mass spectrometry, García and colleagues (2021) [15] detail the composition of *Myrciaria floribunda* fruits, demonstrating a correlation between the orange coloring of the fruits, high concentration of phenolic compounds, and antioxidant activity. The comparison between the findings of Santos and colleagues (2020) [14] and García and colleagues (2021) [15] is particularly enlightening. Both studies examine the same species but focus on different plant structures (peel and fruit), suggesting that distinct organs accumulate specialized metabolites with potential functional and therapeutic applications.

Regarding essential oils, Amaral and colleagues (2013) [16] and Apel and colleagues (2002) [17] provide complementary views on the volatile composition of species in the genus *Eugenia* and *Neomitranthes*. Amaral and colleagues (2013) [16] explore the chemical variability between the leaves and fruits of *Neomitranthes obscura* (also known as "cambuí-preto"), revealing a predominance of sesquiterpenes in the leaves and a shift in the ratio between monoterpenes and sesquiterpenes in the fruits, which is associated with their coloration. This variation may reflect metabolic adaptations related to maturation and the attraction of dispersers, which is also a relevant aspect for the chemical ecology of the plant. On the other hand, Apel and colleagues (2002) [17] identified oxygenated sesquiterpenes, such as β-caryophyllene, viridiflorene, and globulol, in southern Brazilian species of *Eugenia*, highlighting their potential applications in aromatherapy and folk medicine.Both studies emphasize the diversity of volatile metabolites in Myrtaceae and their potential as aromatic and medicinal resources.

The pharmacological dimension is also explored by Ferreira and colleagues (2020) [18], who demonstrate the antileishmanial action of extracts from the fruits of *Eugenia moraviana* (Myrtaceae) against promastigote and amastigote forms, associating the effects with the presence of phenolics and flavonoids. The low cytotoxicity and the impact on the morphology of the parasites position this extract as a promising candidate for alternative therapies in the treatment of leishmaniasis. We highlight that this antiparasitic activity aligns with the antioxidant properties described by other authors, suggesting that the multifunctionality of phenolic compounds can be explored in various therapeutic contexts.

From an ecological and anatomical perspective, the study by Sosa and Gonzalez (2024) [19] examines the morphology of colleters in species of the tribe Myrteae, which are secretory structures that protect meristematic tissues. This study offers insights into the functional taxonomy of the subfamily Myrtoideae, suggesting that anatomical features have implications not only for systematic classification but also for understanding species adaptation and resilience in their natural habitats. This structural analysis can be integrated with phytochemical data, thereby expanding our understanding of the mechanisms underlying the production and secretion of secondary metabolites. Finally, Magedans and colleagues (2024) [20] address the phytotoxic activity of leaf extracts from *Myrciaria cuspidata*, highlighting allelopathic effects attributed to compounds such as tannic acid, quercetin, and gallic acid. This study broadens the perspectives for the application of Myrtaceae in sustainable agriculture by proposing their use as natural bioherbicides in the management of invasive plants.

Thus, when analyzing the nine studies together, a thematic convergence is observed, centered on the phytochemical diversity and functional potential of species from the Myrtaceae family. The integration of physicochemical, morphological, and pharmacological analyses reveals a broad spectrum of applications, ranging from functional and pharmaceutical products to agricultural bioinputs. It reinforces the importance of conserving and sustainably utilizing Brazilian flora. The alignment between chemical data and biological effects significantly contributes to the advancement of bioprospecting and the development of technologies based on national biodiversity [7,12–17,19,20].

Table 1. Lipids, pH, titratable acidity, and moisture analyses' results for the lyophilized cambuí sample.

Physicochemical Analyses	
Lipids (%)	81.31 ± 3.22
pH	3.94 ± 0.22
Titratable acidity (%)	2.76 ± 0.46
Moisture (%)	17.09 ± 0.37

Physico-Chemical Analyses

Table 1 presents the results of the analyses of the physicochemical properties of freeze-dried cambuí

The results obtained demonstrate marked differences in lipid content among regional fruit species. While Baldini (2016) [21] reported average values of 1.21% ± 0.052 lipids in freeze-dried araçá-boi, the determination carried out for cambuí revealed a substantially higher content of 81.31% ± 3.22. This discrepancy suggests not only inherent variations in the metabolic and physiological profiles of the species but also implications for the nutritional and technological potential of these fruits. Araçá-boi, due to its low lipid levels, tends to be more closely associated with low-energy-value products.

In contrast, cambuí, with its high concentration, may represent an alternative source of bioactive lipid compounds. Furthermore, factors such as fruit ripening, environmental growing conditions, and extraction methodologies may contribute to the magnitude of these differences and should be considered in future comparative studies [22].

The cambuí sample exhibited a pH of 3.94. For cambuíva, a fruit of the same genus as cambuí, Garcia and colleagues (2022) [15] reported pH values ranging from 3.26 to 3.70. Goldoni and colleagues (2019) [23] analyzed capoteira, reporting a value of 3.38. According to these studies, pH is influenced by various factors, including species, environmental conditions, and the ripening stage, among others. Fruits with higher acidity decompose more readily and are therefore widely utilized in the food industry [24].

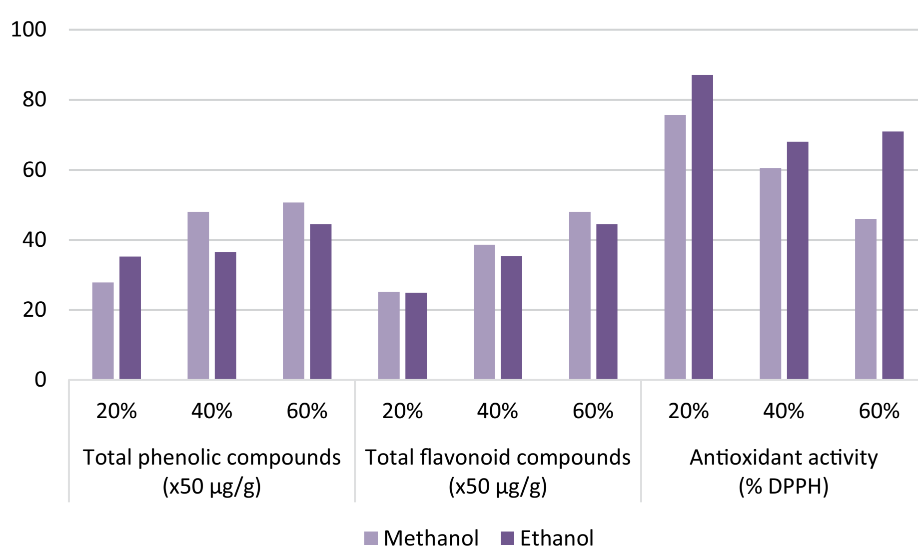
The presence of total organic acids in the fruits was determined by titratable acidity, an important parameter in flavor assessment. The evaluated fruits showed a titratable acidity of 2.76%. The value observed for cambuí samples was higher than that of another fruit from the Myrtaceae family, guava, which presented titratable acidity values ranging from 0.17 to 0.62%, as reported by Singh and colleagues (2023) [25], who evaluated different ripening stages. The cambuí sample also exhibited higher acidity than that reported by Souza and colleagues (2021) in the analysis of 'Sabará' jabuticaba, with values ranging from 0.51 to 0.70% (m/V of pulp).Since the analyzed cambuí was freeze-dried, the removal of water by this process promoted pulp concentration, thereby increasing the proportion of available substances per gram of sample.

In the literature, no moisture analyses were found for freeze-dried cambuí, which was determined in this study to be 17.09%. However, values are available for fresh purple cambuí and dried pulp, corresponding to 82.0% and 3.1%, respectively, as determined by Freitas (2021) [27]. It is expected that freeze-dried fruits present intermediate moisture values between fresh and heat-dried samples. In the former, the naturally occurring liquids are preserved, whereas in the latter, water removal by heating affects not only moisture but also acidity [28].Freeze-drying is a well-established drying process that removes water through sublimation, preserving the nutritional characteristics, as well

Table 2. Total phenolic compounds, total flavonoid compounds, and antioxidant activity analyses' results for each extract of lyophilized cambuí.

Extraction solution	Total phenolic compounds (µg/g)	Total flavonoid compounds (µg/g)	Antioxidant activity (% DPPH)
Methanol 20%	1392.74 ± 0.08	1261.40 ± 0.05	75.69 ± 0.02
Methanol 40%	2400.38 ± 0.04	1930.07 ± 0.01	60.58 ± 0.02
Methanol 60%	2535.03 ± 0.02	2400.07 ± 0.14	45.98 ± 0.03
Ethanol 20%	1761.84 ± 0.04	1247.07 ± 0.26	87.10 ± 0.09
Ethanol 40%	1826.42 ± 0.03	1767.40 ± 0.07	68.03 ± 0.08
Ethanol 60%	2221.60 ± 0.05	2221.40 ± 0.09	70.99 ± 0.05

Figure 3. Comparison of total phenolic compounds, total flavonoid compounds, and antioxidant activity of lyophilized cambuí extracts obtained with extraction solutions of 20, 40, and 60% methanol or ethanol.



as the fruit's color and aroma [29].

Table 2 presents the results of the analyses of total phenolic compounds, total flavonoids, and antioxidant activity of methanolic and ethanolic extracts from freeze-dried cambuí fruit; and Figure 3 the comparison os phenolic and flavonoids compounds.

The total phenolic content was higher in the 60% extracts, both ethanolic and methanolic, with values exceeding 2.2 mg/g. No reports on lyophilized cambuí were found in the literature; therefore, results were compared with those of other lyophilized fruits. The values obtained for lyophilized cambuí were similar to those determined for guava (1.85 and 4.06 mg/g), as reported by Singh and colleagues (2023) [25].

The quantification of flavonoids showed higher amounts in both 60% solutions compared to the other extract concentrations, yielding values between 2.2 and 2.4 mg/g. Antioxidant activity, in turn, showed the best results in both 20% extract solutions, reaching values above 85%.

The relatively low pH (3.94 ± 0.22) and the titratable acidity (2.76 ± 0.46%) contribute to the stability of phenolic compounds, particularly anthocyanins, which may explain part of the values observed in the Figure 3 [30].In addition, the low moisture content (17.09 ± 0.37%) reduces enzymatic degradation of antioxidants, favoring the preservation of antioxidant activity in the extracts [31]. In this context, characteristics such as high lipid content, low acidity, and reduced moisture emerge as key factors both for extraction efficiency and the stability of bioactive compounds [32,33].

Conclusion

The technological and scientific prospecting conducted indicates that the cambuí fruit (*Myrciaria* spp.) remains underexplored in terms of innovation and applied research, with only two patents registered and a limited number of indexed scientific publications compared to other native Brazilian fruits. Nevertheless, the studies analyzed demonstrate the significant functional and bioactive potential of cambuí, primarily associated with its richness in phenolic compounds and flavonoids, which are directly linked to antioxidant, anti-inflammatory, cardioprotective, and even antiparasitic activities.

The results obtained in this study confirm this potential, revealing high levels of total phenolics and flavonoids, as well as significant antioxidant activity, particularly in 60% extraction solutions. The chemical composition of freeze-dried cambuí, combined with its physicochemical characteristics, such as titratable acidity and intermediate moisture content, further supports its applicability across various sectors, with particular relevance to the food, pharmaceutical, and bioproduct industries.

Overall, the integration of phytochemical, pharmacological, and technological findings demonstrates that cambuí represents a valuable source of bioactive compounds, whose sustainable exploitation can promote bioprospecting and the development of new technologies based on Brazilian biodiversity. Thus, this study not only contributes to advancing knowledge about the species but also highlights the need for further research to explore its properties and applications, thereby strengthening the link between science, innovation, and the conservation of the national flora.

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