UNIVERSIDADE FEDERAL DO RIO GRANDE DO SUL

FACULDADE DE FARMÁCIA

TRABALHO DE CONCLUSÃO DO CURSO DE FARMÁCIA

SURVEY OF NATIVE PLANT APHRODISIACS POPULARLY USED IN BRAZIL: AN ETHNOPHARMACOLOGICAL REVIEW

TÁRIK MATTHES TEIXEIRA

Porto Alegre, 2022

UNIVERSIDADE FEDERAL DO RIO GRANDE DO SUL

FACULDADE DE FARMÁCIA

TRABALHO DE CONCLUSÃO DO CURSO DE FARMÁCIA

Tárik Matthes Teixeira

SURVEY OF NATIVE PLANT APHRODISIACS POPULARLY USED IN BRAZIL: AN ETHNOPHARMACOLOGICAL REVIEW

Trabalho de Conclusão de Curso apresentado ao Curso de Farmácia da Universidade Federal do Rio Grande do Sul como requisito à obtenção do título de grau de Farmacêutico.

Orientador: Prof. Dr. Eduardo Luís Konrath

Coorientador: Profª Dra. Mara Rejane Ritter

Porto Alegre, 2022

AGRADECIMENTOS

À Faculdade de Farmácia da Universidade Federal do Rio Grande do Sul por ter me permitido estudar as ciências da Natureza e as ciências do Humano em sua comunhão máxima, que é o desenvolvimento da Farmácia.

Aos professores que não se sujeitaram a somente *estar*, mas que cumpriram seu papel de orientação, auxílio, apoio e incentivo – em especial ao meu orientador, Eduardo Konrath, pela confiança e disponibilidade incessantes durante este período.

À minha família, que é meu alicerce, apoia e ajuda sempre solícita.

Aos meus pais, Dulci e Ari, um agradecimento magno, por cuidarem de mim em seus corações, em suas palavras e em seus atos – amor infinito.

À minha Vó Selma *in memorian*, que habita meu coração em forma de batidas e minha mente em forma de memória.

À Carolina, que sempre confiou no meu trabalho, me apoiando com carinho e ternura.

Aos amigos perenes, obrigado pela presença que não se desfaz através do tempo.

Ao Eterno – para que este trabalho possa contribuir com a vida das pessoas.

APRESENTAÇÃO

Esse Trabalho de Conclusão de Curso foi redigido sob a forma de artigo, o qual foi elaborado segundo as normas da Revista Brasileira de Farmacognosia, apresentadas em anexo.

Survey of native plant aphrodisiacs popularly used in Brazil: an ethnopharmacological review

Tárik Matthes Teixeira [a], Mara Rejane Ritter [b], Eduardo Luis Konrath [a,*]

[a] Faculdade de Farmácia, Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brazil;

[b] Programa de Pós-Graduação em Botânica, Instituto de Biociências, Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brazil.

* Corresponding author at: Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brazil.

E-mail address: eduardo.konrath@ufrgs.br (E.L. Konrath).

Abstract

Research for new therapeutic approaches can find ethnopharmacological data as an efficient guide. The World Health Organization (WHO) stimulates the development and prospection of medicinal plants within the context of traditional and complementary medicine. In this context, our study seeks to expand knowledge of Brazilian native medicinal plants popularly used as aphrodisiacs for the treatment of erectile dysfunction (ED). For this purpose, we conducted an ethnopharmacological compilation from 30 books, which originated a vast table, containing 78 native species, distributed alongside 45 botanical families, popularly recognized for their aphrodisiac properties. The more frequently cited species were *Anemopaegma arvense, Ptychopetalum olacoides, Bixa orellana, Anacardium occidentale, Heteropterys tomentosa* and *Paullinia cupana*. In addition to it, our study sought to analyze present scientifical data status, finding *in vitro* and *in vivo* studies for 17 plant species. Among the mentioned species, only *Mucuna*

pruriens presented clinical studies. To our knowledge, this is the first study to merge ethnopharmacological and scientific data for native aphrodisiacs popularly used in Brazil. In conclusion, ethnopharmacological data can both work in reassuring safety in the use of traditional medicinal plants and in providing a guidance for further research.

Keywords:

Ethnopharmacology; Aphrodisiac; Brazil; Erectile Dysfunction.

1. Introduction

Aphrodisiac is any food or drug capable of increasing both desire and sexual performance (da Silva et al. 2012). Currently, the term aphrodisiac is widely used within the context of traditional medicine and it is etymologically originated from the Greek goddess Aphrodite, whose body symbolizes the concepts of fertility and love (Melnyk and Marcone 2011). Although it became the common expression for sexual enhancement in European reality, the use of medicinal plants in the same manner was nevertheless found in ancient Egypt, Traditional Chinese Medicine, Hindu culture and among pre-Columbians in Amerindian territory. The first ethnopharmacological compilations were made by these groups, in an attempt to preserve their medical knowledge, including the Indian Kama Sutra, old Egyptian papyruses and tombs depicting herbal medicines and sexual arousal (da Silva et al. 2012; Elferink 2013).

Aphrodisiac agents are mainly indicated to the elderly population, which is more sensitive to marketing actions. Some wider indications, like tiredness and disinterest in sex are used to attract a group with matters associated with senescence (Mendes 2011). As part of the growing interest in this subject, the pathological nomenclature has changed from “Impotence” to Erectile Dysfunction (ED), a term upon which rests less prejudice, also considering a spectrum of etiological alterations (McKinlay 2000).

ED is a benign disorder, characterized by the frequent inability to reach and sustain a penile erection during sexual performance (Nicolosi and Glasser 2003). Currently, this sexual dysfunction has been more seriously taken into account due to its consequences, since it affects global aspects on the quality of life of men (Kessler et al. 2019). Among the negative effects associated, a greater risk for depression and anxiety, worsening of interpersonal relationships and other mood-related discrepancies are listed (Yafi et al. 2016). ED can be divided in two groups related to its etiology: psychogenic and organic. Recent research points out that around 80% of the cases have an organic origin, associated with vasculogenic, neurogenic, iatrogenic or hormonal causes (Yafi et al. 2016). Some chronic diseases have well established relations to the development of ED, such as heart disease, diabetes, hypertension and depression. Other risk factors were proved to be correlated to ED, including smoking, elevated cholesterol and absence of physical exercise. (McKinlay 2000; Nicolosi and Glasser 2003).

The first notable attempt to understand the epidemiology of ED was the Massachusetts Male Aging Study (MMAS), composed of men 40-70 years old that found an overall prevalence of 52% in cities and towns near Boston, Massachusetts. The last study to stand out was the European Male Aging Study (EMAS), a cross-sectional multicenter survey performed in the year 2009, that reached an average prevalence of 30% ED in men selected from eight European countries within a slightly larger spectrum of age (40-79) (Corona et al. 2010; Feldman et al. 1994). The prevalence of ED in Brazil was estimated in the year 2001, when 46,2% men reported some dysfunction, being 2,6% complete, 12,6% moderate and 31,5% minimal (Moreira et al. 2001). Different works continuously help to elucidate this topic, showing that socioeconomic and lifestyle characteristics are very important factors for the prevalence of ED, although further

studies are needed to explore the influence of genetic predisposition in different countries (Yafi et al. 2016).

Many nations around the world are watching the increase of life expectancy, implying in a demand for pharmaceutical products to the elderly (da Silva et al. 2012). Initial treatment for ED includes lifestyle modifications, use of PDE5 inhibitors (PDE5Is) and vacuum erection devices, reserving intracavernosal injection and surgical interventions only as a final option (Yafi et al. 2016). PDE5Is are the most common indication for ED, partly because these drugs are associated with only mild adverse effects, including in up to 20% of patients declaring headache, whereas flushing and dyspepsia in up to 15% and 10%, respectively (Retzler 2019). Head-to-head comparisons among PDE5Is class are very few and have shown little or no significant difference (Allen and Walter 2019). Some questioning may arise from the treatment, as it does not ameliorate the underlying pathology, finding approximately 30-35% users without a good therapeutic response which could be due to its inefficacy in increasing libido (Melnyk and Marcone 2011; Retzler 2019). Therefore, a growing interest for research and prospection of medicinal plants within the context of traditional and complementary medicine (T&CM) is at aim by the World Health Organization, to harness the potential of T&CM to the well-being of people-centred health care (World Health Organization (WHO) 2013).

Ethnopharmacological and historical data regarding herbal medicines play a major role in discovering material that might contribute to the development of new treatments, stimulating laboratorial investigation and clinical trials (Ricardo et al. 2017). Some caution is relevant in data analysis, as the term “aphrodisiac”, extensively used in Brazil, is frequently associated with several other indications, depending on the approach of different populations to disease (Mendes 2011). However, the undoubtedly

ability of some natural substances to heighten sexual behavior increased the research on historical aphrodisiacs (Melnyk and Marcone 2011). Promissory phytochemical studies are recognized in the topic of aphrodisiacs, enabling the isolation and further progress of possible candidates as new drugs (da Silva et al. 2012). Reports around the globe are important to gather information from different cultures. Previous ethnopharmacological data from Indian medicinal plants presented an appraisal of 33 aphrodisiac agents (R. Singh et al. 2013), while investigations covering the region of Anatolia, which encompasses the major part of Turkey, found 27 plants related to aphrodisiac properties (Tufan et al. 2018). Unveiling this potential, Brazilian biomes encompass 19% of the global flora, reaching the count of around 56.000 plant species (Giulietti et al. 2005). This work presents a comprehensive review unifying the ethnopharmacological data of books published in Brazil and scientific knowledge, also providing a detailed evaluation of the ongoing research about aphrodisiac plant species native to Brazil. Moreover, an extensive table of native aphrodisiac plants is presented in order to promote a rational pathway towards discovery of alternative drugs in the treatment of ED and other related sexual dysfunctions.

2. Methodology:

The present study was conducted based on the compilation of different books comprising ethnopharmacological data on the medicinal use of aphrodisiac plants of communities living in different regions of Brazil, published between 1930 and 2020. Accepted plant species were identified using some indication criteria such as “aphrodisiac”, “sexual tonic”, “sexual stimulant”, “sexual vigor stimulant”, “for sexual impotency”, “for erectile dysfunction” and related terms in Portuguese. Simpler expressions like “tonic” and “general tonic” were excluded, as they are usually indicative of plants popularly associated with wakefulness or alertness. The valid

scientific names, common synonymies and origin (native to Brazil or exotic) of the aforementioned plants were manually checked in the databases of Flora do Brasil 2020 (2021) and The Plant List (2021). The Brazilian native species cited as useful due to their aphrodisiac effects were assembled in a separate table, containing the following information: popular names and scientific names, family, symptom or claim, used part, prepare form and references.

The current scientific studies were searched in Medline (via PubMed), Google Scholar and the Latin-American and Caribbean Center on Health Sciences Information (LILACS). Chemical data, preclinical and clinical studies were searched combining the binomial scientific names of the selected plants with the terms “aphrodisiac”, “ethnopharmacology”, “tonic” and “toxicity” as keywords.

3. Results and discussion

This work collected a total of 142 aphrodisiac plants popularly used in Brazil (native, exotics and subspontaneous) mentioned in at least one study, which resulted in a total of 222 citations. Seventy-eight native species were mentioned as aphrodisiac plants with folk use by the Brazilian population (Table 1) as the result of a gathering from 30 ethnopharmacological books, which covered all biomes found in Brazil (Amazon Forest, Atlantic Forest, Caatinga, Cerrado, Pampas and Pantanal). Similar findings concerning the sub-Saharan countries in Africa showed a close number of 75 reports of aphrodisiac plants in South Africa, although not excluding exotics from the selection (Ajao et al. 2019).

Table 1 provides a view of the taxonomical distribution, as we identified 65 genera belonging to 45 botanical families. The most frequently cited families are Fabaceae (n = 8), Bignoniaceae (6), Asteraceae (4). Fabaceae and Asteraceae are among the largest

families found in Brazilian territory (Giulietti et al. 2005), corroborating their predominance as an important part of folk medicine in Brazil, including other less frequent families (da Silva et al. 2012). Likewise, the study by Ajao et al. (2019) with sub-Saharan populations also demonstrated that Fabaceae and Asteraceae are relevant sources of aphrodisiacs.

The most cited preparation forms were infusion (17.3%), maceration in alcoholic beverages (16.7%), as a food (16.7%) and decoction (15.6%), followed by tea, milk, tincture, syrup, hydrolate and essential oil. Noteworthy, 19% of the citations lacked any explanation on how the medicinal plant was prepared for use. In Table 1, the popular term “garrafada” was preserved as a way of differentiating it from regular maceration. “Garrafada” is a popular mixture of varied alcoholic beverages, including wine, brandy and cachaça with medicinal plants, that was very common to ancient herbalists and is still used in some traditional communities from Brazil, such as “quilombolas” (slave descendants) (Graciela et al. 2018).

Roots are the predominant used part of the aphrodisiac plants (21.3%), followed by bark (17.34%), seeds (14.4%), leaves (10.4%), whole plant (7.5%), fruits (6.9%), stems (4%), flowers (3.4%), resin or latex (2.3%), nuts (1.7%), pollen (1.1%), while also reaching 8.6% without plant parts specification. The remarkable presence of roots associated with aphrodisiac effects is also found around the world, in regions such as from Turkey, India and African countries (Ajao et al. 2019; R. Singh et al. 2013; Tufan et al. 2018). It was also hypothesized by Mendes and Carlini (2007) that some plants may concentrate their active metabolites in roots when facing stress situation, such as winter, when leaves are lost.

The native species more frequently mentioned as aphrodisiacs in the context of traditional use in Brazil were *Anemopaegma arvense* (n= 12), *Ptychopetalum olacoides*

(n= 8), *Bixa orellana* (n= 6), whereas *Anacardium occidentale*, *Heteropterys tomentosa* and *Paullinia cupana* shared 5 citations each.

In the next sections, a brief analysis of the scientific data regarding the Brazilian native aphrodisiac plants found in ethnopharmacological literature is presented. Preclinical *in vitro* or *in vivo* studies and clinical data directly related to their aphrodisiac properties indexed in the consulted databases was summarized in Table 2. LILACS offered no studies on the subject.

3.1. *Hebanthe erianthos* (Poir.) Pedersen

H. erianthos, previously known as *Pfaffia paniculata* (Mart.) Kuntze, is popularly called "ginseng-brasileiro". Its roots have been used for centuries by native Brazilians, who used the plant for a wide variety of applications, principally as a tonic and aphrodisiac, but also for ulcers, diabetes and rheumatism (Costa et al. 2018; Li et al. 2010).

Arletti et al. (1999) investigated the association between the plant extract administration and changes in sexual behavior in sluggish selected rats, compared to a saline control. The highest dose of a fluid root extract (1 mL/ kg) p.o. influenced positively in a variety of parameters, resulting in diminished mount latency, intromission latency, ejaculatory latency and post-ejaculatory latency, also augmenting percentage of rats achieving ejaculation. Additionally, the influence of *H. erianthos* on both female and male mice hormonal levels was determined by an *ad libitum* access to water supplemented with 5g of powdered root per 100 ml of water for thirty days, as compared to a control fed with just water. As a result, female mice improved their hormonal sexual levels of estradiol-17β and progesterone, while male mice also improved testosterone levels (Oshima and Gu 2003). However, further work is necessary to extend knowledge both over its efficacy and toxicity.

3.2. *Pfaffia glomerata* (Spreng.) Pedersen

Species belonging to the *Pfaffia* genus are popularly known as “ginseng”, due to their morphological resemblance with the *Panax* genus from Asia, being the former known as “ginseng-do-pantanal” because it occurs in the Pantanal biome (Auharek et al. 2019). Similarly to many aphrodisiacs, it has been cited for a range of therapeutic purposes, including anti-inflammatory and febrifuge, anti-carcinogenic, memory and vision enhancer and anti-anemic properties (Dias et al. 2019; Fernandes et al. 2015; Matta et al. 2020).

P. glomerata extracts were shown to interfere with morphometric and biochemical parameters in penile tissue of mice (Auharek et al. 2019; Dias et al. 2020, 2019; Matta et al. 2020). Nitric oxide, an important sustainer of penile erection, was measured after the administration of different concentrations (100-400mg/kg) of *P. glomerata* hydroalcoholic root extract (HaRE), although sildenafil citrate (positive control treatment), reached higher levels (Dias et al. 2020). Paradoxically, Dias et al. (2019) exposed before the need to watch out for different results induced by higher doses or long term exposition, as it showed an impact in lowering testosterone levels and higher cell death rates in testis of adult mice again treated again with the HaRE. Alteration in seminiferous tubule were suggested as another target afflicting spermatogenic homeostasis, as suggested by the analysis of mice submitted to HaRE (300 and 400mg/kg) (Matta et al. 2020). Androgenic-anabolic parameters tested through evaluation of mice exposed to HaRE (600-1000mg/kg) *in utero* and during lactation observed no significant difference in testis weight in perinatal life (Auharek et al. 2019). Moreover, no androgenic or anti-androgenic effects were observed in tests with intact male aging rats or castrated rats receiving dry ethanolic extract (8.5mg/kg, 30mg/kg and 85mg/kg, p.o.). The serum values of testosterone observed were similar to the saline

control (Fernandes et al. 2015), in contrast with a more recent study by Dias et al. (2020), where mice treated with HaRE, despite invigorating properties, decreased testosterone levels alongside Leydig cell viability. These results suggest attention points to obtain precise data, such as extract preparation, dose concentration and different animal strains.

3.3 *Anacardium occidentale* L.

A. occidentale is popularly known as "cajueiro", and its leaves are employed traditionally in Brazil for venereal disease and sexual impotence, whereas in Thailand the leaves have gastronomic purposes (Wattanathorn et al. 2018). Besides that, its use was also found to be associated with a wide range of inflammatory diseases, such as fevers, arthritis and asthma (Olajide et al. 2004).

Leaf hydroalcoholic extracts were tested at doses of 25 to 200mg/kg, orally given to male rats submitted to restraint stress, in a model of sexual dysfunction. Results evidenced aphrodisiac activity *in vivo* through diverse mechanisms, including enhanced sexual behavior, increased testosterone levels, diminished corticosterone, central modulation of dopaminergic neurons and peripheral improvement of penile functions through suppressed PDE5 (Wattanathorn et al. 2018). Later, the same authors investigated the potential toxicity of *A. occidentale* hydroethanolic extracts *in vitro*, using RAW 264.7 cells and the acute and subchronic toxicity in rats. The extracts, tested within 0.625 and 10 mg/mL range of concentration, showed more than 90% cell viability in MTT assay with 2,5mg/ml after one day exposure. The same study verified no acute toxicity of extract even with the highest dose administered (2 g/kg, orally), no subchronic toxicity within the range of tested concentrations (20-500 mg/kg, orally), but showed little hematological and cholesterol alterations, within the acceptable standards (Wattanathorn et al. 2019). Further investigations are still necessary to endow research

and verify the potential for the other parts of this plant, such as fruits and flowers, already cited in Table 1 for the folk use.

3.4. *Spondias mombin* L.

A great variety of popular indications is found for *S. mombin* barks: wound dressing in sores, respiratory problems and even as an antidote to help child-birth (Raji et al. 2006). Its folk use is also widespread for animals, which includes farmers utilizing fresh leaves to aid parturition in small ruminant livestock (Uchendu and Isek 2008). This species was cited in Table 1 as a potential aphrodisiac, whose fruit might be the plant part utilized, albeit no study on this topic utilized it.

S. mombin aqueous bark extract was administered orally in male rats for the acute toxicity test and intragastrically for reproductive parameter analysis. The first test showed an LD_{50} of 55,9mg/kg, being the sublethal dose LD_{20} = 40,1mg/kg and LD_{10} = 36,5mg/kg. As for the reproductive parameters, dose-dependent sperm impairing functions, such as decrease in percentage live spermatozoa, motility and viability, and increase in percentage abnormal spermatozoa were found (8.4, 16.8 and 33.6 mg/kg) (Raji et al. 2006). Leaf ethanolic extract (800 mg/kg) injected intraperitoneally in mated female rats generated anticonceptive activity within immediate postcoitus period (Uchendu and Isek 2008). On the other hand, Oloye et al. (2017) showed an increase levels of testosterone levels and a reduction on LH (luteinizing hormone) in male goats after leaf ethanolic extract (800 mg/kg) administration, although not reaching $p<0,05$ significant values.

Current results are still limited to distinguish between effects and the cause behind aphrodisiac or anti-aphrodisiac evidence. The wide possibilities for *S. mombin* used parts are other criteria to be taken in consideration.

3.5. *Aspidosperma quebracho-blanco* Schltldl.

Aspidosperma tree bark has centuries of reputation in traditional medicine from South America to treat impotence, and was present in Europe for the same indication already by the 19th century (Sperling et al. 2002). Pre-clinical data suggests the efficacy of *A. quebracho-blanco* extracts and their isolated compounds as potential treatments for ED. The alkaloids aspidospermine and quebrachamine were isolated and tested as blockers of phenylephrine-induced contractions in isolated rabbits corpus cavernosum (iRCC), guinea pig vas deferens or human prostatic tissue strips obtained from transurethral resections, indicating possible α-adrenergic blocking activities, similar to yohimbine (Deutsch et al. 1994). Later, Sperling et al. (2002) tested the activity of an hydroethanolic bark extract and four subfractions on the binding for both α1 and α2 isolated adrenergic receptors, by radioligands inhibition. The subfraction B was the more potent antagonist ligand for both types of adrenergic receptors, and was the only one containing yohimbine.

3.6. *Baccharis crispa* Spreng.

A native plant to many South-American countries, including Brazil, Paraguay, Uruguay and Argentina, *B. crispa* is widely used as folk medicine in tea preparations as an anti-inflammatory in liver and gastrointestinal diseases (De Oliveira et al. 2012). Our study found one citation for traditional use for male impotence and female sterility, cited in Table 1. Scientific data on possible aphrodisiac activity showed a low effect of *B. crispa* measured in a model of isolated Guinea pigs corpus cavernosum relaxation. Concentrations from 0,625 mg/mL to 10 mg/mL (aqueous, methanolic and dichloromethane extracts) were tested, showing significant results of 74% and 50% only with the higher concentration (10 mg/mL) of the methanolic and dichloromethane extracts, respectively, following a dose-dependent response (Hnatyszyn et al. 2003).

3.7. *Anemopaegma arvense* (Vell.) Stellfeld ex de Souza

A. arvense is one of the most famous aphrodisiacs in Brazil, of a series of plants popularly called “catuaba”, also regarded as having other properties, such as tonic, analgesic and central nervous system stimulant (Tabanca et al. 2007).

A. arvense aqueous root extracts (12.5 g/100 ml and 25 g/100 ml) administered at 0.5 mL daily to rats by oral gavage during 56 days altered testicular morphological aspects, including increase in seminiferous epithelium thickness and tubular diameter, regions with gametogenesis responsive to androgens. Besides that, the corporal weight of rats treated chronically with the highest dose also augmented, which suggests androgen-dependent mechanisms involved. In addition, histopathological analysis revealed an increase of the volumetric proportion of Leydig cells cytoplasm in treated animals when compared to saline control; however, nuclei proportion parameters were not altered (Chieregatto 2005). More data are required to associate between effects on the sexual organs and the possibility of impact in androgen-dependent pathways in the central nervous system.

3.8. *Hedyosmum brasiliense* Mart. ex Miq.

H. brasiliense is widely known for a variety of popular uses, including migraines, ovarian dysfunction, rheumatism and stomach pain (Murakami et al. 2017). A few pharmacological studies also attribute analgesic, anti-depressant and memory-enhancing properties (Amoah et al. 2015; Gonçalves et al. 2012; Trentin et al. 1999).

Leitolis et al. (2016) investigated the aphrodisiac effect of the hexane fraction of fresh leaves (3 – 300 μg/ ml) and three isolated sesquiterpene lactone compounds (10 nM – 100 μM), incubated separately in rat corpus cavernosum, endothelium-intact (E+) and endothelium-denuded (E-) thoracic aorta. This screening showed a positive response for

both E+ and E-, although E+ aorta responded better to all stimuli, indicating the dependence of nitric oxide production mechanism to the observed effects. Furthermore, the three sesquiterpene lactones showed some degree of *corpus cavernosum* relaxation with their highest concentration (100μM), while the extract did not show any activity, as compared to vehicle only (Leitolis et al. 2016). Research should be stimulated to understand the influence of nitric oxide stimulation from *H. brasiliese* isolated compounds, and to which degree they influence both cardiovascular and sexual parameters.

3.9. *Erythroxylum vacciniifolium* Mart.

This species may be also confounded with other aphrodisiac plants, as it also holds the same popular name "catuaba", and is a long appreciated medicinal plant due to its stimulant and aphrodisiac properties (Boris Zanolari et al. 2003). One study evaluated the inhibitory activity of an alkaloid-rich, dichloromethane, methanolic and methanolic tannin-free extracts obtained from *E. vacciniifolium* crude barks (100μM) against PDE2 and PDE5, all of them displaying a weak effect and not achieving significance. Alongside, nitric oxide (NO) induction was also verified through analysis of NOS III gene promoter activity using all extracts and different isolated tropane alkaloids (10 – 100 μg/ml), separately incubated for 12h and 18h with transient or stably transfected cells respectively, which did not identify greater expression of the enzyme (B. Zanolari et al. 2003). Toxicological effects were conducted in *in vivo* models in mice, on ethanolic extracts obtained from barks or leaves, using different concentrations and mode of administration (intraperitoneally or orally). Signs of intoxication were shared between extracts, including tremor, reduced muscular tone and increased urination, defecation and salivation. The major difference between the two extracts was that the ethanolic bark extract with the highest dose (1000 mg/kg), intraperitoneally or orally,

resulted in death of the subjected animals (Negri et al. 2016). Notwithstanding, the traditional use of *E. vacciniifolium*, scientific data still lacks robustness and, considering the plant widespread use, should be further encouraged.

3.10. *Abrus precatorius* L.

This plant is recognized in traditional medicine as a tonic, purgative, aphrodisiac and also abortifacient, whereas scientific data lacks precise data on efficacy and safety (Ogbuehi et al. 2015; Pokharkar et al. 2009). In Table 1, our ethnopharmacological compilation shows that *A. precatorius* was cited by 2 authors as having 3 different parts used: roots (n=2), leaves and seeds (n=1).

Current evidence suggests methanolic seed or leaf extracts of *A. precatorius* administered *per os* in female rats may display distinguished effects, showing seed extracts (30 – 60 mg/kg) anti-fertility effects, measured by loss of embryonic implantation in mated females. In contrast, leaf extracts (30 – 60 mg/kg) displayed enhancement of sexual behavior in female rats, noted through their mounting frequency and lordosis quotient, associated with enhanced folliculogenesis and ovulation (Ogbuehi et al. 2015). When oil extract of seeds was also orally given to male rats, the result was surprisingly contrary to the reputed aphrodisiac effect, showing a significant decrease in testosterone serum level, testis and cauda epididymis weight reduction, associated with low sperm counting (Pokharkar et al. 2009). In confirmation of these evidence, Abu et al. (2012) verified that an ethanolic seed extract (40 – 80 mg/kg) administered intraperitoneally also revealed antifertility effects in male mice, describing lower doses (40 mg/kg) to generate temporary antifertility activity and a higher dose (80mg/kg) to a more persistent infertility.

3.11. *Mimosa pudica* L.

M. pudica is a perennial herb used for curative effects in folk medicine, such as anti-asthmatic, anti-fertility, aphrodisiac, tonic, sedative and emetic (Onyije et al. 2018). Major pharmacological activities already investigated for this plant include wound healing property, antidepressant, diuretic and also aphrodisiac (Ahmad et al. 2012).

Aphrodisiac activity of the roots ethanolic extract (100 – 500mg/kg) orally given was screened in male mice, resulting in significant increased libido, evaluated through higher mounting and intromission frequency tests, and higher testosterone hormonal levels (Pande and Pathak 2009). Another study analyzed histoarchitectural damage of hypothalamic-pituitary-testicular axis induced by cadmium toxicity in mature male rats, revealing that *M. pudica* aqueous extract (200 mg/kg) given *per os* for 40 consecutive days showed protective and therapeutic properties (Linus Anderson et al. 2015). Such an effect was later confirmed (Onyije et al. 2018), as restorative properties of ethanolic extracts (250 and 500 mg/kg) orally given for 21 days were observed in adult male rats testis after cadmium-induced damage. Further studies are necessary to investigate safety and possible active constituents related to the aphrodisiac and cytoprotective properties in sexual organs by *M. pudica*.

3.12. *Mucuna pruriens* L.

M. pruriens is a common herbal medicine in South America, Africa and South Asia, used for diabetes, ED, neurodegenerative and cardiovascular problems (Sahin et al. 2016; Suresh and Prakash 2010). Table 2 shows that *M. pruriens* was the species for which more scientific data related to aphrodisiac activity was found.

Several studies in rats firstly attested the therapeutic potential of this folk aphrodisiac, demonstrating improvement in sexual behavior patterns (Sahin et al. 2016; Suresh et al.

2009), diminished oxidative stress parameters in aged rat sperm (Suresh et al. 2008), augmented hormonal levels, cytoarchitectural integrity and relative testis weight (Muthu and Krishnamoorthy 2011; Senu et al. 2019; A. P. Singh et al., 2013) and recovery in dorsal nerve penis (Seppan et al. 2018). When tested in streptozotocin-induced diabetic male rats for 60 days, results showed that *M. pruriens* ethanolic seed extract (200 mg/kg) administered by gavage ameliorated penile tissue conditions through antioxidant mechanisms, also displaying clear enhancement of sexual behavior (Suresh and Prakash 2011, 2010). As L-DOPA is a major constituent of *M. pruriens* seeds, (A. P. Singh et al. 2013) attributed spermatogenic benefits to this compound, which was tested separately from the plant extract at a concentration of 20 mg/kg in rats for 56 days. Mutwedu et al. (2019) confirmed aphrodisiac activity with *M. pruriens* as a seed meal (0%, 1.5% and 3%) in rabbit bucks by diverse pathways, such as sexual behavior, better seminal characteristics and biochemical values, in a dose-dependent manner. It is to be noted, however, that one study brought to light that the higher doses (>0.75g) administered as a dietary meal to rats found undesired degenerative lesions in the testis and reduced sperm quality, warning that different doses can also meet negative impacts, mostly associated to reactive oxygen species generation (Senu et al. 2019).

Besides that, *M. pruriens* already has been tested in three different clinical studies, comprised with human healthy controls, showing undoubtedly correlations with reactivation of enzymatic pathways in infertile subjects, regulation of steroidogenesis andbiochemical levels of total lipids, corrected fructose and vitamins related to balanced seminal plasma in men (Ahmad et al. 2008; Gupta et al. 2011; Shukla et al. 2009). Seventy-five men undergoing fertility screening, when compared to healthy controls, received 5 g/day seed powder in a single dose of milk for 3 months and had hormonal seminal and blood levels evaluated before and after treatment. The results showed

treatment was efficient in significantly augmenting dopamine, adrenaline and noradrenaline in both seminal and blood analysis. Also, augmented testosterone and LH in blood was observed, associated with a decrease in PRL and FSH (Shukla et al. 2009), in complete accordance with testosterone, LH, PRL and FSH analysis by (Gupta et al. 2011). Scientific work on this plant suggests that *M. pruriens* can already be considered a safe and promising aphrodisiac, but more data on toxicity, different doses and mode of administration should be encouraged.

3.13. *Heteropterys tomentosa* A. Juss.

Formerly called *H. aphrodisiaca,* this plant is found throughout the Brazilian Cerrado, where it is popularly known as "nó-de-cachorro", reputed for its nervous system stimulant aphrodisiac, tonic and depurative properties (Mendes and Rodrigues 2018; Monteiro et al. 2008).

Chieregatto (2009, 2005) conducted two different studies in animal models, administrating root extract (12.5 and 25g/100mL) in rats for 56 days, resulting in significantly enhanced biometric properties, such as corporal and testis weight, epithelium seminiferous thickness and cytoarchitectural volume from Leydig cells (nucleus and cytoplasm), although spermatic reduction was seen in relation to control groups. Restorative properties were tested with 25g/100ml of root extract administrated for 56 days in rats exposed to cyclosporine A, a known toxic compound to testicular tissue, resulting in a diminished tissue damage when simultaneously given the *H. tomentosa* extract (Monteiro et al. 2008). Later, the combination of trained and sedentary rats with the root extract administration (25g/100mL) for eight weeks were investigated, with focus on the aphrodisiac potential (Gomes et al. 2011). Results showed that testosterone secretion was significantly augmented in sedentary treated individuals, associated with lower levels of apoptosis in testis, suggesting a possible

protective aspect in cell cycle. In the group where animals were trained and treated with the infusion, higher spermatogenesis yield and spermatogonial mitosis rates were observed. The general perspective on *H. tomentosa* is advancing positively in diverse aspects, but behavior tests must be performed in order to prove direct relation to sexual performance.

3.14. *Trichilia catigua* A. Juss.

Another plant species traditionally called "catuaba" in Brazil, known for its sexual and nervous system stimulant properties, *T. catigua* has already been pharmacologically screened for its antidepressant, anti-inflammatory, memory-enhancing, and aphrodisiac properties (Longhini et al. 2017).

T. catigua was tested for *in vitro* relaxation of isolated rabbit corpus cavernosum (iRCC) as part of the Brazilian phytomedicine Catuama® (composed of *Trichilia catigua, Zingiber officinale, Paullinia cupana* and *Ptychopetalum olacoides*). The administration of both Catuama® and *T. catigua* root hydroalcoholic extract (1-10mg) manifested corpus cavernosum relaxation, while long lasting relaxation was delivered only by *T. catigua*, sometimes preceded by contractile responses (Antunes et al. 2001). In contrast, Kletter et al. (2004) examined the aqueous and methanolic bark extracts of *T. catigua*, showing no *in vitro* effects on iRCC. Regarding the possible aphrodisiac mechanisms observed, the plant extract (36 and 72 mg/day) and the commercial preparation Catuama® (0.7ml/kg/day) administered orally for 56 consecutive days caused important negative impacts on Leydig cells and on the volume in testis of rats (Gomes 2007).

The exposure to the crude plant extract (400 mg/kg/day) by gavage during pregnancy and lactation was shown to interfere with the initial phases of pregnancy in adult female

rats, where pre-implantation and post-implantation losses were verified. However, the surviving male offspring did not suffered from any changes in sexual development (Dos Santos et al. 2015). In order to better understand the safety of Catuama®, clinical toxicological tests were performed with a 25 mL dose of for 28 five days (2x/day) in forty-eight healthy volunteers of both sexes aged between 18 and 45, of which no severe sign of toxic effect on biochemical and hematological parameters or medical examinations were observed (Oliveira et al. 2005).

3.15. *Ptychopetalum olacoides* Benth.

P. olacoides is the second most cited plant in the present work (n=8). Popularly called "muirapuama", this Amazonian tree has been used as an alcoholic infusion for centuries as "nerve tonic", which encompasses aphrodisiac and antidepressant reputation (Brunetti et al. 2020; Siqueira et al. 1998).

An hydroalcoholic extract obtained from leaves (2 – 20mg/ kg) was tested in iRCC, causing dose-dependent and brief duration relaxation. For the purpose of unveiling possible mechanisms, iRCC was incubated with an hydroalcoholic extract preparation (1 – 100 mg/mL), detecting its ability to increase cAMP levels, although only slightly (Antunes et al. 2001). Again, the only study indicating any degree of toxicity for *P. olacoides* was dealing with the popular Brazilian preparation called Catuama®. As previously mentioned, no severe sign of toxic effect on biochemical and hematological parameters or medical examinations were observed (Oliveira et al. 2005).

3.16. *Paullinia cupana* Kunth

P. cupana ranked in the most frequently cited plants, reaching n=5. This species is one of the most well-reputed traditional medicines for native communities, where the Brazilian Maués Indian are the first known consumers of this plant and responsible for

naming this fruit as “guaraná” (Marques et al. 2019). Pharmacological investigations conducted with *P. cupana* mentioned cognitive enhancer, cardioprotective, anti-obesity and many other properties, invariably associated with its methylxanthines or its tannins content (Lidilhone et al. 2013; Marques et al. 2019).

The hydroalcoholic extract of *P. cupana* seeds (0,5 – 5 mg/kg) in iRCC at lower doses proved to be more efficient in promoting relaxation, when compared with other plant extracts present in Catuama® – in a dose-dependent and short duration manner. Later, incubations of iRCC and hydroalcoholic extract solutions (1 – 100mg/mL) have shown increased cAMP levels by approximately 200% with the lowest concentration (1 mg/mL), decreasing to 150% (10 mg/mL) and 89% (100 mg/mL). This results suggests that *P. cupana* is mainly responsible for the biological effects observed for the Catuama® preparation (Antunes et al. 2001).

3.17. *Turnera diffusa* Willd. Ex Schult

Popularly known as “damiana”, this plant is highly regarded as an aphrodisiac by traditional medicine knowledge, although other claims of expectorant, antianxiety, antispasmodic, adaptogenic and antiobesity activity are also found (Estrada-Reyes et al. 2013; Szewczyk and Zidorn 2014).

Several *in vitro* studies investigated possible pathways related to sexual performance: ethanolic leaf extracts showed varying degrees of inhibition of PDE-5 enzyme (Feistel et al. 2010); methanolic leaf extract and isolated compounds interfering steroid-hormone pathways, with significant anti-aromatase activity and a low-degree of estrogenic activity (Zhao et al. 2008). Besides that, toxicological examinations attested a protective role for *T. diffusa* aqueous extracts in rats testicular toxicity either induced by fenitrothion and/or hexavalent chromium, or by amitriptyline, suggesting a high

value for preserving oxidative stress status, histological integrity and reproductive hormones levels maintenance (El-Demerdash et al. 2019; Tousson et al. 2020).

When tested in both female and male rats treated during 15 days, an aqueous extract (500 mg/kg) divided in two diary administrations, yielded no significant testicular and ovarian histological alterations, as compared to a saline control group , also finding 100% success in both fertility and gestational rate (Bueno et al. 2009). Another study reported increased mounting behavior for mice treated p.o. with chloroform, methanolic and alkaloid enriched extracts (50 – 400 mg/kg), despite no differences were observed with the volatile oil, aqueous and petroleum ether preparations (Kumar et al. 2009). Sexually exhausted male rats, mimicking a sexual dysfunction state, were given orally an aqueous extract, with the highest dose (80 mg/ kg) tested achieving increased proportion of mounting, intromission and, at least, one ejaculation (Estrada-Reyes et al. 2009). In a different model that selects sluggish rats, Arletti et al. (1999) administered orally a fluid extract, with the higher dose (1ml/ kg) diminishing mounting, intromission and ejaculation latencies, while increasing the percentage of achieved ejaculation. The aforementioned results are very promising, considering amelioration of sexual behavior conditions in treated animals, such as rats and mice.

Later, Estrada-Reyes et al. (2013) verified that aphrodisiac effects may be related to nitric oxide pathway. Rats treated with *T. diffusa* aqueous extracts (10 – 40mg/ kg) or sildenafil citrate (10 mg/kg) as positive control, with or without L-NAME (12,5mg/kg), a nonspecific inhibitor of NO synthase, were efficient in improving sexual patterns exclusively when NO was bioavailable in the absence of L-NAME.

However, it should be noted that a decreased number of rat fetuses and diminished ovarian corpus luteum formation were seen in treated rats by (Bueno et al. 2009), albeit

ejaculations were considered normal in this study. This data should stimulate future research to ensure no influence on animal reproductive parameters.

4. Conclusion

As far as we know, this is the first study to compilate ethnopharmacological and scientific data on aphrodisiac plants native to Brazil. This work aimed at contributing to public health system guidelines concerning use of herbal medicine and ensuring its safety in folk medicine. Our study shows undoubtedly potential for upcoming scientific research, either deepening already obtained information or prospecting medicinal plants that have not yet been fully studied, with Table 1 as a possible reference for future investigations. We found *A. arvense, P. olacoides, B. orellana, A. occidentale, H. tomentosa* and *P. cupana* to be the most cited species in ethnopharmacological literature. Despite this preliminary result, *M. pruriens* and *T. diffusa* yielded more results in scientific databases, which suggests still a gap between popular use of aphrodisiacs and ongoing research. In conclusion, scientific data on aphrodisiacs safety and efficacy are still sparse and should be stimulated.

Author's contributions

Tárik Matthes Teixeira: Conceptualization; data curation; formal analysis; methodology; writing – original draft. **Mara Rejane Ritter:** Formal analysis, methodology. **Eduardo Luis Konrath:** Conceptualization, data curation, writing – original draft, resources, validation, supervision.

Conflict of interest

The authors declare no conflicts of interest.

References

Abu, S.M., Manirul., H.A.B.M., Abdul Majid, M., M Anwarul, I. (2012). Antifertility studies on ethanolic extract of Abrus precatorius L. on swiss male albino mice 3, 288–292.

Agra, M.F. (1996) Plantas da medicina popular dos Cariris Velhos, Paraíba, Brasil: espécies mais comuns. Editora União. João Pessoa.

Ahmad, H., Sehgal, S., Mishra, A., Gupta, R. (2012). Mimosa pudica L. (Laajvanti): An overview. Pharmacogn. Rev. 6, 115–124. https://doi.org/10.4103/0973-7847.99945

Ahmad, M.K., Sc, M., Mahdi, A., Ph, D., Shukla, K., Sc, M. (2008). Effect of Mucuna pruriens on semen profile and biochemical parameters in seminal plasma of infertile men 90. https://doi.org/10.1016/j.fertnstert.2007.07.1314

Ajao, A.A., Sibiya, N.P., Moteetee, A.N. (2019). Sexual prowess from nature: A systematic review of medicinal plants used as aphrodisiacs and sexual dysfunction in sub-Saharan Africa. South African J. Bot. 122, 342–359. https://doi.org/10.1016/j.sajb.2018.08.011

Alice,C.B.; Siqueira, N. C. S.; Mentz, L.A.; Silva, G.A.A.B.; José, K.F. D. (1995). Plantas medicinais de uso popular - Atlas Farmacognóstico. 1. ed. Editora da ULBRA. Canoas

Allen, M.S., Walter, E.E. (2019). Erectile Dysfunction: An Umbrella Review of Meta-Analyses of Risk-Factors, Treatment, and Prevalence Outcomes. J. Sex. Med. 16, 531–541. https://doi.org/10.1016/j.jsxm.2019.01.314

Almeida, E.R. (1993) Plantas medicinais brasileiras: conhecimentos populares e científicos. Hemus Editora. São Paulo

Almeida, S.P. de; Proença, C.E.B..; Sano, S.M.; Ribeiro, J.F. (1998) Cerrado: espécies vegetais úteis. Embrapa- CPAC. Planaltina.

Amoah, S.K.S., Dalla Vecchia, M.T., Pedrini, B., Carnhelutti, G.L., Gonçalves, A.E., Dos Santos, D.A., Biavatti, M.W., De Souza, M.M. (2015). Inhibitory effect of sesquiterpene lactones and the sesquiterpene alcohol aromadendrane-4β,10α-diol on memory impairment in a mouse model of Alzheimer. Eur. J. Pharmacol. 769, 195–202. https://doi.org/10.1016/j.ejphar.2015.11.018

Antunes, E., Gordo, W.M., De Oliveira, J.F., Teixeira, C.E., Hyslop, S., De Nucci, G. (2001). The relaxation of isolated rabbit corpus cavernosum by the herbal medicine Catuama® and its constituents. Phyther. Res. 15, 416–421. https://doi.org/10.1002/ptr.861

Arletti, R., Benelli, A., Cavazzuti, E., Scarpetta, G., Bertolini, A. (1999). Stimulating property of Turnera diffusa and Pfaffia paniculata extracts on the sexual behavior of male rats. Psychopharmacology (Berl). 143, 15–19. https://doi.org/10.1007/s002130050913

Auharek, S.A., Carollo, C.A., Oliveira, R.J., Cunha-Laura, A.L., Monreal, A.C.D., Siqueira, J.M., Costa, D.S., de Paiva Condé, T.R., Wollf, D.I.L., Aloysio Amaral, E. (2019). Evaluation of the testis function of mice exposed in utero and during

lactation to Pfaffia glomerata (Brazilian ginseng). Andrologia 51, 1–8. https://doi.org/10.1111/and.13328

Balbach, A. (1974) Flora Nacional na Medicina Doméstica. Ed. Edel, São Paulo.

Berg, M. E. van den. (1982). Plantas medicinais na amazônia : contribuição ao seu conhecimento sistemático. Conselho Nacional de Desenvolvimento Científico e Tecnológico, Programa Trópico Úmido. Belém.

Borrás, M.R.L. (2003) Plantas da Amazônia: medicinais ou mágicas? Plantas comercializadas no mercado municipal Adolpho Lisboa. Valer Editora. Manaus.

Braga, R. (2015) Plantas do nordeste, especialmente do Ceará. Fundação Vingt-Un Rosado, Mossoró.

Brunetti, P., Lo Faro, A.F., Tini, A., Busardò, F.P., Carlier, J. (2020). Pharmacology of herbal sexual enhancers: A review of psychiatric and neurological adverse effects. Pharmaceuticals 13, 1–52. https://doi.org/10.3390/ph13100309

Bueno, R.T., Hetzl, A.C., Cristina, I., Camargo, C., Gracioso, J.D.S., Frei, F. (2009). Avaliação dos efeitos do extrato aquoso de Turnera diffusa na histologia testicular e ovariana e nos parâmetros reprodutivos de ratos Wistar Evaluation of effects of Turnera diffusa aqueous extract in the testicular and ovarian histology and reproductive. Biosaúde 11, 29–42.

Camargo, M.T.L.A. (1998) Plantas medicinais e de rituais afro-brasileiros II: estudo etnofarmacobotânico. Ícone. Sâo Paulo

Chieregatto, L.C. (2009). Efeitos dos extratos de Heteropterys aphrodisiaca O. Mach. Souza (nó-de-cachorro) e Anemopaegma arvense (Vell.) Stellfeld & J.F. Souza (vergateza) sobre o testículo e o processo espermatogênico de ratos Wistar adultos.

Chieregatto, L.C. (2005). Efeito do tratamento crônico com extratos de Heteropterys aphrodisiaca O. Mach. e Anemopaegma arvense (Vell.) Stellf. no testículo de ratos Wistar adultos.

Coletto, L. M. M.; Pereira, B. M. R.; Cardozo Junior, E. L.; Zardinello. A.; Souza, H. A. S. de; Lawich, M. C. (2010) Plantas medicinais: nativas dos remanescentes florestais do Oeste do Paraná. Itaipu Binacional, Foz do Iguaçu.

Corona, G., Lee, D.M., Forti, G., Connor, D.B.O., Maggi, M., Neill, T.W.O., Pendleton, N., Bartfai, G., Boonen, S., Casanueva, F.F., Finn, J.D. (2010). Age-Related Changes in General and Sexual Health in Middle-Aged and Older Men : Results from the European Male 1362–1380. https://doi.org/10.1111/j.1743-6109.2009.01601.x

Corrêa, A.D.; Batista, R.S.; Quintas, L.E. M. (2003) Plantas medicinais: do cultivo à terapêutica. Vozes. Petrópolis.

Costa, C.A.R.A., Quaglio, A.E.V., Di Stasi, L.C. (2018) Pfaffia paniculata (Brazilian ginseng) extract modulates Mapk and mucin pathways in intestinal inflammation. J. Ethnopharmacol. 213, 21–25. https://doi.org/10.1016/j.jep.2017.10.009

Cruz; G.L. (1979) Dicionário das Plantas Úteis do Brasil. Editora Civilização Brasileira. Rio de Janeiro.

Cruz, M.G. de la. (2008) Plantas medicinais de Mato Grosso : a farmacopéia popular dos raizeiros. Carlini & Caniato. Cuiabá.

da Silva, C. V., M., F., S., E. (2012). Phytochemistry of some Brazilian Plants with Aphrodisiac Activity. Phytochem. - A Glob. Perspect. Their Role Nutr. Heal. https://doi.org/10.5772/26989

De Oliveira, C.B., Comunello, L.N., Lunardelli, A., Amaral, R.H., Pires, M.G.S., Da Silva, G.L., Manfredini, V., Vargas, C.R., Gnoatto, S.C.B., De Oliveira, J.R., Gosmann, G. (2012). Phenolic enriched extract of Baccharis trimera presents anti-inflammatory and antioxidant activities. Molecules 17, 1113–1123. https://doi.org/10.3390/molecules17011113

Deutsch, H.F., Evenson, M.A., Drescher, P., Sparwasser, C., Madsen, P.O. (1994). Isolation and biological activity of aspidospermine and quebrachamine from an Aspidosperma tree source. J. Pharm. Biomed. Anal. 12, 1283–1287. https://doi.org/10.1016/0731-7085(94)00066-2

Di Stasi, L. C.; Hiruma-Lima, C. A. (2002) Plantas medicinais na Amazônia e na Mata Atlântica. (2002) Ed. UNESP, São Paulo.

Dias, F.C.R., Gomes, M. de L.M., Melo, F.C.S.A. de, Menezes, T.P., Martins, A.L., Cupertino, M. do C., Otoni, W.C., Matta, S.L.P. da (2020). Pfaffia glomerata hydroalcoholic extract stimulates penile tissue in adult Swiss mice. J. Ethnopharmacol. 261. https://doi.org/10.1016/j.jep.2020.113182

Dias, F.C.R., Martins, A.L.P., de Melo, F.C.S.A., Cupertino, M. do C., Gomes, M. de L.M., de Oliveira, J.M., Damasceno, E.M., Silva, J., Otoni, W.C., da Matta, S.L.P. (2019). Hydroalcoholic extract of Pfaffia glomerata alters the organization of the seminiferous tubules by modulating the oxidative state and the microstructural reorganization of the mice testes. J. Ethnopharmacol. 233, 179–189. https://doi.org/10.1016/j.jep.2018.12.047

Diniz, M. F. F. M.; Oliveira, R. A. G.; Júnior, A. M.; Medeiros, A. C. D.; Moura, M. D. (2006) Memento de plantas medicinais: as plantas como alternativa terapêutica - Aspectos populares e científicos. UFPB. João Pessoa.

Dos Santos, A.H., Ramos, A.C., Silveira, K.M., Kiss, A.C.I., Longhini, R., Diniz, A., De Mello, J.C.P., Gerardin, D.C.C. (2015). The exposure to Trichilia catigua (catuaba) crude extract impairs fertility of adult female rats but does not cause reproductive damage to male offspring. J. Ethnopharmacol. 166, 86–91. https://doi.org/10.1016/j.jep.2015.03.018

El-Demerdash, F.M., Jebur, A.B., Nasr, H.M., Hamid, H.M. (2019). Modulatory effect of Turnera diffusa against testicular toxicity induced by fenitrothion and/or hexavalent chromium in rats. Environ. Toxicol. 34, 330–339. https://doi.org/10.1002/tox.22688

Elferink, J.G.R. (2013). Aphrodisiac Use in Pre-Columbian Aztec and Inca Cultures 9, 25–36.

Estrada-Reyes, R., Carro-Juárez, M., Martínez-Mota, L. (2013). Pro-sexual effects of Turnera diffusa Wild (Turneraceae) in male rats involves the nitric oxide pathway. J. Ethnopharmacol. 146, 164–172. https://doi.org/10.1016/j.jep.2012.12.025

Estrada-Reyes, R., Ortiz-López, P., Gutiérrez-Ortíz, J., Martínez-Mota, L. (2009). Turnera diffusa Wild (Turneraceae) recovers sexual behavior in sexually exhausted males. J. Ethnopharmacol. 123, 423–429. https://doi.org/10.1016/j.jep.2009.03.032

Feistel, B., Walbroel, B., Benedek, B. (2010). Damiana (Turnera diffusa Willd.) – a traditionally used aphrodisiac as modern PDE-5 inhibitor. Planta Med. 76, 18–19. https://doi.org/10.1055/s-0030-1264300

Feldman, H.A., Irwin, G., Hatzichristou, D.G., Krane, R.J., McKinlay, J.B. (1994). Impotence and its medical and psychosocial correlates: results of the Massachusetts Male Aging Study. J. Urol.

Fernandes, N.F., Martino-Andrade, A.J., Dos Santos Lourenço, A.C., Muller, J.C., Spercoski, K.M., Nihi, F., Miguel, M.D., De Oliveira, V.B., Dalsenter, P.R., Morais, R.N. (2015). Supplementation with Pfaffia glomerata (Sprengel) Pedersen does not affect androgenic-anabolic parameters in male rats. J. Ethnopharmacol. 161, 46–52. https://doi.org/10.1016/j.jep.2014.11.049

Giulietti, A.N.A.M., Harley, R.M., Queiroz, L.P.D.E., Wanderley, A.S.L., Berg, C.V.A.N.D.E.N. (2005). Biodiversity and Conservation of Plants in Brazil 19, 632–639.

Gomes, M. de L.M. (2007). Morfometria testicular de ratos wistar adultos tratados com infusão aquosa de catuaba (Trichila catigua A. Juss. Meliaceae).

Gomes, M.L.M., Monteiro, J.C., Freitas, K.M., Sbervelheri, M.M., Dolder, H. (2011). Association of the infusion of Heteropterys aphrodisiaca and endurance training brings spermatogenetic advantages. Biol. Res. 44, 235–241. https://doi.org/10.4067/S0716-97602011000300004

Gonçalves, A.E., Bürger, C., Amoah, S.K.S., Tolardo, R., Biavatti, M.W., De Souza, M.M. (2012). The antidepressant-like effect of Hedyosmum brasiliense and its sesquiterpene lactone, podoandin in mice: Evidence for the involvement of adrenergic, dopaminergic and serotonergic systems. Eur. J. Pharmacol. 674, 307–314. https://doi.org/10.1016/j.ejphar.2011.11.009

Graciela, da S.M., Rosa, H. da S., Germano, G.-N., Geraldo, A.D.J. (2018). Medicine bottled (garrafada): Rescue of the popular knowledge. J. Med. Plants Res. 12, 325–335. https://doi.org/10.5897/jmpr2018.6606

Guarim Neto, G. (1987) Plantas utilizadas na medicina popular do estado de Mato Grosso. CNPq. Brasília.

Gupta, A., Ali, A., Kaleem, M., Kant, K. (2011). A proton NMR study of the effect of Mucuna pruriens on seminal plasma metabolites of infertile males. J. Pharm. Biomed. Anal. 55, 1060–1066. https://doi.org/10.1016/j.jpba.2011.03.010

Gutierrez, I. E. M. ; Silva Filho, A. R. ; Almeida, M. Z. ; Silva, N. C. B. (2010) Plantas Medicinais no Semiárido: Conhecimentos populares e acadêmicos. EDUFBA. Salvador.

Hnatyszyn, O., Moscatelli, V., Garcia, J., Rondina, R., Costa, M., Arranz, C., Balaszczuk, A., Ferraro, G., Coussio, J.D. (2003). Argentinian plant extracts with relaxant effect on the smooth muscle of the corpus cavernosum of Guinea pig. Phytomedicine 10, 669–674. https://doi.org/10.1078/0944-7113-00261

Kessler, A., Sollie, S., Challacombe, B., Briggs, K., Van Hemelrijck, M. (2019). The global prevalence of erectile dysfunction: a review. BJU Int. 124, 587–599. https://doi.org/10.1111/bju.14813

Kletter, C., Glasl, S., Presser, A., Werner, I., Reznicek, G., Narantuya, S., Cellek, S., Haslinger, E., Jurenitsch, J. (2004). Morphological, chemical and functional analysis of Catuaba preparations. Planta Med. 70, 993–1000. https://doi.org/10.1055/s-2004-832627

Kumar, S., Madaan, R., Sharma, A. (2009). Evaluation of Aphrodisiac Activity of Turnera aphrodisiaca. Int. J. Pharmacogn. Phytochem. Res. 1, 1–4.

Lainetti, R.; Brito, E.R.S. (1980) A saúde pelas plantas e ervas do mundo inteiro. Ediouro. Rio de Janeiro

Leitolis, A., Amoah, S.K.S., Biavatti, M.W., da Silva-Santos, J.E. (2016). Sesquiterpene lactones from Hedyosmum brasiliense induce in vitro relaxation of rat aorta and corpus cavernosum. Rev. Bras. Farmacogn. 26, 363–368. https://doi.org/10.1016/j.bjp.2016.01.005

Li, J., Jadhav, A.N., Khan, I.A. (2010). Triterpenoids from brazilian ginseng, pfaffia paniculata. Planta Med. 76, 635–639. https://doi.org/10.1055/s-0029-1240631

Lidilhone, H., Genise, V.S., Neusa, T. (2013). Paullinia cupana Kunth (Sapindaceae): A review of its ethnopharmacology, phytochemistry and pharmacology. J. Med. Plants Res. 7, 2221–2229. https://doi.org/10.5897/jmpr2013.5067

Linus Anderson, E., Kunlere, O., Edem Ekpenyong, E., Adewale Abdullateef, T., Adebanji Modupe, A., Oladunni Eunice, K. (2015). The impact of Mimosa pudica on the histoarchitecture of hypothalamic-pituitary-testicular axis in Cadmium treated rats. Edem al. World J. Pharm. Pharm. Sci. 4.

Longhini, R., Lonni, A.A.S.G., Sereia, A.L., Krzyzaniak, L.M., Lopes, G.C., de Mello, J.C.P. (2017). Trichilia catigua: Therapeutic and cosmetic values. Rev. Bras. Farmacogn. 27, 254–271. https://doi.org/10.1016/j.bjp.2016.10.005

Lopes, A.M.V; Alvarez Filho, A. (1997) Plantas usadas na medicina popular do Rio Grande do Sul. UFSM. Santa Maria.

Lorenzi, H.; Matos, F.J. de A. (2008) Plantas medicinais no Brasil: nativas e exóticas. 2. ed. Nova Odessa: Instituto Plantarum. São Paulo.

Maroni, B. C.; Machado, S.R.; Di Stasi, L.C. (2006) Plantas medicinais do cerrado do Botucatu. Editora UNESP. São Paulo.

Marques, L.L.M., Ferreira, E.D.F., Paula, M.N. de, Klein, T., Mello, J.C.P. de (2019). Paullinia cupana: a multipurpose plant – a review. Rev. Bras. Farmacogn. 29, 77–110. https://doi.org/10.1016/j.bjp.2018.08.007

Matta, A.P.L.F., Leite, J.P. V., Gomes, M.L.M., Morais, D.B., Carvalho, F.A.R., Otoni, W.C., Matta, S.L.P. (2020). Deleterious effects of Pfaffia glomerata (Spreng.) Pedersen hydroalcoholic extract on the seminiferous epithelium of adult Balb/c mice. Int. J. Exp. Pathol. 101, 183–191. https://doi.org/10.1111/iep.12363

McKinlay, J.B. (2000). The worldwide prevalence and epidemiology of erectile dysfunction. Int. J. Impot. Res. 12, S6–S11. https://doi.org/10.1038/sj.ijir.3900567

Melnyk, J.P., Marcone, M.F. (2011). Aphrodisiacs from plant and animal sources-A review of current scientific literature. Food Res. Int. 44, 840–850. https://doi.org/10.1016/j.foodres.2011.02.043

Mendes, F.R. (2011). Tonic, fortifier and aphrodisiac: Adaptogens in the Brazilian folk medicine. Rev. Bras. Farmacogn. 21, 754–763. https://doi.org/10.1590/S0102-695X2011005000097

Mendes, F.R., Carlini, E.A. (2007). Brazilian plants as possible adaptogens: An ethnopharmacological survey of books edited in Brazil. J. Ethnopharmacol. 109, 493–500. https://doi.org/10.1016/j.jep.2006.08.024

Mendes, F.R., Rodrigues, E. (2018). Heteropterys tomentosa A. Juss. 227–239. https://doi.org/10.1007/978-94-024-1552-0_20

Monteiro, J.C., Predes, F.S., Matta, S.L.P., Dolder, H. (2008). Heteropterys aphrodisiaca infusion reduces the collateral effects of Cyclosporine A on the testis. Anat. Rec. 291, 809–817. https://doi.org/10.1002/ar.20709

Moreira, E.D., Abdo, C.H.N., Torres, E.B., Lôbo, C.F.L., Fittipaldi, J.A.S. (2001). Prevalence and correlates of erectile dysfunction: Results of the Brazilian study of sexual behavior. Urology 58, 583–588. https://doi.org/10.1016/S0090-4295(01)01274-2

Murakami, C., Cordeiro, I., Scotti, M., Moreno, P., Young, M. (2017). Chemical Composition, Antifungal and Antioxidant Activities of Hedyosmum brasiliense Mart. ex Miq. (Chloranthaceae) Essential Oils. Medicines 4, 55. https://doi.org/10.3390/medicines4030055

Muthu, K., Krishnamoorthy, P. (2011). Evaluation of androgenic activity of Mucuna pruriens in male rats 10, 15017–15019. https://doi.org/10.5897/AJB09.896

Mutwedu, V.B., Ayagirwe, R.B.B., Bacigale, S.B., Mwema, L.M., Butseme, S., Kashosi, T., Mitima, B. (2019). Effect of dietary inclusion of small quantities of Mucuna pruriens seed meal on sexual behavior , semen characteristics , and biochemical parameters in rabbit bucks (Oryctolagus cuniculus).

Negri, G., Almondes, J.G.S., Cavalcanti, S.M.P., Duarte-Almeida, J.M., Cavalcanti, P.M.S. (2016). Phytochemical evaluation and toxicological effects of ethanolic extracts of bark and leaves from erythroxylum vacciniifolium in models in vivo. Rev Ciên Saúde 1, 17–31.

Nicolosi, A., Glasser, D.B. (2003). Incidence of Erectile Dysfunction in men 40 to 69 years old: results from a population-based cohort study in Brazil 4295, 431–436. https://doi.org/10.1016/S0090-4295(02)02158-1

Ogbuehi, I., Ebong, O., Obianime, A. (2015). A Preliminary Study on the Effect of Abrus precatorius Linn on Reproductive Parameters in Female Rattus norvegicus, Wistar Strain. European J. Med. Plants 7, 156–166. https://doi.org/10.9734/ejmp/2015/15271

Olajide, O.A., Aderogba, M.A., Adedapo, A.D.A., Makinde, J.M. (2004). Effects of Anacardium occidentale stem bark extract on in vivo inflammatory models. J. Ethnopharmacol. 95, 139–142. https://doi.org/10.1016/j.jep.2004.06.033

Oliveira, C.H., Moraes, M.E.A., Moraes, M.O., Bezerra, F.A.F., Abib, E., De Nucci, G.

(2005). Clinical toxicology study of an herbal medicinal extract of Paullinia cupana, Trichilia catigua, Ptychopetalum olacoides and Zingiber officinale (Catuama®) in healthy volunteers. Phyther. Res. 19, 54–57. https://doi.org/10.1002/ptr.1484

Oloye, A., Ola-Davies, O., Oyeyemi, M. (2017). Haemogram and hormonal profile of WAD bucks treated with leaf ethanolic extract of Spondias mombin. Sokoto J. Vet. Sci. 15, 85. https://doi.org/10.4314/sokjvs.v15i3.12

Onyije, F.M., Nwanze, M.C., Alade, G.O., Alade, T.O., Mgbere, O.O., Okpora, C.K. (2018). Mimosa pudica Protects the Testes Against Cadmium-Induced Inflammation and Oligospermia: Potential Benefits in Treatment of Heavy Metal Toxicity. Pathophysiology 25, 293–297. https://doi.org/10.1016/j.pathophys.2018.04.005

Oshima, M., Gu, Y. (2003). Pfaffia paniculata-induced changes in plasma estradiol-17β, progesterone and testosterone levels in mice. J. Reprod. Dev. 49, 175–180. https://doi.org/10.1262/jrd.49.175

Pande, M., Pathak, A. (2009). "Aphrodisiac Activity of Roots of Mimosa pudica Linn. Ethanolic Extract in Mice." Int. J. Pharm. Sci. Nanotechnol. 2, 477–486. https://doi.org/10.37285/ijpsn.2009.2.1.12

Pereira, Nuno A. (2007) A contribuição de Manuel Freire Alemão de Cisneiros para o conhecimento de nossos fitoterápicos.PUBLIT. Rio de Janeiro.

Pokharkar, R.D., Saraswat, R.K., Kanawade, M.G. (2009). Contraceptive evaluations of oil extract of seeds of Abrus precatorius (L) in male albino rats. Pharmacologyonline 3, 905–914.

Pott, A.; Pott, V. J. (1994) Plantas do Pantanal. EMBRAPA-SPI, Brasilia.

Raji, Y., Gbadegesin, M.., Osonuga, O.., Adisa, R.A., Akinsomisoye, O.S., Awobajo, F.., Kunle-Alabi, O.T., Peters, P.R.C.E., Osonuga, I.O., Lamidi, A.F. (2006). Reproductive, Haematologic and Biochemical Profiles of Male Rats Treated with Aqueous Extract of Spondias mombin Bark.

Retzler, K. (2019). Erectile Dysfunction: A Review of Comprehensive Treatment Options for Optimal Outcome. J. Restor. Med. 8. https://doi.org/10.14200/jrm.2019.0104

Ricardo, L.M., De Paula-Souza, J., Andrade, A., Brandão, M.G.L. (2017). Plants from the Brazilian traditional medicine: Species from the books of the polish physician piotr czerniewicz (pedro luiz napoleão chernoviz, 1812–1881). Rev. Bras. Farmacogn. 27, 388–400. https://doi.org/10.1016/j.bjp.2017.01.002

Rodrigues, V. E. G.; Carvalho, D. A. de. (2001) Título: Plantas medicinais no domínio dos cerrados. Ano de publicação: 2001. Fonte/Imprenta: UFLA. Lavras.

Sahin, K., Orhan, C., Akdemir, F., Tuzcu, M., Gencoglu, H., Sahin, N., Turk, G., Yilmaz, I., Ozercan, I.H., Juturu, V. (2016). Comparative evaluation of the sexual functions and NF- κ B and Nrf2 pathways of some aphrodisiac herbal extracts in male rats. BMC Complement. Altern. Med. 1–11. https://doi.org/10.1186/s12906-016-1303-x

Sangirardi Jr., A.B. (1983) Plantas Eróticas**.** 2ªed., Nórdica.

Senu, J., Ojo, F., Balikis, F., Eyinjuoluwa, D., Ireti, O., Olugbemiga, S. (2019). Assessment of reproductive function in male albino rat fed dietary meal supplemented with Mucuna pruriens seed powder. Heliyon 5, e02716. https://doi.org/10.1016/j.heliyon.2019.e02716

Seppan, P., Muhammed, I., Mohanraj, K.G., Premavathy, D., Muthu, S.J., Wungpam, K., Sathyanathan, S.B. (2018). Therapeutic potential of Mucuna pruriens (Linn .) on ageing induced damage in dorsal nerve of the penis and its implication on erectile function : an experimental study using albino rats. Aging Male 0, 1–14. https://doi.org/10.1080/13685538.2018.1439005

Shukla, K.K., Sc, M., Mahdi, A., D, M.P.P., Ahmad, K., Sc, M. (2009). Mucuna pruriens improves male fertility by its action on the hypothalamus – pituitary – gonadal axis. Fertil. Steril. 92, 1934–1940. https://doi.org/10.1016/j.fertnstert.2008.09.045

Silva Araújo, J.E.; Lucas, V. (1930). Catálogo de extratos fluidos. Silva Araújo e Cia. Ltda, Rio de Janeiro.

Simões, C.M.O; Mentz, L.A.; Schenkel, E.P.; Irgang, B.E.; Stehmann, J.R. (1986) Plantas da medicina popular no Rio Grande do Sul / Medicinal plants in Rio Grande do Sul. Universidade Federal do Rio Grande do Sul. Porto Alegre; Brasil.

Singh, A.P., Sarkar, S., Tripathi, M., Rajender, S., (2013). Mucuna pruriens and Its Major Constituent L-DOPA Recover Spermatogenic Loss by Combating ROS , Loss of Mitochondrial Membrane Potential and Apoptosis 8, 1–10. https://doi.org/10.1371/journal.pone.0054655

Singh, R., Ali, A., Jeyabalan, G., Semwal, A. (2013). Current status of Indian medicinal plants with aphrodisiac potential. J. Acute Dis. 2, 13–21. https://doi.org/10.1016/s2221-6189(13)60088-8

Siqueira, I.R., Lara, D.R., Silva, D., Gaieski, F.S., Nunes, D.S., Elisabetsky, E. (1998). Psychopharmacological properties of Ptychopetalum olacoides Bentham (Olacaceae) 36, 327–334.

Sperling, H., Lorenz, A., Krege, S., Arndt, R., Michel, M.C. (2002). An extract from the bark of Aspidosperma quebracho blanco binds to human penile α-adrenoceptors. J. Urol. 168, 160–163. https://doi.org/10.1016/S0022-5347(05)64852-5

Suresh, S., Prakash, S. (2011). Effect of Mucuna pruriens (Linn.) on Oxidative Stress-Induced Structural Alteration of Corpous Cavernosum in Streptozotocin-Induced Diabetic Rat 1943–1956. https://doi.org/10.1111/j.1743-6109.2011.02221.x

Suresh, S., Prakash, S. (2010). Effect of Mucuna pruriens (Linn.) on Sexual Behavior and Sperm Parameters in Streptozotocin-Induced Diabetic Male Rat. https://doi.org/10.1111/j.1743-6109.2010.01831.x

Suresh, S., Prithiviraj, E., Prakash, S. (2009). Dose- and time-dependent effects of ethanolic extract of Mucuna pruriens Linn . seed on sexual behaviour of normal male rats 122, 497–501. https://doi.org/10.1016/j.jep.2009.01.032

Suresh, S., Prithiviraj, E., Prakash, S. (2008). Effect of Mucuna pruriens on oxidative

stress mediated damage in aged rat sperm 33, 22–32. https://doi.org/10.1111/j.1365-2605.2008.00949.x

Szewczyk, K., Zidorn, C. (2014). Ethnobotany, phytochemistry, and bioactivity of the genus Turnera (Passifloraceae) with a focus on damiana - Turnera diffusa. J. Ethnopharmacol. 152, 424–443. https://doi.org/10.1016/j.jep.2014.01.019

Tabanca, N., Pawar, R.S., Ferreira, D., Marais, J.P.J., Khan, S.I., Joshi, V., Wedge, D.E., Khan, I.A. (2007). Flavan-3-ol-phenylpropanoid conjugates from Anemopaegma arvense and their antioxidant activities. Planta Med. 73, 1107–1111. https://doi.org/10.1055/s-2007-981563

Tavares, Dr. J. C. (2018) Plantas Medicinais: Uso, orientações e precauções. Thieme Revinter Publicações. Rio de Janeiro.

Teske, M.; Trentini, A. M. (1995). Compêndio de fitoterapia: Herbarium. 3. ed. Herbarium Laboratório Botânico. Curitiba.

Tousson, E., Hafez, E., Zaki, S., Gad, A., Elgharabawy, R.M. (2020). Evaluation of the testicular protection conferred by damiana (Turnera diffusa Willd.) against amitriptyline-induced testicular toxicity, DNA damage and apoptosis in rats. Biomed. Pharmacother. 132, 110819. https://doi.org/10.1016/j.biopha.2020.110819

Trentin, A., Santos, A., Guedes, A., Pizzolatti, M., Yunes, R., Calixto, J. (1999). Antinociception Caused by the Extract of Hedyosmum brasiliense and its Active Principle, the Sesquiterpene Lactone 13-Hydroxy-8,9-dehydroshizukanolide. Planta Med. 65, 517–521.

Tufan, S., Gülsoy Toplan, G., Mat, A. (2018). Ethnobotanical usage of plants as aphrodisiac agents in anatolian folk medicine. Marmara Pharm. J. 22, 142–151. https://doi.org/10.12991/mpj.2018.51

Uchendu, C.N., Isek, T. (2008). Antifertility activity of aqueous ethanolic leaf extract of Spondias mombin (Anacardiaceae) in rats. Afr. Health Sci. 8, 163–167.

Villas Bôas, G.K.; Galvão, M.N.; Machado, M.; Fraga, S.A.P.M. (2018) Conhecimento popular de plantas medicinais do extremo sul da Bahia. Outras Expressões. São Paulo.

Wattanathorn, J., Prabsattroo, T., Somsapt, P., Sritragool, O., Thukham-mee, W., Muchimapura, S. (2018). Sexual Enhancing Effect of Anacardium occidentale in Stress-Exposed Rats by Improving Dopaminergic and Testicular Functions 2018.

Wattanathorn, J., Wannanon, P., Muchimapura, S., Thukham-mee, W., Tong-un, T., Polyiam, P. (2019). Toxicity Evaluation of Anacardium occidentale , the Potential Aphrodisiac Herb 2019. https://doi.org/10.1155/2019/1459141

World Health Organization (WHO) (2013). WHO Traditional Medicine Strategy 2014-2023. World Heal. Organ. 1–76. https://doi.org/2013

Yafi, F.A., Jenkins, L., Albersen, M., Corona, G., Isidori, A.M., Goldfarb, S., Maggi, M., Nelson, C.J., Parish, S., Salonia, A., Tan, R., Mulhall, J.P., Hellstrom, W.J.G. (2016). Erectile dysfunction. Nat. Rev. Dis. Prim. 2, 16003. https://doi.org/10.1038/nrdp.2016.3

Zanolari, Boris, Guilet, D., Marston, A., Queiroz, E.F., De Queiroz Paulo, M.,

Hostettmann, K. (2003). Tropane Alkaloids from the Bark of Erythroxylum vacciniifolium. J. Nat. Prod. 66, 497–502. https://doi.org/10.1021/np040144h

Zanolari, B., Ndjoko, K., Ioset, J.R., Marston, A., Hostettmann, K. (2003). Natural aphrodisiacs: studies of commercially-available herbal recipes, and phytochemical investigation of Erythroxylum vacciniifolium Mart. (Erythroxylaceae) from Brazil.

Zhao, J., Dasmahapatra, A.K., Khan, S.I., Khan, I.A. (2008). Anti-aromatase activity of the constituents from damiana (Turnera diffusa). J. Ethnopharmacol. 120, 387–393. https://doi.org/10.1016/j.jep.2008.09.016

Table 1 – Medicinal plants used as aphrodisiacs native to Brazil

Family	Species	Popular name	Used part	Prepare form	Symptom or claim	References
Acanthaceae	*Avicennia germinans* (L.) L. [cited as *A. nitida* Jacq.)]	Siriúba	Leaves	Infusion	Aphrodisiac	Sangirardi Jr. (1981)
	Hebanthe erianthos (Poir.) Pedersen [cited as *P. paniculata* (Mart.) Kuntze]	Ginseng-brasileiro, fáfia, paratudo, suma	Roots	Tea	General tonic, aphrodisiac, to calm nerves	Lorenzi e Matos (2008)
	Justicia pectoralis Jacq.	Chambá, chachambá, anador, trevo-do-Pará, trevo-cumaru	Leaves	NI	Aphrodisiac	Lorenzi e Matos (2008)
Amaranthaceae	*Pfaffia glomerata* (Spreng.) Pedersen	Ginseng-do-pantanal	Roots	NI	Aphrodisiac, against stress	Pott e Pott (1994)
Anacardiaceae	*Anacardium occidentale* L.	Cajueiro	1 – Flowers and nuts 2 – Nuts 3 – Flowers, fruits 4 – NI 5 – Nuts	1 – Food 2 – Food 3 – Tea and food 4 – NI 5 – Food	1 – Aphrodisiac, tonic, exciter 2 – Aphrodisiac 3 – Aphrodisiac 4 – Aphrodisiac, genital organ exciter 5 – Aphrodisiac	1 – Sangirardi Jr. (1981) 2 – Almeida (1993) 3 - Di Stasi e Hiruma-Lima (2002) 4 – Cruz (1982) 5 – Braga (1960)
	Spondias mombin L. [cited as *S. lutea* L.)]	Cajá-mirim	Fruits	Food	Aphrodisiac	Sangirardi Jr (1981)
Annonaceae	*Xylopia aromatica* (Lam.) Mart.	Envira, envireira, jejerecu, pacovi,	1 – Seeds and stem barks 2 – Fruits	1 – Consume of roasted and powdered seeds and	1 – Tonic, exciter, aphrodisiac 2 – Aphrodisiac,	1 – Van den Berg (1982) 2 – Almeida, Proença,

		pimenta-de-gentio, pimenta-de-macaco, pimenta-de-negro	3 – Seeds 4 – Stems	tincture 2 – Infusion 3 – Consume of roasted and powdered seeds and tincture from stems. 4 – Tincture	tonic 3 – Aphrodisiac 4 – Aphrodisiac, tonic	Sano, Ribeiro (1998) 3 – Lorenzi e Matos (2008) 4 – Maroni (2006)
	Xylopia frutescens Aubl.	Envira, pindaíba, pindaúba, jejerecu, pimenta-de-gentio	1 – Seeds and stem barks 2 – Seeds	1 – Consume of roasted seeds and tincture 2 – Maceration in brandy	1 – Aphrodisiac, tonic 2 – Aphrodisiac	1 – Van den Berg, (1982) 2 – Sangirardi Jr (1981)
Apiaceae	*Eryngium foetidum* L.	Coentro-do-Maranhão, coentro-de-urubu	1 – Roots 2 – Roots	1 – Tea 2 – NI	1 – Aphrodisiac 2 – Aphrodisiac	1 - Van den Berg (1982) 2 – Braga (1960)
Apocynaceae	*Aspidosperma quebracho-blanco* Schltdl.	Quebracho-branco	NI	NI	Aphrodisiac	Pott e Pott (1994)
	Secondatia floribunda A.DC.	Catuaba	NI	NI	Aphrodisiac	Pereira (1982)
	Temnadenia violacea (Vell.) Miers.	Catuaba	NI	NI	Aphrodisiac	Pereira (1982)
Aquifoliaceae	*Ilex conocarpa* Reissek	Catuaba-do-mato	Leaves	Infusion	Aphrodisiac, tonic	Sangirardi Jr (1981)
Araceae	*Anthurium oxycarpum* Poepp.	Yeuri-Cumajé	Leaves	Infusion	Aphrodisiac	Sangirardi Jr (1981)
Aristolochiaceae	*Aristolochia triangularis* Cham. & Schltdl	Cipó-mil-homens	Stems	Infusion	Aphrodisiac	Lopes (NI)
Asteraceae	*Baccharis articulata* (Lam.) Pers.	Carqueja-doce	Whole plant	Infusion	Aphrodisiac	Sangirardi Jr (1981)
	Baccharis ochracea	Erva-santa	Whole plant	Infusion	Aphrodisiac	Sangirardi Jr (1981)

	Spreng.					
	Baccharis crispa Spreng. [cited as *B. trimera* (Less.) DC.]	Carqueja	Whole plant	Infusion	Male sexual impotence and female sterility	Maroni (2006)
	Vernonanthura ferruginea (Less.) H. Rob. [cited as *Vernonia ferruginea* Less.]	Calção-de-velho	NI	NI	Aphrodisiac	Pott e Pott (1994)
Balanophoraceae	*Langsdorffia hypogaea* Mart.	NI	Flowers	Food	Aphrodisiac	Pott e Pott (1994)
	Lophophytum mirabile Schott & Endl.	Fel-da-terra	Pollen, inflorescences	Food	Aphrodisiac	Sangirardi Jr (1981)
	Scybalium fungiforme Schott & Endl	Esponja-de-raiz	Floral peduncles and pollen from male flowers	Food	Aphrodisiac	Sangirardi Jr (1981)
Bignoniaceae	*Anemopaegma album* Mart. ex DC	Catuaba	Barks	Infusion, tincture	Aphrodisiac	Braga (1960)
	Anemopaegma arvense (Vell.) Stellfeld ex de Souza [also cited as *A. mirandum* (Cham.) Mart. ex DC.]	Catuaba, verga-tesa, alecrim-do-campo	1 – Leaves and roots 2 – Roots 3 – Barks 4 – Roots and barks 5 – Root barks 6 – NI 7 – Barks and rhizomes 8 – Roots,	1 – Infusion in brandy (“garrafada”) 2 – Infusion in wine 3 – NI 4 – Maceration (4-10 g in wine or sugar water) 5 – Maceration in brandy 6 – NI 7 – NI	1 – Aphrodisiac 2 – Tonic, energizer, stimulant and aphrodisiac 3 – For sexual impotence, difficulty in reasoning, neurasthenia 4 – Aphrodisiac, tonic, stimulates nervous system	1 - Van den Berg (1982) 2 – Almeida (1998) 3 – Teske e Trentini (2001) 4 - Silva Araújo e Lucas (1930) 5 - Sangirardi Jr (1981) 6 – Pereira (1982) 7 – Corrêa, Batista, Quintas (1998)

			leaves, whole plant 9 – Roots 10 – Barks 11 – Roots, leaves 12 – Barks, roots	8 – Maceration in wine (“garrafada”) 9 – NI 10 – Infusion, tincture 11 – Infusion in wine 12 – Decoction	5 – Aphrodisiac 6 – Aphrodisiac 7 – Aphrodisiac 8 – Aphrodisiac, frigidity, sexual impotence 9 – Aphrodisiac 10 – Aphrodisiac 11 – Aphrodisiac 12 – Aphrodisiac	8 – De La Cruz (2008) 9 – Guarim Neto (1987) 10 – Braga (1960) 11 – Maroni (2006) 12 – Tavares (2018)
	Anemopaegma glaucum Mart. ex DC.	Alecrim-do-campo fêmea	1 – Roots, leaves, whole plant 2 – Barks	1 – Maceration in wine (“garrafada”) 2 – Infusion, tincture	1 – Aphrodisiac, frigidity, sexual impotence 2 – Aphrodisiac	1 - De La Cruz (2008) 2 – Braga (1960)
	Anemopaegma scabriusculum Mart. ex DC.	Catuaba	Barks	Infusion, tincture	Aphrodisiac	Braga (1960)
	Fridericia chica (Bonpl.) L.G. Lohmann [cited as *Arrabidaea chica* Bonpl. Verl.]	Carajuru	Leaves	Infusion	Aphrodisiac	Sangirardi Jr (1981)
	Tynanthus cognatus (Cham.) Miers [cited as *T. elegans* Miers]	Cipó-cravo	1 – Root barks 2 – Root barks 3 – Whole plant	1 – Tea, infusion in wine 2 – Decoction, infusion in brandy 3 – Decoction, infusion	1 – Aphrodisiac, tonic 2 – Sexual stimulant, aphrodisiac 3 – Sexual impotence, tonic	1 - Van den Berg (1982) 2 - Sangirardi Jr (1981) 3 – Rodrigues e Carvalho (2001)
Bixaceae	*Bixa orellana* L.	Urucum, falso-açafrão, colorau,	1 – Seeds 2 – Seeds	1 – Semi-solid mass obtained from seeds	1 – Aphrodisiac 2 – Aphrodisiac	1 – Lorenzi e Matos (2008)

		urucuuba	3 – Seeds 4 – Seeds 5 – Seeds, young shoots, crude leaves 6 – Seeds, leaves, roots	2 – Food 3 – Powdered seeds 4 – Powdered seeds 5 – Decoction, tea, food 6 – Decoction, infusion	3 – Aphrodisiac 4 – Aphrodisiac 5 – Aphrodisiac 6 – Aphrodisiac	2 – Teske e Trentini (2001) 3 – Sangirardi Jr (1981) 4 – Camargo (1998) 5 – Di Stasi e Hiruma-Lima (2002) 6 – Tavares (2018)
Bromeliaceae	*Tillandsia usneoides* (L.) L.	Barba-de-velho	Branches	NI	Aphrodisiac	Sangirardi Jr (1981)
Burseraceae	*Protium catuaba* (Soares da Cunha) Daly & P.Fine. [cited as *Tetragastris catuaba* Soares da Cunha]	Catuaba	NI	NI	Aphrodisiac	Pereira (1982)
Caryocaraceae	*Caryocar brasiliense* Cambess.	Pequi	1 – Seeds 2 – Seeds	1 – Maceration in brandy 2 – Maceration in brandy	1 – Aphrodisiac, tonic 2 – Aphrodisiac, tonic	1 – Rodrigues e de Carvalho (2001) 2 – Maroni (2006)
Celastraceae	*Monteverdia guyanensis* (Klotzsch ex Reissek) Biral [cited as *Maytenus guyanensis* Klotzsch ex Reissek]	Chichuá	Barks	NI	Aphrodisiac, sexual impotence	Borrás (2003)
Chloranthaceae	*Hedyosmum brasiliense* Mart. ex Miq.	Erva-de-soldado	Leaves, flowers	Maceration in wine	Aphrodisiac, tonic	Sangirardi Jr (1981)
Combretaceae	*Combretum leprosum* Mart.	Mofumbo, pente-de-macaco	Barks	Infusion	Aphrodisiac	Lorenzi e Matos (2008)
Convolvulaceae	*Turbina corymbosa* (L.)	Ololiuhqui	Seeds	Crushed seed,	Aphrodisiac	Sangirardi Jr (1981)

	Raf. [cited as *Ipomoea sidaefolia* Choisy]			ointment, alcoholic maceration		
Cucurbitaceae	*Fevillea trilobata* L.	Fava-de-santo-Inácio	Seeds	NI	Aphrodisiac, sexual stimulant	Sangirardi Jr (1981)
Cyperaceae	*Bulbostylis aff. capillaris* (L.) C.B. Clarke	Capim-barba-de-bode	Whole plant	Decoction	Aphrodisiac, sexual weakness	De La Cruz (2008)
	Cyperus articulatus L. [cited as *C. nodosus* Humb. & Bonpl. ex. Willd.]	Junco-miúdo	Tubers	Food	Aphrodisiac, restorative	Sangirardi Jr (1981)
Dilleniaceae	*Davilla rugosa* Poir.	Cipó-caboclo	Whole plant	NI	Aphrodisiac	Sangirardi Jr (1981)
Erythroxylaceae	*Erythroxylum catuaba* A.J.Silva	Catuaba	Barks	Decoction, tea, tincture	Aphrodisiac	Almeida (1993)
	Erythroxylum suberosum A. St.-Hil.	Sombra-de-touro	NI	NI	Aphrodisiac	Pott e Pott (1994)
	Erythroxylum vacciniifolium Mart.	Catuaba (pau), catuaba-verdadeira	1 – Barks 2 – Barks 3 – Barks	1 – Infusion, decoction 2 –NI 3 – NI	1 – Sexual tonic 2 – Aphrodisiac 3 – Aphrodisiac	1 - Lorenzi e Matos (2008) 2 - Sangirardi Jr (1981) 3 – Pereira (1982)
Fabaceae	*Abrus precatorius* L.	Jequiriti, piriquiti, olho-de-cabra, olho-de-pombo, cipó-de-alcaçuz, tento-miúdo	1 – Roots 2 – Roots, leaves, seeds	1 – NI 2 – Decoction in milk	1 – Aphrodisiac 2 – Aphrodisiac, tonic for the nerves	1 - Lorenzi e Matos (2008) 2 - Sangirardi Jr (1981)
	Betencourtia neesii (DC.)	Feijão-bravo	Roots	Infusion	Aphrodisiac	Sangirardi Jr (1981)

	L.P. Queiroz [cited as *Galactia neesii* DC.]					
	Cerradicola peduncularis (Benth.) L.P. Queiroz [cited as *Galactia penduncularis* (Benth.) L.P. Queiroz]	Vergatesa	NI	NI	Aphrodisiac	Pereira (1982)
	Hymenaea courbaril L.	Jatobá-mirim	Barks, sap, resin	Mixed in wine or tonic formulas and milk, decoction	Sexual weakness, frigidity, sexual impotence	De La Cruz (2008)
	Hymenaea stigonocarpa Mart. ex Hayne	Jatobá-do-campo	Barks	Decoction, syrup	Sexual weakness, frigidity, sexual impotence	De La Cruz (2008)
	Mimosa pudica L.	Sensitiva	Roots	Tea, decoction	Aphrodisiac, tonic of the seminal vessels	Sangirardi Jr (1981)
	Mucuna pruriens (L.) DC. [also cited as *M. pluricostata* Barb. Rodr.]	Pó-de-mico, Café-do-Pará	1 – Seeds 2 – Seeds 3 – Roots, fruit hairs, seeds	1 – Paste made from seeds cooked with milk, butter and sugar 2 – Internal use 3 – NI	1 – Aphrodisiac, tonic of the nervous system 2 – Aphrodisiac 3 – Aphrodisiac	1 - Sangirardi Jr (1981) 2 – Cruz (1982) 3 – Sangirardi Jr (1981) [as *M. pluricostata*]
	Vachellia farnesiana (L.) Wight & Arn. [cited as *Acacia farnesiana* (L.) Willd.]	Esponjeira	Flowers	Hydrolate	Aphrodisiac, sexual stimulant	Sangirardi Jr (1981)
Loganiaceae	*Strychnos pseudoquina* A. St.-Hil.	Casca-aromática, falsa-quina, quina-branca, quina-de-	Barks	Infusion, maceration (“garrafada”), tea	Aphrodisiac, tonic	Almeida (1998)

		cerrado, quina-chapada, quina-do-campo				
Malpighiaceae	*Heteropterys tomentosa* A. Juss. [cited as *H. aphrodisiaca* Machado]	Nó-de-cachorro	1 – NI 2 – NI 3 – Roots 4 – Roots 5 – Roots	1 – NI 2 – NI 3 – Maceration in brandy 4 – Decoction and maceration in wine 5 – Alcoholic maceration (“garrafada”)	1 – Aphrodisiac, sexual stimulant 2 – Aphrodisiac 3 – Aphrodisiac 4 – Aphrodisiac, tonic, frigidity, sexual impotence 5 – Aphrodisiac	1 - Sangirardi Jr (1981) 2 – Pereira (1982) 3 - Pott e Pott (1994) 4 – De La Cruz (2008) 5 – Guarim Neto (1987)
Malvaceae	*Byttneria melastomaefolia* A.St. Hil.	Raiz-de-bugre	1 – Roots and leaves 2 – Roots	1 – Decoction, maceration in wine and brandy 2 – Alcoholic maceration (“garrafada”)	1 – Sexual impotence, frigidity 2 – Aphrodisiac	1 – De La Cruz (2008) 2 – Guarim Neto (1987)
Meliaceae	*Trichilia catigua* A. Juss	Catuaba	NI	NI	Aphrodisiac	Pereira (1982)
Moraceae	*Brosimum acutifolium* Huber	Mururé	Barks	Decoction, infusion	Aphrodisiac	Borrás (2003)
	Ficus adhatodifolia Schott in Spreng.	Coajinguva	1 – Stem latex 2 – Seeds	1 – NI 2 – Food	1 – Aphrodisiac, tonic 2 – Aphrodisiac	1 – Cruz (1982) 2 – Braga (1960)
	Ficus insipida Willd.	Apuí-acu, caxinguba, figueira-do-mato, gameleira	1 – Stem latex 2 – Fruits 3 – Seeds 4 – Fruits	1 – Mixed with water, alcoholic infusion 2 – Food (consumed *in natura*) 3 – Food	1 – Aphrodisiac 2 – Aphrodisiac 3 – Aphrodisiac 4 – Aphrodisiac	1 – Van den Berg (1982) 2 – Lorenzi e Matos (2008) 3 – Sangirardi Jr (1981)

Myristicaceae	*Virola sebifera* Aubl.	Ucuuba, gordura-de-virola, ucuuba-do-cerrado, bicuíba	Seeds	4 – Food NI	Aphrodisiac	4 – Pott e Pott (1994) Almeida (1998)
Myrtaceae	*Myrcia multiflora* (Lam.) DC. [cited as *M. sphaerocarpa* DC.]	Cambuizero	Fruits	Maceration in brandy	Aphrodisiac	Sangirardi Jr (1981)
Olacaceae	*Ptychopetalum olacoides* Benth.	Marapuama	1 – Roots 2 – Barks, wood 3 – Barks, roots 4 – Barks 5 – Barks 6 – Stems, roots from young plants 7 – Barks 8 – Stem barks, stem roots	1 – Infusion, decoction 2 – Tincture, decoction, wine, syrup 3 – Tea, alcoholic maceration (“garrafada”) 4 – Decoction, alcoholic maceration (“garrafada”) 5 – Maceration in wine 6 – Infusion 7 – Decoction 8 – Decoction	1 – Tonic, aphrodisiac 2 – Aphrodisiac, for neurasthenia 3 – Aphrodisiac 4 – Male genital organ exciter, aphrodisiac, sexual stimulant 5 – Aphrodisiac, for neurasthenia 6 – Sexual impotence, tonic of the nervous system and muscles 7 – For genital neurasthenia 8 – Aphrodisiac	1 – Teske e Trentini (2001) 2 – Silva Araújo e Lucas (1930) 3 – Pereira (1982) 4 – Borrás (2003) 5 – Sangirardi Jr (1981) 6 – Balbach (NI) 7 – Cruz (1982) 8 – Tavares (2018)
	Ptychopetalum uncinatum Anselmino	Marapuama	1 – Whole plant, mainly	1 – Tea 2 – Maceration in	1 – Aphrodisiac, tonic	1 – Lorenzi e Matos (2008)

			barks and roots 2 – Barks 3 – Stems and roots from young plants	wine 3 – Infusion	2 – Aphrodisiac, for neurasthenia 3 – Sexual impotence, tonic of the nervous system and muscles	2 – Sangirardi Jr (1981) 3 – Balbach (NI)
Orchidaceae	*Vanilla mexicana* Mill. *Vanilla palmarum* (Salzm. ex. Lindl.) Lindl.	Baunilha Baunilha-de-acuri	Fruits Fruits	NI NI	Sexual impotence Aphrodisiac	Cruz (1982) Pott e Pott (1994)
Passifloraceae	*Passiflora quadrangularis* L. [cited as *P. macrocarpa* Mast.]	Maracujá-melão	Leaves and fruit juice	Infusion	Aphrodisiac, sedative, anxiolytic	Sangirardi Jr (1981)
Phyllanthaceae	*Margaritaria nobilis* L.f. [cited as *Phyllanthus nobilis* (L.f.) Müll.Arg.]	Catuaba	NI	NI	Aphrodisiac	Pereira (1982)
Poaceae	*Sporobolus aeneus* (Trin.) Kunth [cited as *S. sprengelii* Kunth]	Capim-barba-de-bode	Whole plant	Infusion	Aphrodisiac	Sangirardi Jr (1981)
Rubiaceae	*Chiococca alba* (L.) Hitch.	NI	Roots	NI	Aphrodisiac	Pott e Pott, 1994
	Genipa americana L.	Jenipapeiro, jenipapo	1 – Roots, barks, fruits 2 – Fruits	1 – Decoction, syrup 2 – Food	1 – Aphrodisiac, panacea 2 – Aphrodisiac	1 – Sangirardi Jr (1981) 2 – Pott e Pott (1994)
Salviniaceae	*Azolla caroliniana* Willd.	Mururé-rendado	Leaves	Tea, alcoholic maceration	Aphrodisiac	Sangirardi Jr (1981)
Sapindaceae	*Paullinia cupana* Kunth	Guaraná	1 – Seeds 2 – Seeds	1 – Powder or syrup made with toasted	1 – General stimulant (tonic),	1 – Van den Berg (1982)

			3 – Seeds 4 – Seeds 5 – Seeds	seeds diluted in water 2 – Powder 3 – Drink 4 – Decoction 5 – Decoction	mild aphrodisiac 2 – Stimulant, energizer, astringent, aphrodisiac 3 – Stimulant, aphrodisiac 4 – Aphrodisiac, tonic, astringent 5 – Aphrodisiac	2 – Teske e Trentini (2001) 3 – Sangirardi Jr (1981) 4 – Borrás (2003) 5 – Tavares (2018)
Selaginellaceae	*Selaginella convoluta* (Arn.) Spring.	Mão-fechada	Whole plant	Decoction, infusion	Aphrodisiac, increases female fertility	Agra (1996)
Smilacaceae	*Smilax brasiliensis* Spreng.	Salsaparrilha	Barks	Decoction, infusion	Sexual impotence	Maroni (2006)
	Smilax longifolia Rich. [cited as *S. papyracea* Duhamel]	Salsaparrilha	Roots	Decoction	Aphrodisiac	Tavares (2018)
Solanaceae	*Solanum americanum* Mill.	Maria-pretinha, erva-moura	1 – Whole plant 2 – Whole plant	1 – Decoction 2 – Decoction	1 – Sedative, aphrodisiac 2 – Aphrodisiac	1 – Rodrigues e Carvalho (2001) 2 – Maroni (2006)
Turneraceae	*Turnera diffusa* Willd. ex Schult [cited as *T. aphrodisiaca* Ward]	Damiana	1 – Leaves 2 – Leaves 3 – NI 4 – NI	1 – Infusion (2 -4 g, 3x/day). 2 – Essential oil, infusion, decoction, powder 3 – NI 4 – NI	1 – Tonic, stimulant, aphrodisiac 2 – Tonic, aphrodisiac 3 – Sexual impotence, tonic for the nerves 4 – Aphrodisiac	1 – Silva Araújo e Lucas (1930) 2 – Sangirardi Jr (1981) 3 – Balbach (NI) 4 – Cruz (1982)

Vochysiaceae	*Vochysia elliptica* Mart.	Pau-doce	Barks	Infusion, alcoholic maceration	Aphrodisiac	Sangirardi Jr (1981)

NI: Not informed

Table 2 – Quantity of articles found per plant species

Species	Scientific literature	
	PubMed	Google Scholar
Hebanthe erianthos [cited as *Pfaffia. paniculata*]	1	1
Pfaffia glomerata	4	1
Anacardium occidentale	1	1
Spondias mombin	1	2
Aspidosperma quebracho-blanco	1	1
Baccharis crispa [cited as *B. trimera*]	1	X
Anemopaegma arvense	1	X
Hedyosmum brasiliense	X	1
Erythroxylum vacciniifolium	X	2
Abrus precatorius	X	3
Mimosa pudica	1	3
Mucuna pruriens	8	11
Heteropterys tomentosa [cited as *H. aphrodisiaca*]	1	4
Trichilia catigua	3	2
Ptychopetalum olacoides	1	2
Paullinia cupana	X	2
Turnera diffusa	5	11

Anexo 1: Instructions for Authors

Instructions for Authors

Manuscript Submission

Manuscript Submission

Submission of a manuscript implies: that the work described has not been published before; that it is not under consideration for publication anywhere else; that its publication has been approved by all co-authors, if any, as well as by the responsible authorities – tacitly or explicitly – at the institute where the work has been carried out. The publisher will not be held legally responsible should there be any claims for compensation.

Permissions

Authors wishing to include figures, tables, or text passages that have already been published elsewhere are required to obtain permission from the copyright owner(s) for both the print and online format and to include evidence that such permission has been granted when submitting their papers. Any material received without such evidence will be assumed to originate from the authors.

Online Submission

Please follow the hyperlink "Submit manuscript" and upload all of your manuscript files following the instructions given on the screen.

Source Files

Please ensure you provide all relevant editable source files at every submission and revision. Failing to submit a complete set of editable source files will result in your

article not being considered for review. For your manuscript text please always submit in common word processing formats such as .docx or LaTeX.

Back to top ↑

Types of articles

The Brazilian Journal of Pharmacognosy accepts for publication original scientific work, reviews and communication articles written only in English.

• Original papers: Original papers are research articles describing original experimental results.Themanuscript shouldbearrangedinthefollowingorder:Graphicalabstract, Title,Abstract,Keywords,Introduction,Materialand methods,Results,Discussion,

Authors' contributions, Acknowledgements, References, Figures with Legends, Tables, Structural Formulae and Supplemental files (if applicable). Results and Discussion sections may appear as a combined 'Results and Discussion' section. The normal length of the main text of an Original Paper (excluding references, tables, figures and figure legends) is approximately 3,000 words. Longer manuscripts may be accepted only in exceptional and well justified cases.

•Short communications: This section will cover mainly the isolation of known compounds from new neotropical sources, or complementary results of on-going work. The text should be arranged as follows: Graphical abstract, Title, Abstract of 200 words, Keywords, Introductory Remarks, Material and Methods with brief experimental details without subheadings, Results and Discussion as one body of text without headlines, Acknowledgements, Authorship, References (up to 20 citations) and Figures and/or Tables (up to 3). The text should not exceed 2,000 words.

•Reviews: Authors are invited to submit a review article that provides concise and critical updates on a subject, and with around 100 references. The main purpose of reviews is to provide a concise, accurate introduction to the subject matter and inform the reader critically of the latest developments in the field. Review articles should be designed to give an interesting insight into a hot topic in Pharmacognosy, focusing on the key developments that have shaped a field rather than giving a very comprehensive overview of a very specific topic. They should be concise and include details of the search strategy used, such as time frame, search terms, used databases.

A review should be an article that produces knowledge and not just a survey of the existing literature. The review must be a response to an initial question. Reviews of a particular herbal drug will be considered if they contain the newest issue and a perspective on future directions.

Authors are strongly recommended to prepare a manuscript using a A4-sized paper, double-spaced, with Times New Roman size-12 font, fully justified, with margins of 2 cm.

Back to top ↑

Submission checklist

You can use this list to carry out a final check of your submission before you send it to the journal for review. Please check the relevant section in this Guide for Authors for more details.

Ensure the following:

- One author has been designated as the corresponding author with contact details: Institutional e-mail address; full postal address;
- ORCID ID for allauthors;
- Authors' contributions;
- Allauthors,withtheirrespectiveemailaddresses,shouldbeenteredintothesystem.
- Allnecessaryfileshavebeenuploaded:Graphicalabstract,Manuscript;Include keywords; All figures with Legends; All tables (including titles, description, footnotes); and Supplemental files (ifapplicable).
- All figure and table citations in the text match the files provided;
- Manuscript has been 'spell checked' and 'grammar checked;

- All references mentioned in the Reference List are cited in the text, and vice versa;

- Permission has been obtained for use of copyrighted material from other sources (including the Internet);

- Relevant declarations of interest have been made;

- Journal policies detailed in this guide have been reviewed.

Back to top ↑

Additional information

- All plant, microorganism and marine organism materials used in the described research should be supported by an indication of the site (including GPS coordinates, if possible) and country of origin, the name of the person identifying the biological material and the location of the voucher specimen.

- Authors should be prepared to provide documentary evidence that approval for collection was afforded from an appropriate authority in the country of collection and, if applicable, to follow the rules concerning the biodiversity rights.

- The journal will not accept responsibility for research works that do not comply with the legislation of the country of residence of the author.

- We strongly recommend that authors avoid stating that the popular or traditional **use of a certain herb was confirmed by pre-clinical, in vitro assays or in vivo tests using animals.**

- The Revista Brasileira de Farmacognosia-Brazilian Journal of Pharmacognosy strongly encourages the submission of original works in which the experimental procedures were conducted taking into consideration green chemistry principles, such as by employing green solvents and environmental resource saving experimental designs in any step of the investigation.

- Evaluations using animal models to provide evidences for the pharmacological

efficacy of plants do not fall into the areas of interest of the journal when polyphenol-rich plant extracts are involved and, therefore, making the results predictable.

• For the pharmacological studies to explore the therapeutic roles of polyphenols, such as antioxidant activity, antibacterial, antiviral, hepatoprotective, anti-inflammatory, antipyretic, anti-obesity, cardioprotective, neuroprotective, anti-hypertension, free radicals scavenger, and central nervous system stimulators, the journal will give

preference to articles that make use of molecular tools over animal models for the characterization of the mechanism(s) of action of isolated pure compounds.

• For the pharmacobotanical studies, the use of DNA barcodes combined with chemical profile analysis (TLC and HPLC) would be the required approach to solve the problems of quality control of medicinal plants.

• The use of HPLC or UHPLC coupled to hybrid state-of-the-art mass spectrometers are becoming a key tool for the rapid and accurate analysis and dereplication of substances in complex plant matrices to rapidly estimate their pharmacological

potential, making unnecessary the use of in vivo models to validate it where polyphenols are the major constituents.

• The Revista Brasileira de Farmacognosia-Brazilian Journal of Pharmacognosy explicitly encourages the submission of chemically characterized extracts by GC (volatile oils), HPLC and/or NMR.

• It is a mandatory requirement for authors to include copies of NMR spectra for all new compounds and tested bioactive compounds from a natural source in the Supporting Information.

• For works describing the structural elucidation of novel natural products, it is mandatory to include evidences for the absolute configuration.

The following immediate rejection criteria apply

i. the manuscript does not fall into the areas of interest of the journal;

ii. manuscripts not formatted in accordance with the standards of the journal, e.g., papers requiring English proof-reading can be refused without further editorial

inspection.

iii. the manuscript results are preliminary, e.g., chemical analysis using different reagents for the identification of classes and types of secondary metabolites;

pharmacobotanical studies without the use of DNA barcodes combined with chemical profile analysis;

iv. results not presenting chemically characterized extracts;

v. experimental work based on preliminary biological and pharmacological analysis for extracts without the identification of the active constituent(s) or dereplication of major constituents by GC (volatile compounds), HPLC or NMR.

vi. manuscripts reporting activity data without comparison with a reference, without a positive control/appropriate control or not based on adequate statistics;

vii. the biological source (e.g. plant, microorganism, marine organism etc.) is not clearly identified, authenticated and documented;

viii. experimental work on antioxidant activity of crude extracts without isolation, identification and content estimation of the active compounds; phenolic compounds are widely spread in nature and fully recognized as antioxidants or scavengers;

ix. experimental work on antimicrobial activity with crude extracts without isolation and identification of the active compounds, with large MIC values (μg/ml) for antimicrobial activity (≥250 μg/ml for plant extracts and ≥50 μg/ml for pure compounds) and without appropriate identification of culture collections/strain designation codes;

x. experimental work on volatile oils with only one sample of a single plant specimen with a single chromatographic analysis and without appropriate statistical analyses; without oil yield (%) and characterization and component quantification not

undertaken using GC-MS-FID. Analyses of the retention indices of the components not calculated using n-alkane homologous series together with analyses of some of the isolated natural components. Biological activity of essential oil without chemical characterization;

xi. too preliminary data using in vitro or in vivo assays will not be acceptable if (i) no information on the type of activity is given; (ii) single dose or very high concentrations (must show dose–response studies); (iii) repetition of a simple bioassay (usually one assay with replicates); (iv) lack of appropriate controls (solvents; positive or negative substances according to the study); (v) no IC50 values (if applicable); (vi) predictable **bioactivity is described (e.g., therapeutic roles of polyphenols);**

xii. pharmacological efficacy of plants in animal models when the results involved polyphenol-rich plant extracts;

xiii. use of only the brine shrimp assay (Artemia salina) to access the toxicity of extracts;

xiv. isolation and bioassay of well-known compounds with small or no relationship to the activity, or to the medicinal use of the plant without clear justification;

xv. manuscripts reporting pharmacological or biological activities of crude extracts or phytopharmaceuticals without chemical and technical standardization. Standardization of the plant extracts is considered to be the complete description of manufacturing parameters such as granulometry, solvent-plant ratio, time of extraction, solvent composition etc., together with marker quantification and chromatographic fingerprint analyses by HPLC.

xvi. structural elucidation of novel natural products without complete spectroscopic and spectrometric analyses (NMR and HRMS) and evidences for the absolute configuration.

Back to top ↑

Graphical abstract

A Graphical abstract is mandatory for this journal. It should summarize the contents of the article in a concise and simple pictorial form designed to capture the attention of a wide readership online. Authors must provide images that clearly represent the work described in the article. This graphical abstract should capture the reader's attention

and, in conjunction with the manuscript title, should give the reader a quick visual impression of the essence of the manuscript without providing specific results. Graphical abstracts should be submitted as a separate file in the online submission system. Image size: please provide an image with a minimum of 531 x times; 1328 pixels (h & w) or proportionally more. The image should be readable at a size of 5 x 13 cm using a regular screen resolution of 96 dpi. Preferred file types: TIFF, EPS, PDF or MS Office files. *BJP does not accept Graphical abstract using images of animals.*

Back to top ↑

Title Page

Title Page

Please make sure your title page contains the following information.

Title

The title should be concise and informative.

Author information

- **The name(s) of the author(s)**
- **The affiliation(s) of the author(s), i.e. institution, (department), city, (state), country**
- **A clear indication and an active e-mail address of the corresponding author**
- **If available, the 16-digit ORCID of the author(s)**

If address information is provided with the affiliation(s) it will also be published.

For authors that are (temporarily) unaffiliated we will only capture their city and country of residence, not their e-mail address unless specifically requested.

Abstract

Please provide an abstract of 150 to 250 words. The abstract should not contain any undefined abbreviations or unspecified references.

For life science journals only (when applicable)

- **Trial registration number and date of registration for prospectively registered trials**
- **Trial registration number and date of registration, followed by “retrospectively registered”, for retrospectively registered trials**

Keywords

Please provide 4 to 6 keywords which can be used for indexing purposes.

Statements and Declarations

The following statements should be included under the heading "Statements and Declarations" for inclusion in the published paper. Please note that submissions that do not include relevant declarations will be returned as incomplete.

- Competing Interests: **Authors are required to disclose financial or non-financial interests that are directly or indirectly related to the work submitted for publication. Please refer to “Competing Interests and Funding” below for more information on how to complete this section.**

Please see the relevant sections in the submission guidelines for further information as well as various examples of wording. Please revise/customize the sample statements according to your own needs.

Backtotop ↑

Text

Text Formatting

Manuscripts should be submitted in Word.

- **Use a normal, plain font (e.g., 10-point Times Roman) for text.**
-

Use italics for emphasis.

- Use the automatic page numbering function to number the pages.
- Do not use field functions.
- Use tab stops or other commands for indents, not the space bar.
- Use the table function, not spreadsheets, to make tables.
- Use the equation editor or MathType for equations.
- Save your file in docx format (Word 2007 or higher) or doc format (older Word versions).

Manuscripts with mathematical content can also be submitted in LaTeX. We recommend using Springer Nature's LaTeX template.

Headings

Please use no more than three levels of displayed headings.

Abbreviations

Abbreviations should be defined at first mention and used consistently thereafter.

Footnotes

Footnotes can be used to give additional information, which may include the citation of a reference included in the reference list. They should not consist solely of a reference citation, and they should never include the bibliographic details of a reference. They should also not contain any figures or tables.

Footnotes to the text are numbered consecutively; those to tables should be indicated by superscript lower-case letters (or asterisks for significance values and other statistical data). Footnotes to the title or the authors of the article are not given reference symbols.

Always use footnotes instead of endnotes.

Acknowledgments

Acknowledgments of people, grants, funds, etc. should be placed in a separate section on the title page. The names of funding organizations should be written in full.

Backtotop ↑

References

Citation

Cite references in the text by name and year in parentheses. Some examples:

- **Negotiation research spans many disciplines (Thompson 1990).**
- **This result was later contradicted by Becker and Seligman (1996).**
- **This effect has been widely studied (Abbott 1991; Barakat et al. 1995a, b; Kelso and Smith 1998; Medvec et al. 1999, 2000).**

Reference list

The list of references should only include works that are cited in the text and that have been published or accepted for publication. Personal communications and unpublished works should only be mentioned in the text.

Reference list entries should be alphabetized by the last names of the first author of each work. Please alphabetize according to the following rules: 1) For one author, by name of author, then chronologically; 2) For two authors, by name of author, then name of coauthor, then chronologically; 3) For more than two authors, by name of first author, then chronologically.

If available, please always include DOIs as full DOI links in your reference list (e.g. "https://doi.org/abc").

- **Journal article**
  Gamelin FX, Baquet G, Berthoin S, Thevenet D, Nourry C, Nottin S, Bosquet L (2009) Effect of high intensity intermittent training on heart rate variability in prepubescent children. Eur J Appl Physiol 105:731-738. https://doi.org/10.1007/s00421-008-0955-8

  Ideally, the names of all authors should be provided, but the usage of "et al" in long author lists will also be accepted:

  Smith J, Jones M Jr, Houghton L et al (1999) Future of health insurance. N Engl J

Med 965:325–329

- Article by DOI

  Slifka MK, Whitton JL (2000) Clinical implications of dysregulated cytokine production. J Mol Med. https://doi.org/10.1007/s001090000086

- Book

  South J, Blass B (2001) The future of modern genomics.

- Blackwell, London Book chapter

  Brown B, Aaron M (2001) The politics of nature. In: Smith J (ed) The rise of modern genomics, 3rd edn. Wiley, New York, pp 230-257

- Online document

  Cartwright J (2007) Big stars have weather too. IOP Publishing PhysicsWeb. http://physicsweb.org/articles/news/11/6/16/1. Accessed 26 June 2007

- Dissertation

  Trent JW (1975) Experimental acute renal failure. Dissertation, University of California

Always use the standard abbreviation of a journal's name according to the ISSN List of Title Word Abbreviations, see

ISSN LTWA

If you are unsure, please use the full journal title.

Backtotop ↑

Tables

- **All tables are to be numbered using Arabic numerals.**
- **Tables should always be cited in text in consecutive numerical order.**
- **For each table, please supply a table caption (title) explaining the components of the table.**
- **Identify any previously published material by giving the original source in the form of a reference at the end of the table caption.**
- **Footnotes to tables should be indicated by superscript lower-case letters (or asterisks for significance values and other statistical data) and included beneath the table body**