PAB Pesquisa Agropecuária Brasileira 60 years

COP30
Food Technology/ Original Article

jornada pelo CLIMA #TemQueTerCiência

ISSN 1678-3921

Journal homepage: www.embrapa.br/pab

For manuscript submission and journal contents, access: www.scielo.br/pab

Adding value to sociobiodiversity: quality and stability of buriti derivatives from the Cerrado biome

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Received
May 11, 2025

Accepted
August 05, 2025

How to cite
BORGUINI, R.G.; MONTEIRO, R.P.; SOARES, J.F.; PACHECO, S.; WILHELM, A.E.; JESUS, M.S.C. de; ANTONIASSI, R.; NOGUEIRA, R.I.; GUEDES, A.M.M. Adding value to sociobiodiversity: quality and stability of buriti derivatives from the Cerrado biome. **Pesquisa Agropecuária Brasileira**, v.60, e04132, 2025. DOI: https://doi.org/10.1590/S1678-3921.pab2025.v60.04132.

Abstract – The objective of this work was to evaluate the quality and shelf life of buriti oil and its coproduct, defatted cake, as high value-added food ingredients. The derivatives of buriti fruits were processed by a cooperative of family farmers in the north of the state of Minas Gerais, Brazil, including agroextractivists. Buriti oils were evaluated for their fatty acid composition, tocopherol and carotenoid contents and profiles, peroxide index, and free fatty acid content and conjugated diene contents. The coproducts were analyzed for their proximate composition, water activity, and carotenoids. Buriti oil presents an adequate quality for use as a food ingredient, except for its free fatty acid content, which can be reduced by adopting Good Practices. Buriti oils present high levels of provitamin A carotenoids, which remained stable across the different packaging used to study shelf life. Small quantities of buriti oil can provide the adult recommended daily intake of vitamin A. In addition, the oils can be used as a natural food coloring. Defatted buriti cakes show high levels of fiber and provitamin A carotenoids, indicating their potential as a functional ingredient. After being stored for 169 days, the cakes maintain an adequate water activity, ensuring food safety.

Index terms: *Mauritia flexuosa*, buriti oil, carotenoids, defatted buriti cake, tocopherols.

Agregando valor à sociobiodiversidade: qualidade e estabilidade de derivados do buriti do bioma Cerrado

Resumo – O objetivo deste trabalho foi avaliar a qualidade e a vida útil do óleo de buriti e do seu coproduto, torta desengordurada, como ingredientes alimentícios de alto valor agregado. Os derivados do fruto do buriti foram processados por uma cooperativa de agricultores familiares do Norte do estado de Minas Gerais, Brasil, envolvendo agroextrativistas. Os óleos de buriti foram avaliados quanto à composição de ácidos graxos, aos teores e ao perfil de tocoferóis e carotenoides, ao índice de peróxidos, e aos teores de ácidos graxos livres e dienos conjugados. Os coprodutos foram analisados quanto à composição centesimal, à atividade de água e aos carotenoides. O óleo de buriti apresenta qualidade adequada para uso como ingrediente alimentar, exceto pelo teor de ácidos graxos livres, que pode ser reduzido com a adoção de Boas Práticas. Os óleos apresentam altos teores de carotenoides provitaminicos A, que se mantiveram estáveis nas diferentes embalagens utilizadas para o estudo de vida útil. Pequenas quantidades de óleo de buriti podem fornecer a ingestão diária recomendada de vitamina A para adultos. Além disso, os óleos podem ser utilizados como corante alimentar natural. As tortas desengorduradas de buriti apresentam altos teores de fibras e carotenoides, o que indica seu potencial para uso como ingrediente funcional. Após 169 dias de armazenamento, as tortas mantêm uma atividade de água adequada, o que garante a segurança alimentar.

Termos para indexação: *Mauritia flexuosa*, óleo de buriti, carotenoides, torta desengordurada de buriti, tocoferóis.

Introduction

Buriti palm (*Mauritia flexuosa* L.) is a native species of the Arecaceae family distributed throughout South America. In Brazil, it occurs especially in the Amazon and Cerrado biomes, being present in the North, Midwest, as well as in part of the Northeast and Southeast regions (Vieira et al., 2016; Vianna, 2025). The species holds significant ecological importance, since it promotes relevant ecosystem services and indicates the presence of surface water (Vieira et al., 2016; Bhomia et al., 2019). Furthermore, due to its sociobiodiversity and food value, buriti was selected as a priority species in public policies aimed at encouraging the commercialization of native Brazilian species (Brasil, 2021).

In Brazil, the rapid expansion of agricultural activities has compromised the populations of *M. flexuosa* through the destruction of springs and veredas, which is a type of Cerrado wetlands (Vieira et al., 2016). However, to promote the species' conservation, the development of high added-value products from buriti fruits offers a promising strategy by providing economic incentives for its sustainable use.

Buriti oil has been used as an ingredient in cosmetic products (Pereira et al., 2018), evaluated for use as biofuel (Barbosa et al., 2020), and reported for its antioxidant properties and technological functionalities (Speranza et al., 2016; Reis et al., 2020). Additionally, its potential for use as food is particularly promising due to its composition and sensory characteristics. The buriti fruit has the highest known concentration of β-carotene among a wide range of Brazilian native foods (Coradin & Pombo, 2008), and the oil contains high levels of oleic acid, carotenes, and tocopherols (Silva et al., 2009). This nutritional profile indicates its potential for culinary use in blends with other oils, increasing the levels of vitamins A and E.

Buriti oil is among the main products marketed by the Grande Sertão Cooperative, a major rural social organization in the mesoregions of northern Minas Gerais and Jequitinhonha, which face significant social challenges, particularly for their rural populations. The cooperative works with traditional family farmers, agrarian reform settlers, extractivists, indigenous people, and fishermen across 25 municipalities in the Caatinga and Cerrado biomes. To produce the oil, the cooperative has developed a system for collecting and pre-processing the fruits in agro-extractive communities, with a particular focus on the involvement of women.

At the organization's processing unit in the municipality of Montes Claros, the defatted buriti cake, a coproduct of the oil extraction, has shown great potential as a food source. However, its optimal use requires a detailed characterization of its composition and stability, as well as the development of processes for its best application.

The derivatives of buriti fruits were processed in a specific production system created by a cooperative of family farmers that included a stage of collection and pre-processing of the fruits in rural areas involving agroextractivists.

The objective of this work was to evaluate the quality and shelf life of buriti oil and its coproduct, defatted cake, as high value-added food ingredients.

Materials and Methods

Buriti fruits were collected during the 2022/2023 harvest from the Cerrado biome in the north of the state of Minas Gerais, Brazil. The collection sites were the municipalities of Brasília de Minas (16°7'53.72"S, 44°21'54.74"W) and Cônego Marinho (14°44'18.03"S, 44°38'37.67"W).

After harvesting, the fruits were sanitized by washing with running water and treating with chlorine solution (200 ppm). They were then submerged in water for 14 hours to facilitate peeling. For the pulping and drying process, a method similar to that used by agroextractivists was adopted: slices of the pulp were removed, placed on nylon screens, and exposed to the sun for natural drying.

The pulp was left to dry for 6 to 12 hours, reaching an average moisture content of 11%. It was then packaged in 15 kg low-density polyethylene plastic bags measuring 60 x 90 cm, which were sealed to prevent moisture reabsorption. The dried pulp was subsequently sent to the processing unit of the Cooperativa dos

Agricultores Familiares e Agroextrativistas Grande Sertão in Montes Claros, MG, where it was pressed. Buriti oil was obtained through mechanical pressing in an expeller-type press.

Six 500 mL bottles of each buriti oil from the two municipalities, Cônego Marinho (BOCM) and Brasília de Minas (BOBM), were sent to the laboratory. The oil samples were homogenized before being fractionated into different types of packaging. The oils were transferred to transparent 15 mL glass tubes with screw caps, designated as standard packaging, and to 50 mL PET plastic bottles, defined as original packaging, as they are currently commercialized by the cooperative. All samples were then stored at room temperature (24 to 28°C) and exposed to natural light.

The partially defatted cake, a coproduct of the buriti oil extraction, was ground in a hammer mill, model B-611 (Maqtron, Joaçaba, SC, Brazil) with a 3 mm sieve. This process obtained buriti coproduct from the two municipalities: Cônego Marinho and Brasília de Minas.

The material was packaged in metallized polyethylene stand-up pouches and stored under refrigeration. For the stability study, regarding carotenoid concentration and water activity, the coproduct from both regions was fractionated into portions and placed in natural Kraft stand-up pouches of 17 X 24 cm, with a polyethylene lining, window and ziplock. This packaging was selected to simulate the product's marketing conditions by the cooperative. The samples were then stored in a dry place at room temperature (24 to 28°C).

For the determination of fatty acid composition, the methyl esters were obtained according to the method of Antoniassi et al. (2018) and analyzed by gas chromatography. Analysis was performed on an Agilent 7890 with a flame ionization detector at 280°C and using an HP FFAP capillary column (25 m x 0.2 mm x 0.30 µm). The oven temperature was programmed as follows: an initial temperature of 150°C for 1 min. The temperature was then ramped from from 150 to 180°C at a rate of 30°C min^{-1}; followed by an increase to 200°C, at 20°C min^{-1}, and a final ramp to 230°C at 3°C min^{-1}. The final temperature was held for 10 min. The injector was set to 250°C and operated in a 1:50 split mode, and 1 µL sample was injected. Identification was performed using standards of NU-CHEK PREP, Inc. (Elysian, MN, USA) and Supelco (Bellefonte, PA, USA) with quantification based on internal normalization.

To access tocopherol profile, oil samples were analyzed by high-performance liquid chromatography using an Alliance 2695 liquid chromatograph (HPLC) (Milford, Massachusetts, USA). The system was equipped with a Waters 2475 fluorescence detector operated at emission wavelength of 290 nm and excitation wavelength of 330 nm. The oil was dissolved in isopropanol. Tocopherols were identified using standards, and individual compounds were quantified by the external standard method and the concentration of each tocochromanol stock solution was calculated according to the official method AOCS Ce 8-89 (AOCS, 2009). The analysis was carried out using the following conditions: C18 X-Bridge reversed-phase analytical column (3.5 µm, 150 X 3.0 mm i.d.) (Waters Corporation, Milford, MA, USA), an isocratic elution acetonitrile:methanol 50:50 (v/v) mobile phase, a running time of 20 min, column temperature of 35°C, and sample temperature of 15°C.

The iodine value was calculated according to the official method AOCS Cd 1c-85 (AOCS, 2009) and saponification value was calculated based on the fatty acid composition. The peroxide value, the free fatty acid content (expressed as percentage of oleic acid), and the conjugated dienes content were measured according to the official methods Cd 8 53, Ca 5a 40, and Cd 7-58, respectively (AOCS, 2009). These properties were evaluated in the oil samples during the storage period, which lasted up to 186 days.

Total carotenoid content in buriti oil was determined by spectrophotometry. Approximately 0.5 g of buriti oil was weighed in 25 mL volumetric flasks and topped up with petroleum ether. The concentration of total carotenoids was then measured at a wavelength of 450 nm.

The carotenoid profiles were determined by HPLC system controlled by the Empower software equipped with a column oven at 33ºC and a photodiode array detector. The sample was prepared in a solution composed of 200 µL of oil and 800 µL of acetone (Borguini et al., 2021). Carotenoid separation was obtained on a C30 column (S-3 Carotenoid, 4.6 mm × 250 mm; 3µ) using a gradient elution of methanol and methyl tert-butyl ether. The flow rate was 0.8 mL min^{-1}, and the running time was 28 min. The injection volume of the samples was 15 µL.

DOI: 10.1590/S1678-3921.pab2025.v60.04132

Carotenoids were identified based on their retention times and UV/Vis absorption spectra, which were compared to the retention times of the carotenoid standards (Pacheco et al., 2014). The carotenoid quantification was carried out using analytical standards for lutein, α-carotene, and β-carotene, which were previously isolated in the laboratory according to Kimura & Rodriguez-Amaya (2002).

Estimates for the conversion of provitamin A carotenoids to vitamin A (retinol) were calculated as defined by IOM (2001): 1 μg of retinol activity equivalent (μg RE) would be equal to 1 μg of all-trans-retinol, 12 μg of β-carotene, 24 μg of α-carotene or β-cryptoxanthin, and 2 μg of β-carotene in oil. The retinol equivalent (RE) was calculated according to Equation 1: $RE = [(\alpha\ carotene/2) + \beta\ carotene]/2$

The water activity of the coproducts was determined, in triplicate, using an automatic Aqualab meter, model CX-2.

The proximate composition of the partially defatted buriti cake was determined using methods from the Association of Official Analytical Chemists (AOAC, 2010). Specifically, moisture (934.06), ash (923.03), ether extract (945.38), total nitrogen/protein (2001.11 modified) and dietary fiber (985.29) were analyzed. Carbohydrate content and caloric value were calculated according to Resolution RDC nº 429, (October 8, 2020) from the Brazilian Health Regulatory Agency (ANVISA, 2020b), which determines the nutritional labeling of packaged foods. The total caloric value was accessed by summing the caloric values of protein, fat, and carbohydrate.

The carotenoids were extracted according to the method of Rodriguez-Amaya (2001). Total carotenoid content was determined by spectrophotometry, and the carotenoid profile was determined by HPLC, using the same method described for buriti oil (Pacheco et al., 2014).

Results and Discussion

The main fatty acids of buriti oils from two provenances were identified as C18:1 (76.7% and 76.8%), comprising C18:1 n-9 and C18:1 n-11, C16:0 (16.9% and 16.4 %), C18:0 (1.9% and 2.2 %), C18:2 (1.6% and 1.8%) and C18:3 (0.92% and 0.88%) (Table 1). Minor fatty acids, including for C16:1, C17:0, C17:1, C20:0, and C20:1 were quantified at levels below 0.4%. While only slight differences were observed among the samples, some fatty acids (C16:0, C16:1, C18:0, C18:2, C18:3 and C20:1) showed significant differences ($p < 0.05$). This is likely because the method's low uncertainty allows for the detection of minor variations. However, no significant differences were found for C18: ($p > 0.05$). The high C18:1 content in the buriti oils falls within the typical range for olive oil (55%–83%), which is favorable finding, since the oleic acid is known to be protective against pathologies, such as cardiovascular and inflammatory diseases (Marcelino et al., 2022).

The sum of monounsaturated fatty acids comprised 77.4% to 77.5%, while saturated and polyunsaturated fatty acids were 18.8% to 19% and 2.6% to 2.7%, respectively. These values were lower than the ranges observed for of olive oil. Consistent with these results, the iodine value of buriti oil was also lower than that of olive oil. The saponification value, however, was within the typical range observed for most edible oils.

The results of the present work were consistent with other reported studies on buriti oil, although some discrepancies were noted. For instance, Marcelino et al. (2022) found C18:2 content of 0.01%, while Speranza et al. (2016) reported 4.9%, for commercial

Table 1. Fatty acid composition (g fatty acid 100 g^{-1} of total fatty acids)[(1)] of buriti (*Mauritia flexuosa*) oils from two municipalities in the north state of Minas Gerais, Brazil[(2)].

Fatty acid	Cônego Marinho	Brasília de Minas
C16:0	16.95±0.090a	16.41±0.070b
C16:1	0.28±0.002a	0.25±0.002b
C17:0	0.09±0.001	0.08±0.000
C17:1	0.08±0.000	0.06±0.000
C18:0	1.93±0.004b	2.19±0.004a
C18:1	76.71±0.120a	76.85±0.190a
C18:2	1.64±0.001b	1.85±0.003a
C18:3	0.92±0.001a	0.88±0.002a
C20:0	0.09±0.001	0.10±0.002
C20:1	0.34±0.003b	0.37±0.002a
Saturated fatty acids	19.0	18.8
Monounsaturated fatty acids	77.4	77.5
Polyunsaturated fatty acids	2.6	2.7
Iodine value[(3)] (g 100g^{-1})	71.8	72.2
Saponification value[(3)] (mg KOH g^{-1})	194.8	194.7

[(1)]Results expressed as the average and standard deviation of three replicates. [(2)]Means followed by different letters, in the rows, are significantly different by Tukey's test, at 5% probability. [(3)]Calculated.

cold-pressed buriti oils. Conversely, Rodrigues et al. (2010) and Darnet et al. (2011) presented the a content of 2.1% of C18:2 for oils obtained from buriti pulp extracted by the Bligh and Dyer method from the municipality of Belém, PA, Brazil. Speranza et al. (2016) reported 8.2% of C18:3, which was not detected by Darnet et al. (2011) and Rodrigues et al. (2010), while the results of the present work were similar to those of Marcelino et al. (2022). These differences may be related to provenance, climatic conditions, genetic variation, and oil extraction methods, among other factors.

Buriti oil presented a high concentration of total tocopherols, with an average of 841.3 ± 35.6 μg g^{-1} for BOCM and 844.8 ± 26.62 μg g^{-1} for BOBM. Alpha-tocopherol was the main tocol with concentrations of 460.1 ± 23.47 and 463.3 ± 13.78 μg g^{-1}, respectively. This was followed by gamma-tocopherol (378.6 ± 11.53 and 378.7 ± 15.09 μg g^{-1}) and lower amounts of delta-tocopherol (2.5 ± 4.48 and 4.3 ± 2.54 μg g^{-1}). No significant differences were observed for the two buriti oil samples ($p < 0.05$).

Darnet et al. (2011) and Rodrigues et al. (2010) both reported gamma-tocopherol as the main tocol of buriti oil from Belém, PA, followed by alpha-tocopherol. However, these studies used a solvent-based extraction method, which may account for the differences. Rodrigues et al. (2010) reported gamma- and alpha-tocopherol contents of 476 and 197 μg g^{-1}, respectively, while Speranza et al. (2016) reported 1,074 and 1,125 μg g^{-1} of oil, respectively., According to Azzi (2019), alpha-tocopherol is the only tocopherol that has been shown to prevent vitamin E deficiency, while gamma-tocopherol is recognized for its strong antioxidant activity in bulk oils.

BOCM presented a total carotenoid content of 62,996.5 ± 383.96 μg $100g^{-1}$. β-carotene (40,645.5 ± 248.19 μg $100g^{-1}$) was the main content, followed by 13-cis-β-carotene (9,594.5 ± 58.69 μg $100g^{-1}$), 9-cis β-carotene (4,340.5 ± 26.16 μg $100g^{-1}$), and α-carotene (1,386 ± 8.49 μg $100g^{-1}$). Similarly, the oil from BOBM had a total carotenoid content of 79.734 ± 773.57 μg $100g^{-1}$. β-carotene (52.593 ± 510.53 μg $100g^{-1}$) was also the majority, followed by 13-cis-β-carotene (11.346 ± 110.31 μg $100g^{-1}$), 9-cis β-carotene (5.079 ± 49.50 μg $100g^{-1}$), and α-carotene (2.025 ± 19.80 μg $100g^{-1}$). The carotenoid contents of the buriti oil from both municipalities are very high, with β-carotene representing 65% of the total.

Variations in the carotenoid content are expected in fruits from different regions, considering that edaphoclimatic factors interfere with carotenoid biosynthesis (Coradin & Pombo, 2008), as well as the degree of fruit ripeness can also interfere with carotenoid content. Serra et al. (2019) reported a total carotenoid content of 1,722.87 μg 100 g^{-1} in Amazonian buriti oil, and Silva et al. (2009) evaluated five samples of Amazonian buriti oil from industrial and artisanal suppliers and found levels between 252 and 1,890 μg 100 g^{-1}.

BOCM and BOBM presented 20,669.5 and 26,802.75 μg 100 g^{-1} of retinol equivalent, respectively. The Recommended Daily Intake (RDI) for vitamin A is 800 μg RE for an adult (ANVISA, 2020b), which can be obtained from the ingestion of 3.9 and 3.0 mL, approximately a quarter of a tablespoon, of buriti oil from Cônego Mineiro and Brasília de Minas, respectively. The high retinol equivalent values indicate that ingesting small quantities of these buriti oils can contribute to preventing and/or mitigating vitamin A deficiency, which is a recognized public health issue in several countries and populations worldwide.

The stability of carotenoids in buriti oils from both provenances was evaluated in different packages (Figure 1). The total carotenoid levels remained stable up to 187 days of storage, with a 100% retention observed for the oils from both regions and in packages studied.

The buriti oils from both provenances had a free fatty acid content of 3.5%, while the samples presented peroxide values of 11 and 13 meq kg^{-1}, at the beginning of the storage for BOBM and BOCM, respectively, higher than the results reported by Marcelino et al. (2022). The limit of Brazilian regulation for free fatty acid content is 2% (4 mg KOH g^{-1}) and 15 meq Kg^{-1} for peroxide value (ANVISA, 2021). The content of conjugated dienes was around 0.15% to 0.16% for both oils.

The oil acidity is primarily a result of lipase activity on triglycerides, which releases free fatty acids. To prevent this increase in acidity, the wet pulp must be dried immediately after the fruit is pulped and bunch harvesting. Therefore, time is a crucial factor for obtaining high-quality oil. This process is artisanal and challenging, since the removal of pulp is time-consuming and difficult, because the pulp adheres tightly to the peel. Additionally, the pulp is dried naturally by sun exposure. These factors highlight that controlling the process conditions could improve the final oil quality.

Over the 186-day storage period, a significant and linear increase ($p < 0.05$) in free fatty acid content was observed for all four buriti oil samples, regardless of their packaging and origin (Figure 2). This increase in oil acidity may be attributed to the presence of residual water following pressing, which leads to the triacylglycerol hydrolysis. The acidity analysis by titration is not selective, as it measures not only fatty acids but also other acidic compounds resulting from

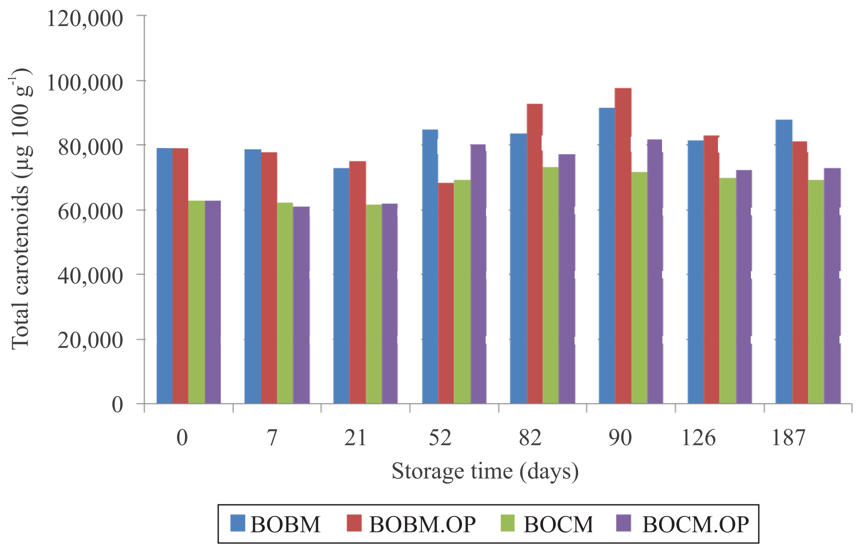

Figure 1. Total carotenoids in buriti oil from the municipalities of Cônego Marinho and Brasília de Minas, in the state of Minas Gerais, Brazil, during storage. BOBM, buriti oil from Brasilia de Minas; BOBM.OP, buriti oil from Brasilia de Minas original packaging; BOCM, buriti oil from Cônego Marinho; BOCM.OP, buriti oil from Cônego Marinho original packaging.

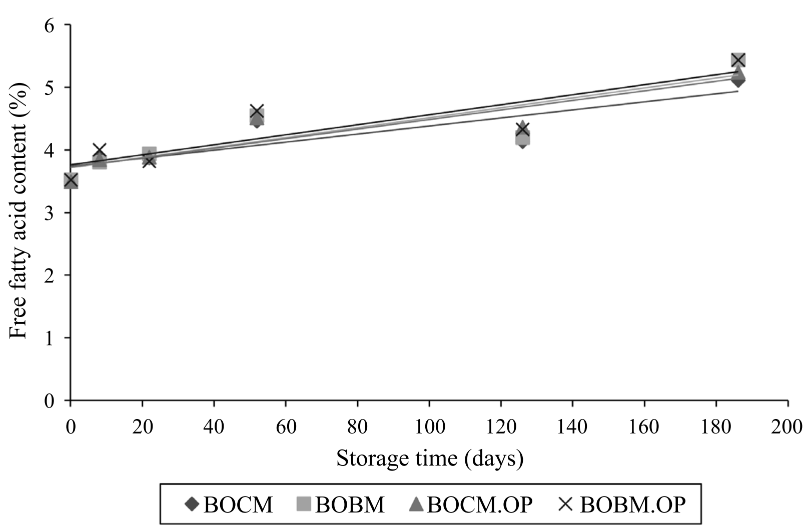

Figure 2. Oil acidity measured as free fatty acid content (% expressed as oleic acid) in buriti oil from the municipalities of Cônego Marinho and Brasília de Minas, in the state of Minas Gerais, Brazil, during storage. BOBM, buriti oil from Brasília de Minas; BOBM.OP, buriti oil from Brasília de Minas original packaging; BOCM, buriti oil from Cônego Marinho; BOCM.OP, buriti oil from Cônego Marinho original packaging.

the degradation of various oil components. Therefore, a low initial free fatty acid content is essential to prevent the oil from exceeding legal limits during storage.

The peroxide value of the buriti oils showed a trend of reduction during storage (Figure 3), although a significant and linear reduction ($p < 0.05$) was observed exclusively in the samples stored in PET plastic packaging. This difference is likely due to the permeability of PET to oxygen. The peroxide value and conjugated dienes are assays that measure primary oxidation products, and their presence confirmed that oxidation process was initiated because the content of C18:2 was very low. While the hydroperoxide formation increases exponentially during the propagation phase of lipid oxidation, it was not observed in the buriti oils. This stability can be attributed to the tocopherols, which either prevented the formation of hydroperoxides or reacted with free radicals. The antioxidant role of carotenes has also been observed for bulk oils.

A significant linear increase in conjugated dienes content was observed over the 186-day storage period ($p < 0.05$). BOBM showed a lower increase (from 0.16% to 0.2%) compared to the BOCM, which varied from 0.17% to 0.23% (Figure 4). Oxidation caused

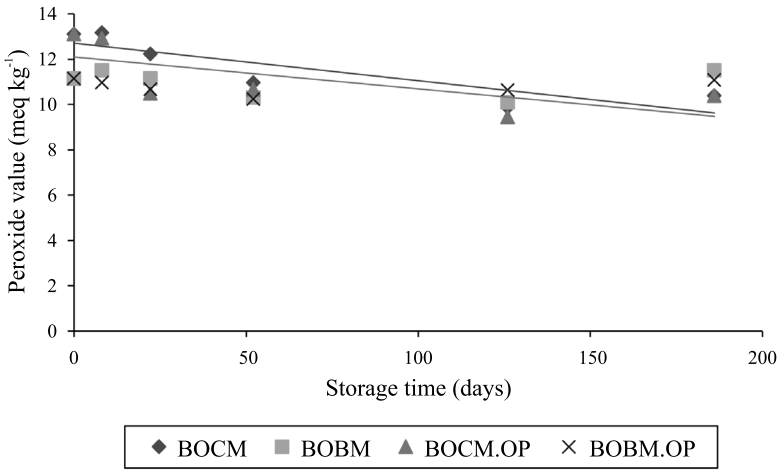

Figure 3. Peroxide value in buriti oil from the municipalities of Cônego Marinho and Brasília de Minas, in the state of Minas Gerais, Brazil, during storage. BOBM, buriti oil from Brasília de Minas; BOBM.OP, buriti oil from Brasília de Minas original packaging; BOCM, buriti oil from Cônego Marinho; BOCM.OP, buriti oil from Cônego Marinho original packaging.

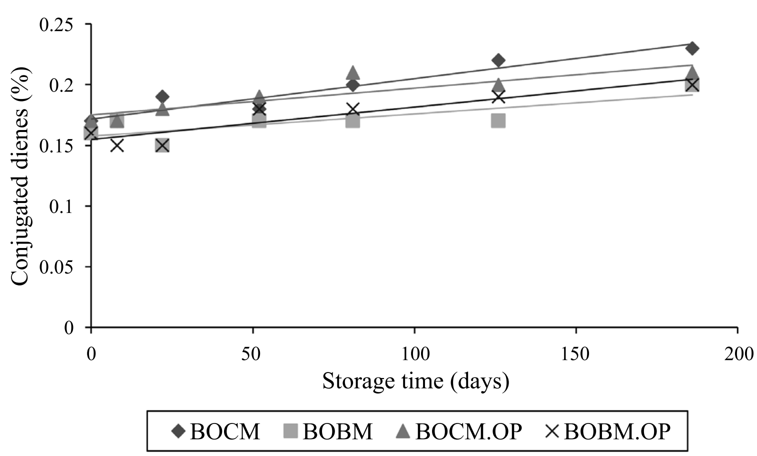

Figure 4. Conjugated dienes in buriti oil from the municipalities of Cônego de Minas and Brasília de Minas, in the state of Minas Gerais, Brazil, during storage. BOBM, buriti oil from Brasília de Minas; BOBM.OP, buriti oil from Brasília de Minas original packaging; BOCM, buriti oil from Cônego Marinho; BOCM.OP, buriti oil from Cônego Marinho original packaging.

DOI: 10.1590/S1678-3921.pab2025.v60.04132

the isomerization of linoleic acid (C18:2), which generated conjugated dienes with conjugated double bonds. Although this process occurred during storage, it is not possible to evaluate if these compounds are conjugated hydroperoxides, free radicals, or fatty acids. Additionally, the compounds generated by lipid oxidation process react with tocopherols and carotenes, reducing the initial amounts in the oil.

The coproduct obtained by expeller pressing showed lower levels of protein (6.55 and 6.5 g 100 g^{-1}), moisture (5.96 and 5.78 g 100 g^{-1}), and ashes (3.89 and 4.18 g 100 g^{-1}) for the oils from COCM and COBM, respectively. The residual oil content was 8.2% and 8.0%, which highlighted the efficacy of the screw pressing method (expeller) on dried buriti pulp. This efficacy depended on the pressing conditions, pre-treatment performed, and composition of raw materials, such as the oil content of raw material. The coproduct also exhibited a high content of dietary fiber (54.11 and 52.28 g 100 g^{-1}), which is favorable for its application in food due to its potential health benefits. The carbohydrate content, comprised of sugars and starch, was 21.29 and 23.26 g 100 g^{-1}, and low caloric values of 185 and 191 kcal 100 g^{-1} for COCM and COBM, respectively.

Water activity (WA) was evaluated throughout the storage of the coproduct. Initially, the WA values were 0.49 and 0.43 for oils from COCM and COBM, respectively. These values increased slightly over the storage period, reaching 0.53 for COCM and 0.47 for COBM at the 169-days mark. The differences in WA between the coproducts from the two regions were expected, given that the pre-processing for drying the buriti peels operation was carried out in different locations. Considering both WA values and the moisture content of less than 6%, the coproducts from both regions presented adequate conditions concerning food safety.

The total carotenoid contents at initial storage time were 4,302.5 µg 100 g^{-1} for COCM and 4,857 µg 100 g^{-1} for COBM. The main carotenoid content of the coproducts was β-carotene (2,480.5 µg 100 g^{-1} and 2,766 µg 100 g^{-1}), followed by 13-cis β-carotene (662.5 µg 100 g^{-1} and 749 µg 100 g^{-1}), 9-cis- β-carotene (299 µg 100 g^{-1} and 304 µg 100 g^{-1}), and α-carotene (136 µg 100 g^{-1} and 188 µg 100 g^{-1}). According to Coradin & Pombo (2008), foods with more than 2,000 µg 100g^{-1} of carotenoids are considered rich sources of these important compounds. Therefore, the coprodut from both regions can be considered as significant sources of provitamin A carotenoids.

Total carotenoid levels remained stable for up to 169 days of storage (approximately six months), with a retention of 85% for COCM and 88% for COBM in the coproduct (Figure 5). This is a notable finding, considering that carotenoids are normally unstable in powdered products due to their exposure to oxygen, which leads to degradation. Therefore, the oil present in the buriti coproduct may have contributed to the preservation of the carotenoids. Furthermore, the absence of lipid oxidation is a particularly interesting result, as it indicates that the sensory characteristics

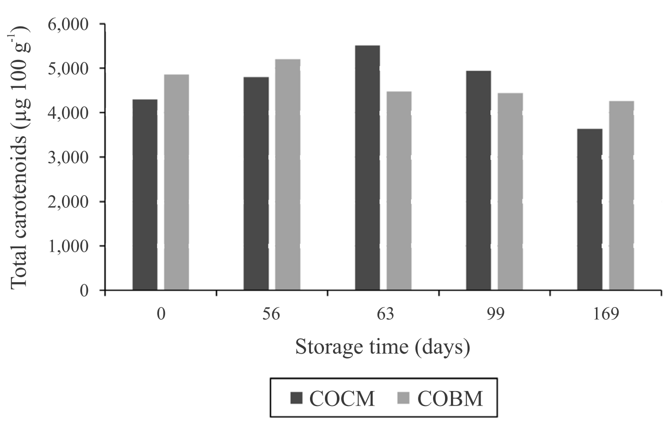

Figure 5. Total carotenoids in buriti coproduct from the municipalities of Cônego de Minas and Brasília de Minas, in the state of Minas Gerais, Brazil, during storage. COCM, coproduct from Cônego Marinho; COBM, coproduct from Brasília de Minas.

of the coproduct were likely preserved throughout the storage period.

Ensuring the quality and stability of buriti pulp oil and its coproduct increases their potential for use as natural food ingredients and enables large-scale commercialization. This adds value to products from Brazilian biodiversity, which can be produced and processed sustainably. Such initiatives generate income, combating poverty and regional inequalities. This work was conducted in partnership with a cooperative that produces buriti oil through Good Management Practices for sustainable extractivism, with family farmers and agroextractivists as the main beneficiaries.

Conclusions

1. The buriti (*Mauritia flexuosa*) oil from fruits collected in the Cerrado biome in the municipalities of Cônego Marinho and Brasília de Minas, in the state of Minas Gerais, Brazil, present adequate quality for use as food ingredient, except for the free fatty acid content, which can be reduced by adopting Good Practices.
2. The oils show excellent oxidative stability throughout storage due to the high content of carotenoids and tocopherols.
3. Buriti oils present high levels of provitamin A carotenoids, which remain stable throughout the shelf life studied across different packaging; and small quantities of buriti oil can provide the adult Recommended Daily Intake of vitamin A.
4. The oils can be used as natural food coloring.
5. Defatted buriti cakes show high levels of fiber and provitamin A carotenoids, indicating their potential as a functional ingredient; and after being stored for 169 days, they maintain adequate water activity, ensuring food safety.

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Chief editor: Edemar Corazza
Edited by: Célia Tremacoldi

Data availability statement

Data in article: research data are available in the published article.

Declaration of use of AI technologies

No generative artificial intelligence (AI) was used in this study.

Conflict of interest statement

The authors declare no conflicts of interest.

Acknowledgments

To Empresa Brasileira de Pesquisa Agropecuária (Embrapa), for financial support (Project Number 30.22.90.008.00.00) and to family farmers of Cooperativa Grande Sertão, for the partnership in the research development.

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