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REVIEW

Bacaba, Pracaxi and Uxi Oils for Therapeutic Purposes: A Scoping Review

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Abstract: Fruits such as bacaba (*Oenocarpus bacaba* Mart), pracaxi (*Pentaclethra macroloba* Kuntze) and uxi (*Endopleura uchi* (Huber) Cuatrec), from the Amazon rainforest, are potentially interesting for studies of natural products. The current article aims at mapping and characterizing studies on the bacaba, pracaxi and uxi species. This review reports the main bioactive compounds identified in these species and discusses their therapeutic potential. Searches were performed in MEDLINE (Via Pubmed) and Web of Science. Thirty-one studies that described or evaluated the development of formulations aimed at the therapeutic use of the species were included. The findings suggest that species have the potential for the development of pharmaceutical formulations due to their therapeutic properties. However, further studies are required to assess safety and efficacy of these products. Therefore, it is suggested that new research studies propose strategies so that technological development is based on awareness and preservation of the biome.

Key words: *Oenocarpus bacaba* Mart, *Pentaclethra macroloba* Kuntze, *Endopleura uchi* (Huber) Cuatrec, phytomedications, Amazon biome

1 Introduction

The Amazon rainforest, belonging to the Brazilian territory, has a diversity of plants and plant species, including native ones little or not at all investigated. Fruits commonly used in the locus, such as bacaba (*Oenocarpus bacaba* Mart), pracaxi (*Pentaclethra macroloba* Kuntze) and uxi (*Endopleura uchi* (Huber) Cuatrec), are potentially relevant for studies of natural products, as vegetable oils are known to have beneficial health effects, in addition to being abundant and readily available renewable resources[1].

Bacaba one of the most studied species, has valuable nutritional potential, as its oil is rich in unsaturated fatty acids, nonetheless, there is little knowledge about it, mainly about its chemical composition[2, 3].

Pracaxi provides oil with high concentrations of oleic, linoleic and behenic fatty acids, and the oil extracted from the seeds of this plant has been used for therapeutic activities such as wound and cut healing, skin hydration and cell renewal, and other dermatological[1, 4].

Like these species, uxizeiro popularly known as "uxi-amarelo" or "uxi-smooth", presents antioxidant action, its bark is used in the preparation of teas and is indicated as an adjuvant in the treatment of diseases of the female urinary tract, inflammation of the uterus, diabetes and arthritis[5−8].

To date, the published reviews about the fruits from the Amazon biome are scarce. A review evaluating the use of

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nutraceuticals prepared from fruits and seeds from the Amazon did not consider the bacaba, pracaxi and uxi oils[9]. These reviews did not perform a systematized mapping of information about the biomes[9, 10].

This scoping review can assist researchers in the development of phytomedications from the Amazon biomes and as well as increase the options of medications in the therapeutic arsenal of the Unified Health System (Sistema Único de Saúde, SUS)[11]. Therefore, the current study aims at mapping and characterizing studies on the bacaba, pracaxi and uxi species, belonging to the Amazon rainforest.

2 Materials and Methods

2.1 Study design

This scoping review followed the methodological guidelines proposed by the Joanna Briggs Institute and was reported following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses - Extension for Scoping Reviews (PRISMA-ScR) checklist[12, 13].

2.2 Protocol and registration

A protocol has been previously developed and is available, with open access, in the Open Science Framework repository[14].

2.3 Eligibility criteria

2.3.1 Population

Plants of the bacaba, pracaxi and uxi species, regardless of the plant organ.

2.3.2 Types of study

Primary studies that described or evaluated the development of formulations aimed at the therapeutic use of the bacaba, pracaxi and uxi species were included.

2.3.3 Outcome

Therapeutic effects of the bacaba, pracaxi and uxi species.

2.4 Information sources

2.4.1 Databases

The following databases were consulted: MEDLINE (Via PubMed) and Web of Science.

2.4.2 Other information resources

1. The Grey Literature was consulted from the following repositories: Google Scholar to identify potentially eligible studies;
2. A manual check of the references of the studies included was performed;
3. An automatic alert in the databases was monitored until November 2022 to identify eligible studies.

2.4.3 Search strategy

A previously developed search strategy was used with the following keywords accompanied by Boolean operators: "*Bacaba*", "*Uxi*", "*Pracaxi*", "*Oenocarpus bacaba*", "*Endopleura uchi*", "*Pentaclethra macroloba*", "*composition*", "*formulation*", "*phytochemistry*". The strategy has been adapted for each database as well as for the other information resources and is described in full in appendix additional 2. No restrictions regarding year of publication were applied and only studies in English, Spanish and Portuguese were selected.

2.5 Eligibility determination

The references were managed and screened in the Rayyan software (*Qatar Computing Research Institute*) and all duplicates were automatically removed. The titles and abstracts were independently evaluated by two reviewers (MSA and LPNL) to verify whether they met the eligibility criteria. Subsequently, a full reading of the studies was performed by the same reviewers (MSA and LPNL), also independently, to confirm eligibility of the guidelines. Any and all discrepancies were resolved by consensus or by a third reviewer (ZMFF), when necessary.

2.6 Data extraction

The information was organized in a Microsoft Excel spreadsheet; the same reviewers (MSA and LPNL) independently extracted the data. Any and all discrepancies were resolved through discussion and consensus, or with the help of a third reviewer (ZMFF). Previously, the reviewers had been calibrated by extracting at least three documents of different quality levels and reaching consensus. This procedure was repeated until the reviewers could extract the data. For this study, the following data were considered: 1) Characteristics of the studies: country, study design and bibliometric information; 2) Characteristics of the plants: genus, species, main marker, majority components, therapeutic activity and plant organ used, results, limitations and conclusions.

2.7 Synthesis of the results

The data were presented and categorized by plant and descriptively according to guidelines for systematic reviews without meta-analysis[15].

3 Results

A total of 233 references were identified. Of these, 48 duplicate publications were automatically removed and a total of 185 records were included for initial screening. Based on the reading of titles and abstracts, 39 studies were excluded and 146 were included for full-text review. A detailed analysis of these studies resulted in the inclusion of 31 studies for data synthesis. The process to select the studies is described in Fig. 1. Six articles dealing with the bacaba species were identified, as well as 13 articles for

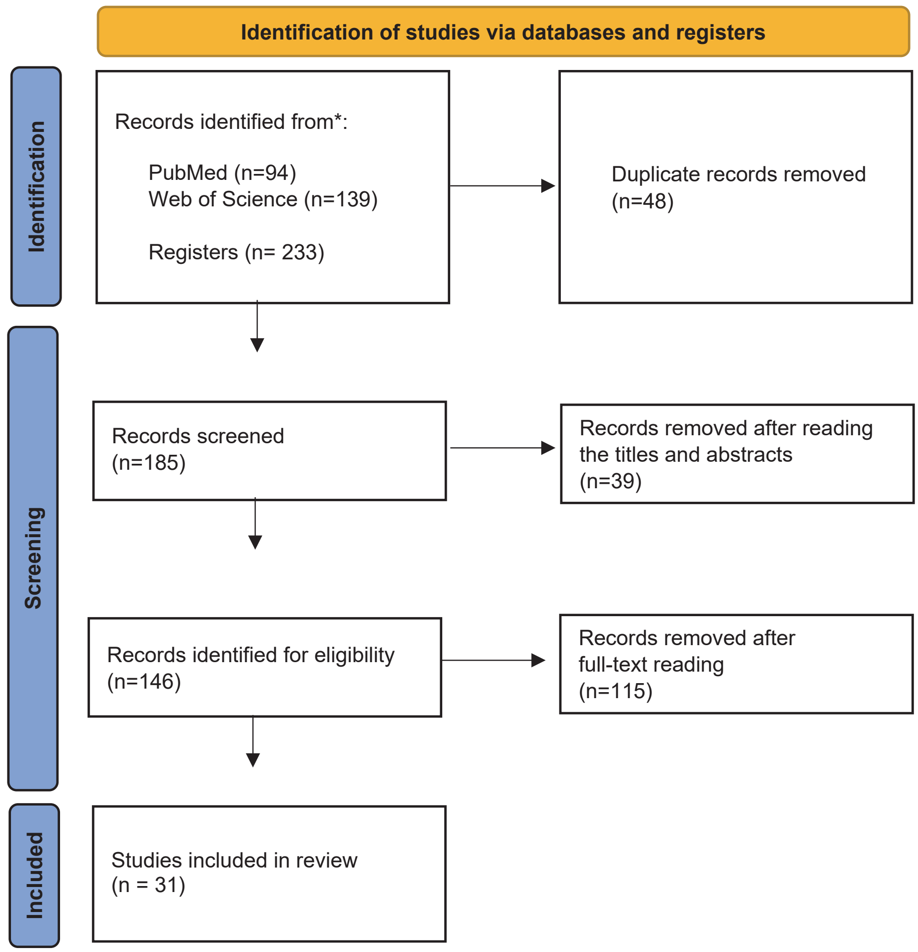

Fig. 1 PRISMA flowchart describing the results of the searches in the databases and the reference list of the selected studies.

pracaxi and 12 for uxi.

3.1 Distribution and agricultural production of Bacaba, Pracaxi and Uxi in Brazil

3.1.1 Bacaba (*Oenocarpus bacaba* Mart.)

All the studies included (n = 6) were analytical and Brazilian. Of these, 5 were carried out in the North region of the country. Only one study did not report the plant organ used, the others used the bacaba fruit. No study reported the main markers; however, three cited their major components: oleic and palmitic acids. Only one study identified α-tocopherol, a potent antioxidant, in this species (Table 1).

3.1.2 Pracaxi (*Pentaclethra macroloba* Kuntze)

No study on Pracaxi reported the main marker, and only one presented seeds of the species as the plant organ used. However, nine of them classified oleic acid as its major component, followed by behenic acid. As for the design of the studies, ten were analytical and conducted in four Brazilian states (nine of these belonging to the North region); two were experimental; and one referred to clinical research, which is an international study (Table 1).

3.1.3 Uxi (*Endopleura uchi* (Huber) Cuatrec)

Among the studies identified on Uxi (n = 12), the majority were Brazilian (n = 11). Of these, seven were conducted in the Brazilian North region and the others (n = 4) in the states of São Paulo (n = 3) and Rio de Janeiro (n = 1). Four were analytical studies and eight were related to experimental research. Eight of them used the fruit peel as plant organ, but in different ways: powdered bark, bark extract and stem bark. Two studies used uxi pulp and one employed leaves and branches from this species. Only two reported fatty acids as major components, and eight classified bergenin and its derivatives as main markers (Table 1).

3.2 Beneficial compounds and therapeutic use using Bacaba, Pracaxi and Uxi

3.2.1 Bacaba

Of the studies included for Bacaba (n = 6), some did not report its therapeutic applications (n = 3) while others confirmed its use for the treatment of cardiovascular diseases (n = 3), and its potent antioxidant activity (n = 1). Three

Table 1 Distribution and agricultural production of Bacaba, Pracaxi and Uxi in Brazil.

Reference	Study locus	Study design	Plant organ	Main marker	Major components
			Bacaba		
16)	Brazil - Tocantins	Primary study - Analytical	Fruit	Not reported	Oleic acid (30.7%) and palmitic acid (10.3%)
17)	Brazil - Amapá	Primary study - Analytical	Fruit	Not reported	α-tocopherol
18)	Brazil - Amapá	Primary study - Analytical	Fruit	Not reported	Oleic and palmitic acids
19)	Brazil - Amapá	Primary study - Analytical	Fruit	Not reported	Not reported
20)	Brazil - Pará	Primary study - Analytical	Fruit	Not reported	Oleic acid (61.16%) and palmitic acid (23.30%)
21)	Brazil - Brasilia	Primary study - Analytical	Not reported	Not reported	Oleic acid
			Pracaxi		
22)	Brazil - Pará	Primary study - Analytical	Seed	Not reported	Oleic acid (53%), behenic (1,6%), linoleic (1,3%), lignoceric (1,8%) and linolenic acid (2,5%). Subsequently, the uric, myristic, aquídic and erucid fatty acids were found in the pracaxi oil
1)	Brazil - Pará	Primary study - Analytical	Seed	Not reported	Oleic, behenic, linoleic and lignoceric acids
23)	Brazil - Pará	Primary study - Analytical	Not reported	Not reported	Stearic, oleic, linoleic and erucic acids
24)	Brazil - Rio Grande do Sul	Primary study - Analytical	Not reported	Not reported	Not reported
25)	United States - Houston	Primary study - Clinical Research	Not reported	Not reported	Oleic, linoleic and behenic acids
26)	Brazil - Pará	Primary study - Experimental Research	Not reported	Not reported	Not reported
2)	Brazil - Pernambuco	Primary study - Experimental Research	Not reported / Seed	Not reported	Oleic, behenic, stearic and palmitic acids
27)	Brazil - Pará	Primary study - Analytical	Not reported	Not reported	Oleic acid (47.3%) and behenic (22.6%) acids
28)	Brazil - São Paulo	Primary study - Analytical	Not reported	Not reported	Not reported
29)	Brazil - Pará	Primary study - Analytical	Not reported	Not reported	Oleic, behenic and lignoceric acids
30)	Brazil - Pará	Primary study - Analytical	Seed	Not reported	Oleic (72.16%), linoleic (18.84%), stearic (4.65%) and palmitic (2.3%) acids
31)	Brazil - Pará	Primary study - Analytical	Not reported	Not reported	Phenolic compounds (84.5%), carotenoids (10.9%), antioxidant capacity (2.2%)
32)	Brazil - Pará	Primary study - Analytical	Not reported	Not reported	Oleic and behenic acids and triolein triglycerides
			Uxi		
33)	Brazil - Pará	Primary study - Experimental Research	Powdered bark	Acetylbergenin	Not reported
34)	Brazil - São Paulo	Primary study - Experimental Research	Powdered bark	Not reported	Not reported
35)	Brazil - São Paulo	Primary study - Experimental Research	Wood bark	Not reported	Not reported
36)	Portugal - Porto	Primary study - Experimental Research	Powdered bark	Bergenin and derivatives	Not reported
37)	Brazil - Amazonas	Primary study - Experimental Research	Stem	Bergenin	Not reported
38)	Brazil - Amapá	Primary study - Experimental Research	Bark	Bergenin	Not reported
39)	Brazil - Amapá	Primary study - Experimental Research	Stem bark	Bergenin	Not reported
40)	Brazil - Rio de Janeiro	Primary - Analytical Study	Pulp and peel	Not reported	Linoleic acid
41)	Brazil - Amazonas	Primary - Analytical Study	Leaves, twigs and barks	Bergenin	Not reported
7)	Brazil - São Paulo	Primary study - Experimental Research	Phytocomplex	Bergenin	Not reported
8)	Brazil - Pará	Primary - Analytical Study	Pulp	Not reported	Oleic, linoleic, palmitic and stearic acids
42)	Brazil - Amazonas	Primary - Analytical Study	Peel extract	Bergenin	Gallic and quinic acids

Table 2 Beneficial compounds and therapeutic use using Bacaba, Pracaxi and Uxi.

Reference	Results	Therapeutic applications	Conclusion
		Bacaba	
17)	Monounsaturated fatty acids were the most abundant and, in all samples, the main compounds were diacylglycerols. Higher concentrations of tocopherols and tocotrienols	Monounsaturated fatty acids provide protection against cardiovascular diseases	The oils mentioned in the study have great potential as edible vegetable oils. In addition to the high content of monounsaturated fatty acids, bioactive compounds can confer them added value as healthy oils
18)	The content of free fatty acids in the bacaba oil exceeded the maximum limit set of 2%. The content in unsaturated fatty acids was around 70%	Monounsaturated fatty acids provide protection against cardiovascular diseases	The bacaba oil has had high levels of monounsaturated fatty acids and can be considered a healthy oil, providing protection against cardiovascular diseases
20)	The highest global yields of the bacaba oil were observed under conditions of higher pressures and CO_2 densities. The antioxidant capacity values were lower than those found in the literature	Prevention of chronic-degenerative diseases and treatment of cardiovascular diseases	The increase in temperature and pressure favored the increase of mass yield in the extraction process of the bacaba oil with supercritical CO_2. It can be used in human diets, such as table oil, similar to olive oil
21)	Formulation corroborating with other studies on microemulsions containing oil extracted from natural products. Drop size was consistent	Potential antioxidant activity	The bacaba oil microemulsions developed with the highest amount of water were stable and increase the antioxidant potential of the oil when compared to their respective oil dilutions
		Pracaxi	
25)	The patient applied handled medication in the ulcer for 6 days and, at the end of the application period, the ulcer was completely closed and the patient reported a significant reduction in pain. A handled drug containing the mupirocin (2%) antibacterial agent was prescribed on an anhydrous silicone base containing pracaxi oil, applied topically and directly to the ulcer three times a day	Anti-inflammatory	Handled drugs based on topical anhydrous silicone containing fatty acids from the pracaxi oil may be valuable in the treatment of diabetic ulcers
26)	The pracaxi oil contains large amounts of oleic, linoleic and behenic acids, which are often used in the cosmetic industry due to their ability to maintain the skin moist. A number of studies have found different concentrations of behenic acid in the pracaxi oil	Wound healing. Lipids can also protect the skin by preventing dehydration	Many of the oils included in this study have a fatty acid similar profile to commercial reference lotions, which would suggest that these oils may be an alternative and natural source of fatty acids for wound treatment applications. These results would support the development of a new product using a balanced composition of fatty acids from natural sources as an alternative method for the treatment of wounds
30)	One of the highest contents of monounsaturated fatty acids was found in the pracaxi oil. The pracaxi oil is a good source of vitamin E, as four isomers of methyl tocol were identified, with γ-tocopherol as the most prevalent, accounting for nearly 70% of the total vitamin E content. Total carotenoids were detected only in the buriti and pracaxi oils; however, the carotenoid content in the pracaxi oil has never been reported in the literature	Antioxidant and anti-inflammatory activities, preventing chronic diseases such as cancer, cardiovascular and neurodegenerative diseases	Oils with a high oleic acid content, methyl tocois and total carotenoids (i.e . pracaxi), can be used as health-promoting products
		Uxi	
46)	A given sample containing acetylbergenin showed a significant analgesic effect ($p<0.05$) in acetic acid-induced abdominal constrictions, so it has an analgesic effect of peripheral origin. and a given dose was able to significantly inhibit the second phase of formalin testing, indicating an action related to the inflammatory process	Possible analgesic and anti-inflammatory activities	Acetylbergenin can produce antinociceptive effects by inhibiting cyclooxygenase and reducing the synthesis of prostaglandins

studies concluded that bacaba has great potential as a healthy vegetable oil, and only one used this asset for the development of formulations (Table 2).

3.2.2 Pracaxi

Only three articles reported therapeutic applications for this oil, being considered good for healing due to its antioxidant and anti-inflammatory activities, also assisting in other types of chronic diseases such as cancer, cardiovascular and neurodegenerative diseases. Five studies concluded that it can be used in the pharmaceutical industry, as well as in food and/or cosmetics. Three studies considered pracaxi valuable in the treatment of wounds due to the presence of fatty acids. (Table 2).

3.2.3 Uxi

The studies agreed that this species has possible anti-inflammatory action (n = 4). Three mentioned its antioxidant activity e one concluded its great antidiabetic potential and another. Only one considered that this species can be used as a phytotherapeutic product in the treatment of coronary and cardiovascular diseases. Other studies have found that further research is required to encourage use of its extracts in human health applications (n = 2). A research study con-

Table 2 Continued.

Reference	Results	Therapeutic applications	Conclusion
35)	A crude polysaccharide (AGb) obtained from the decoction of the *E. uchi* bark was purified, obtaining an arabinogalactan (AG) type II that was characterized by chemical and spectroscopic methods. The results suggest that the cytotoxicity exhibited does not involve pathways related to the cell cycle	Decoction of the *E. uchi* bark, which is used in traditional medicine as an anti-inflammatory agent and to treat arthritis, cholesterol, diabetes, uterine infections and fibroids, contains an arabinogalactan type II	Purified arabinogalactan from *E. uchi* bark decoction exhibited antiproliferative effect against HeLa cells
36)	HPLC analysis of *E. uchi* bark extracts allowed identifying five phenolic compounds. Antibacterial activity was investigated against several strains of bacteria and there was no considerable variation between the different bacteria and extracts studied	*E. uchi* bark can be considered as a part of the plant with great antidiabetic potential	Extracts from *E. uchi* bark are a rich source of bergenin and bergenin derivatives presenting inhibiting properties against α-glycosidase, antibacterials and cholinesterases (AChE and BuChE) and radical elimination capacity
40)	The ethanol extract of Uxi (EU) showed the highest content of phenolic compounds. The main bioactive compounds were terpenoids; Phenolic and flavonoid acids were identified in aqueous and ethanolic extracts, respectively. In EU extracts, 23% of terpenes were also identified. The heat map indicated that the metabolites found in uxi extracts showed higher abundance when compared to other extracts, especially in ethanol ones. The highest antioxidant activity was found in the ethanolic Uxi samples. In relation to the ORAC assay, the results revealed that extracts with uxi obtained higher values	Antioxidant	The results of this study highlight the potential of uxi as a valuable source of natural antioxidants
41)	Highest concentrations of bergenin in methanolic extracts from the bark and lowest concentration in aqueous extracts from branches. The extracts and fractions can be considered as a source of active substances in the treatment of inflammatory processes	Anti-inflammatory and antioxidant	The results were positive for antioxidant activity by iron reduction, methods of depth radical elimination capacity, as well as anti-inflammatory activity. They suggest that the *Endopleura uchi* species can be considered an important plant material with therapeutic potential
7)	Phytocomplex was able to reverse the cytotoxicity caused by LPS in all these cell lines. The treatment of chondrocytes with Phytocomplex reduced the secretion of interleukins and chemokines, corroborating the literature. In addition, it may presented as an adjuvant therapy in the treatment of psoriasis	Anti-inflammatory and antioxidant	In this sense, the literature shows that some bioactive molecules present in the components of the Miodesin™ formulation may have an epigenetic effect, and understanding these aspects can generate strategies for the development of new therapeutic approaches, making room for future studies with the objective of investigating the participation of Miodesin™ in epigenetic mechanisms related for the control of different inflammatory processes
8)	Oil from uxi + CO_2 showed a direct relationship between CO_2 yield, pressure, and density. It was possible to extract the oil through lower energy consumption and less work performed by the pump	It can be applied in the synthesis of functional food products or as a herbal product in the treatment of coronary and cardiovascular diseases based on *n*-9 and *n*-6	A number of studies have shown that the uxi oil has functional quality due to the majority composition of fatty acids. It can be consumed in human diet as table oil, similar to olive oil

sidered the benefits and advantages of uxi, such as functional quality effects due to the majority composition of fatty acids (Table 2).

4 Discussion

The studies included point to the Brazilian biodiversity, as it has in its territory biomes rich in animal and plant species, such as the Amazon[9, 16, 17, 18, 25, 28, 29, 39]. Among the plant classes, there is bacaba, pracaxi and uxi.

Twenty-one articles included in this review were conducted in northern Brazil. The fruits belong to native trees in this region of the country, which explains the widespread use by the local population[40].

Plants have been important sources of constituents with pharmacological activities, especially fatty acids. This justifies the fact that this class was mentioned among the studies on these oils, indicating their potential and nutritional quality[7, 17, 21]. Oleic acid, for example, which was mainly present in all oils, ranging from 30.7% to 72.16%, due to its hypocholesterolemic action, has the advantage of not reducing High-Density Lipoprotein (HDL) cholesterol[43]. It is considered promising for pharmaceutical formulations because it has properties that improve wound healing[27].

Linoleic acid, reported in six studies, when ingested, through the action of the elongase and desaturase enzymes, undergoes an unsaturated reaction and is converted into longer-chain polyunsaturated fatty acids[44, 45]. These compounds are present, for example, in the production of hormones such as Series 3 Prostaglandin, which regulates and protects the body against various effects, such as platelet aggregation (due to its antithrombotic activation) and reduces the risk of cardiovascular diseases[44].

In addition to the fatty acids found predominantly in all species, some studies[5, 6, 36–38, 40, 41, 46] cited another chemical class identified as dominant in uxi: Bergenin, a *C*-glycoside from 4-*O*-methyl gallic isolated from several medicinal plants with multiple biological activities. Its antimalarial, antidiabetic, anti-cancer, gastroprotective, antituberculosis, antiarrhythmic, hepatoprotective, antiviral, antiangiogenic, neuroprotective, immunomodulatory, antimicrobial, hypolipidemic, healing, antioxidant, anti-hyperuricemic activities and anti-inflammatory properties stand out[47]. This suggests that this plant has great potential to be used as a therapeutic agent for the development of more effective and safer phytomedications[48].

A number of research studies also cite the presence of phenolic compounds[16, 30] such as α-tocopherol, commonly known as vitamin E, and considered one of the best natural antioxidants in the bacaba and pracaxi species, and this demonstrates the antioxidant profile and potential therapeutic application against inflammatory diseases of these plants[16, 29]. Inflammation and oxidative stress are related to phenomena involved in pathological conditions such as cardiovascular and phenolic compounds that can contribute to the reduction of inflammatory events[49].

Several therapeutic applications were mentioned for the species chosen for this study. Some authors agree on the protection that bacaba confers against cardiovascular diseases[17, 21, 42]. As well as others, which inquired that pracaxi has anti-inflammatory and healing actions and prevents chronic diseases such as cancer, cardiovascular and neurodegenerative diseases, respectively[23, 26, 28].

For uxi, the records indicate analgesic and anti-inflammatory activities to treat arthritis, cholesterol, diabetes, uterine infections and fibroids[34, 46] for example. It also mentioned great antidiabetic potential[35], antioxidant activity[6, 40] and the usefulness of this species in the treatment of coronary and cardiovascular diseases[7].

Due to the antioxidant knowledge about the bioactive compounds present in these species, some studies have performed phytochemical assays for uxi[5, 33, 35, 36, 39, 40]. These assays focus on models capable of discovering molecular profiles with high antioxidant power or even evaluating the antioxidant potential of a molecule already known and extracted.

The *in vitro* phytochemistry studies included in this review used extraction methods to obtain a specific molecule or molecular type. Among them, two evaluated antioxidant activity by the DPPH assay, considered a rapid methodology for this objective[36, 40]. While one study found positive results for uxi's *in vitro* antioxidant capacity, another reported low antioxidant activity of this species by this same methodology.

The planting modality and place are limiting factors in the cultivation of some species, as it is obvious that plants depend on climate and soil conditions[27]. This can be highlighted by the findings of the review, which identified different profiles of most of the products in the same species. Although most studies mention these predominant compounds, others did not perform this evaluation. It is of paramount importance to know the profile of these products since, although compounds isolated from plant extracts present biological activity, their crude extracts may not have all the desired characteristics[50].

Although they are promising natural resources, studies related to the oils of the studied species (bacaba, pracaxi and uxi) have some limitations, such as variation of fatty acid concentrations according to temperature and pressure, which can directly influence quality of the final product formed by these plants and consequent oxidation[19, 21, 26]. In addition, when considering the development of formulations that have applicability in the pharmaceutical sector, it is necessary to choose chemically compatible constituents, as some substances may or may not present antioxidant activity when isolated[27].

The methodologies used by two authors for extracting and obtaining pracaxi oil, respectively, require the use of solvents, which, despite showing positive perspectives, deserve attention regarding toxicity, as its traces can remain in the oil and, therefore, in the case of medicinal products, an adequate choice is needed[28, 32, 50].

Although all studies have cited positive results for uxi, such as antinociceptive effects that inhibit cyclooxygenase[46], the antiproliferative effect of this plant against HeLa cells[34], inhibiting properties of α-glycosidase, antibacterials and cholinesterases[35], substantial antioxidant activity *in vitro* and *in vivo*[36], they showed the need for further research studies on the use of their extracts in therapeutic applications, as their biological activities, as well as their toxicological profile, are not yet elucidated[36]. In addition, few studies have been conducted in humans, and it is necessary to propose clinical trials, especially randomized and controlled, for a safety and efficacy measure.

From the statements related to the main bioactive compounds and the therapeutic potential identified in these species, however, some limitations emerge due to the absence of important parameters, such as, absence of clinical trials, heterogeneity of studies, methodological quantitative analysis, difficulties in large-scale exploration, variability extraction methods and others. In view of this, this review maps information from the literature that may help in the development of studies focused on this topic in the future, since more investigations and outcomes are needed for this population.

The therapeutic effects reported in the studies included in this review are, for the most part, assumptions that are not based on evidence, since this proof requires the performance of clinical trials that must be approved and monitored by ethical and regulatory authorities to ensure that the ethical conduct and technical aspects of research conform to the required standards[51].

It is noted that there is potential in these plants for technological prospecting and investment in more economical, safe and sustainable products for the environment, especially because they meet the SUS epidemiological demands, as cardiovascular diseases, the main therapeutic activity elucidated, represent a significant percentage of expenses and availability of high-complexity services for public health[52].

As they are considered an important source of biologically active natural products, there are some dilemmas regarding the development of medications, as it is necessary to use techniques that allow obtaining a final product with stability, quality and efficacy also for acceptability by the population, as suggested by studies involving the Evaluation of Health Technologies[53, 54]. For the pharmaceutical sector, herbal medications can mean an opportunity for development, not only because of the abundance of the country's fauna and flora, but also because of the traditional and scientific knowledge about the biological activity of plants[55].

Although many Brazilian studies have shown promising results on bacaba, pracaxi and uxi, none of them proposed strategies for the sustainable use of these plants, nor have they presented any concern regarding environmental preservation in technological innovation. In this sense, it is necessary to conduct studies that prioritizes herbal medications, but also that include sustainable development from environmental awareness in their methodology[56, 57].

This scoping review followed the methodological guidelines proposed by the Joanna Briggs Institute and was reported following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses - Extension for Scoping Reviews is provided in appendix additional 1 to document the completeness of reporting of this review (PRISMA-ScR) checklist[12, 13]. As for limitations, there is the fact that only 2 scientific databases were consulted. Nevertheless, to mitigate publication bias, searches were conducted in the Grey Literature.

5 Conclusion

The findings of this scoping review suggest that products from bacaba, pracaxi and uxi have a potential for the development of pharmaceutical formulations due to their therapeutic properties. However, further studies are required, especially randomized controlled clinical trials, to assess safety and efficacy of these products. Furthermore, future studies need to prioritize environmental-centered development, as none of the studies identified mentioned any strategy for environmental preservation.

Conflict of Interest

The authors declare that there is no conflict of interest.

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Appendix 1 Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist.

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
TITLE			
Title	1	Identify the report as a scoping review.	1
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	3
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	3
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and, if available, provide registration information, including the registration number.	6

Appendix 1 Continued.

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	6
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date in which the most recent search was performed.	7
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, so that it could be repeated.	6
Selection of sources of evidence †	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	7
Data charting process ‡	10	Describe the methods for charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from researchers.	7
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	7
Critical appraisal of individual sources of evidence §	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was employed in any data synthesis (if appropriate).	Does not apply
Synthesis of the results	13	Describe the methods for handling and summarizing the data that were charted.	7
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	23
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	3
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of the included sources of evidence (see item 12).	Does not apply
Results of individual sources of evidence	17	For each source of evidence included, present the relevant data that were charted that relate to the review questions and objectives.	3
Synthesis of the results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	3
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	3
Limitations	20	Discuss the limitations of the scoping review process.	5
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	7
FUNDING			
Funding	22	Describe funding sources for the included sources of evidence, as well as funding sources for the scoping review. Describe the role of the scoping review funders.	8

Appendix 2 Search strategy for the articles on Bacaba, Pracaxi and Uxi.

Plant species	Database	Keywords
Bacaba	PubMed, Web of Science, Google Scholar	"*Bacaba*", "*Bacaba oil*", "*Oenocarpus bacaba*", "*Oenocarpus bacaba and composition*", "*Oenocarpus bacaba and phytochemistry*", "*Oenocarpus bacaba and oil*", "*Oenocarpus bacaba and characterization*", "*Oenocarpus bacaba and chromatography*" and "*Oenocarpus bacaba and formulation*"
Pracaxi		"*Pracaxi*", "*Pracaxi and formulation*", "*Pracaxi and composition*", "*Pentaclethra macroloba*", "*Pentaclethra macroloba and oil*", "*Pentaclethra macroloba and behenic acid*", "*Pentaclethra macroloba and linolenic acid*", "*Pentaclethra macroloba and oleic acid*", "*Pentaclethra macroloba and lignoceric acid*", "*Pentaclethra macroloba and phytochemical*", "*Pentaclethra macroloba and composition*" and "*Pentaclethra macroloba and formulation*"
Uxi		"*Endopleura uchi*", "*Endopleura uchi and oil*", "*Endopleura uchi and composition*", "*Endopleura uchi and phytochemistry*", "*Endopleura uchi and composition and oil*" and "*Endopleura uchi and oil and phytochemistry*"