Pharmacognosy

Ethnobotany, ecology, pharmacology, and chemistry of *Anredera cordifolia* (Basellaceae): a review

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**Abstract**

The potential of a plant with medicinal and nutritional properties, *Anredera cordifolia*, is reviewed. Its common names include “Bertalha” and “folha gorda” and it is popularly used for wound healing and against fungal infections and other types of infections. Its pharmacological properties have been widely investigated and acknowledged, especially with regard to its antibacterial activity, which improves the healing of wounds infected by *Staphylococcus aureus*, and to its antifungal activity against *Candida albicans*. It is an unconventional food plant, with leaves and aerial tubers used as food prepared in varied ways. It is also considered an invasive plant in several countries and thus classified as a weed. Its characteristics of a Brazilian native plant, with proven medicinal properties and unconventional use as food, underlie our study on its ecology and botanical classification, as well as the pharmacological assays and screening of chemical constituents.

**Key words**: antimicrobial activity, invasive plants, medicinal plants, phytochemistry, unconventional food plant.

**Resumo**

O potencial de uma planta com propriedades medicinais e alimentícias, *Anredera cordifolia*, é abordado nesta revisão. Esta planta é conhecida no Brasil por “bertalha” ou “folha gorda”, sendo utilizada popularmente para o tratamento de feridas, fungos e infecções. Suas propriedades farmacológicas têm sido amplamente investigadas e confirmadas, com destaque para a ação antibacteriana, melhorando a cicatrização de feridas infeccionadas por *Staphylococcus aureus*, e ação antifúngica contra *Candida albicans*. É uma hortaliça não convencional, sendo suas folhas e bulbos aéreos consumidos na alimentação sob diversas formas. Também faz parte da flora invasora de vários países, e classificada popularmente como “erva daninha”. Suas características de planta nativa brasileira, com reconhecido efeito medicinal e uso alimentício não convencional, conduzem as nossas investigações sobre ecologia e classificação botânica, ensaios farmacológicos e rastreio de constituíntes químicos realizados com essa espécie.

**Palavras-chave**: atividade antimicrobiana, plantas invasoras, plantas medicinais, fitoquímica, planta alimentícia não convencional.

**Introduction**

The traditional medicine approaches to the prevention and diagnosis of diseases, improvement of physical and mental functions, and maintenance of health also include medicinal plants (OMS 2013). These plants are used in different formulations (infusions, ointments, syrups, among others) for the treatment and cure of diseases, and they are considered to be an age-old tradition in healthcare (Veiga Junior *et al.* 2005; Oliveira *et al.* 2007).

In Brazil, a country ripe with biodiversity, species regarded as medicinal tend to be highly estimated. For example, 89 new monographs on plants and the review of another 58 (Brasil 2017) were included in the second supplement of Brazilian Pharmacopeia 5. Even though plants...
are broadly investigated in Brazil, it is widely known that many gaps still exist, especially in the case of angiosperms (Stehmann & Sobral 2017). Many plant species continue to be used in popular medicine without proven medicinal effects and despite the lack of knowledge of their possible undesirable effects (Heinzmann & Barros 2007).

With irrefutable medicinal properties Anredera cordifolia (Ten.) Steenis stands out in the treatment of wounds, fungal infections, and other types of infections (Heisler et al. 2012). Anredera cordifolia, which belongs to the family Basellaceae, is of great interest, not only because of its pharmacological properties, but also because of its high nutritional value.

The family Basellaceae includes genera without fleshy to succulent tendrils, herbaceous plants, or occasionally woody plants and erect plants. These perennial plants have subterranean and aerial tubers, with simple leaves without stipules, and with succulent, herbaceous, or lignified stems (Erikson 2007; Pellegrini & Imig 2019).

Basellaceae has a pantropical distribution of the genera Anredera Juss., Basella L., Tournonia Moq., and Ullucus Caldas. In Brazil, Anredera cordifolia and Anredera tucumarensis (Lillo & Hauman) Sperling are native species (Pellegrini & Sakuragui 2017), and the genus Basella was introduced in Brazil (Souza & Lorenzi 2012).

Anredera is the largest genus of this family with approximately 12 species, with broader diversity in the Andean region. It differs from the genus Basella because of its inflorescences with thin rachises (vs. fleshy ones in Basella), connate sepalas (free ones in Basella), stalked and fragrant flowers (odorless and sessile in Basella), and spheroidal and echinate pollen (cuboidal and reticulate in Basella) (Erikson 2007; Pellegrini & Sakuragui 2017).

Native but not endemic to Brazil, Anredera cordifolia is popularly known as “bertalha, basela, folha-gorda, or trepadeira-mimoso” (Pellegrini & Imig 2013; Souza & Lorenzi 2012). In Indonesia and neighboring regions, it is known as “binahong” (Sumartiningsih 2011), whereas in Australia it is called “madeira vine” (Vivian-Smith 2001). In Argentina, it is known as “zarza-parilla” (Scarpa 2004) and “papa santa” (Hilgert 2001).

It is considered an unconventional food plant, as its leaves and aerial tubers are eaten in varied forms (Kelen et al. 2015), serving as an excellent source of proteins and fibers (Martinevski et al. 2013). The leaves are used for making breads (Martinevski et al. 2013) and the tubers can be eaten either cooked or fried (Kinupp & Lorenzi 2014). It is also grown as an ornamental plant (Souza & Lorenzi 2012) e.g., as hedge (Mogale et al. 2019). This species has a wide tropical distribution in America, Australia, China, Malaysia, Southern Pacific Islands, and Africa (Rasingam & Lakshminarasimhan 2012). In Brazil, it is found in the northeast (Bahia, Ceará, and Pernambuco); midwest (Mato Grosso do Sul); southeast (Espírito Santo, Minas Gerais, Rio de Janeiro, and São Paulo); and south (Paraná, Rio Grande do Sul, and Santa Catarina) (Pellegrini & Imig 2019).

In Brazil, this species has fallen into disuse (Kinupp et al. 2004), and it has been underinvestigated in pharmacological studies. In other countries such as Indonesia, many studies have been conducted, corroborating its pharmacological potential. A literature review was performed, demonstrating the medicinal and nutritional properties of this species, as well as its potential for the development of pharmaceuticals.

Materials and Methods
A literature search was conducted in Scielo, Scopus, Web of Science, Medline, and BioOne databases, in addition to books and other sources such as botanical gardens around the world. The scientific names (Anredera cordifolia and Bossingaultia gracilis) were used as descriptor, with no restriction imposed on year of publication. The species Anredera cordifolia was photographed in the city of Sarandi-RS (27°58'11,9064"S - 52°54'29,7864"W) and was identified by the curator Prof. Cristiano Roberto Buzzatto. The exsiccates are stored under the number: RSPF 14413, at the Herbarium RSPF which is linked to the Zoobotanic Museum Augusto Ruschi (MUZAR), from the Institute of Biological Sciences of the University of Passo Fundo (UPF).

Results and Discussion
Botany, ecology, and chemical and biological control
Anredera cordifolia is a climbing plant, found in forest borders, on fences along roads, and in plots of land at 1,000 m to 2,000 m (Rasingam & Lakshminarasimhan 2012). It is also seen in anthropized regions, such as in vacant lots in urban areas (Fig. 1a) (Imig et al. 2015), as it is considered to be ruderal (Pellegrini & Sakuragui 2017). In
Brazil, more specifically in the state of Rio Grande do Sul, it is found on the borders of rainforests and in the Pampa region (Souza & Lorenzi 2012; Pellegrini & Sakuragui 2017).

This species grows in well-lit environments and has fleshy tubers that may be seen in the nodes of aerial petioles (Fig. 1b) (Vivian-Smith et al. 2007). Its leaves are cordate to ovate (Boyne et al. 2013) very fleshy, dark green, shiny, and rarely elliptical (Imig et al. 2015; Pellegrini & Sakuragui 2017). It is characterized by white, pendent, and fragrant inflorescences (Souza & Lorenzi 2012) such as racemes or panicles, either axillary or terminal (Fig. 1c). The flowers are perfect with triangular to broadly ovate bracteoles, the sepals are broadly ovate to broadly elliptical, the petals are uniform, patent, elliptical to obovate, white or greenish white, with trifid style and capitate stigma. The fruit is a patent brown achene (Pellegrini & Sakuragui 2017).

*Anredera cordifolia* differs from *Anredera tucumarensis* because of the presence of aerial tubers, membranous leaves with no involute margins in sicco, poorly apparent secondary veins, connate bracteoles, uniform petals larger than the sepals, and trifid style (Erikson 2007; Pellegrini & Sakuragui 2017). In terms of leaf anatomy, the epidermis of *A. cordifolia* lacks trichomes and the stomata have two to three subsidiary cells on both leaf surfaces. The mesophyll has mucilage cells, calcium oxalate, narrow vascular bundles, and no sclerenchyma (Boyne et al. 2013). Chromosome analysis revealed that *A. cordifolia* subspecies *gracilis* has sexual reproduction, bearing viable fruits, with 2n = 24 chromosomes. *Anredera cordifolia* subspecies *cordifolia* only reproduces vegetatively, with 2n = 36 chromosomes (Xifreda et al. 2000).

Widely known in Portugal, this species was introduced there in 1961, when it was regarded as a species that would be problematic in the future (Silva et al. 2015). *Anredera cordifolia* includes highly invasive lianas, as a result of phenotypic plasticity (Pintó-Marijuan & Munné-Bosch 2013) and it is therefore classified as an “invasive plant” (Kinupp et al. 2004) or “weed” (Palmer et al. 2010). It is known as an “alien plant” in Australia, China, and Africa (Jian et al. 2008; Baard & Kraaij 2014; Byrne et al. 2017; Gao et al. 2018; Shen et al. 2018), where sustained effort has been put in for its control (Van Driesche et al. 2010).

In China, it is found in vacant lots, orchards, forests, roads, and conservation units, and it has been reported to invade crops such as banana, lemon, and orange (Shen et al. 2017; Zhu et al. 2018). In abandoned lands with yellow soil, there are a large number of vines as compared to other species, and these vines eventually reduce the number of seedlings, inhibiting restoration and ecological succession (Haitan et al. 2011).

*Anredera cordifolia* is a threat to several plant communities (Vivian-Smith et al. 2007) and it is also harmful to riparian vegetation (Floyd 1989).

In New South Wales, Australia, it has been a threat to the local biodiversity, requiring control measures (Downey et al. 2010). A study undertaken in Argentina revealed that a beetle belonging to the family Chrysomelidae, *Plectonycha correntina* Lacordaire, may be used as a biocontrol agent against *A. cordifolia* (Cagnotti et al. 2007; Westhuizen 2011). This species is host to *Dichotomophthora*, they are used for the biological control of *A. cordifolia*, as they cause leaf abscesses, spots, and seed rot (Marin-Felix et al. 2019). Regarding chemical control, *Anredera cordifolia* is tolerant of glyphosate and fluroxypyrmeptyl treatments in some cases (Waryszak et al. 2018).

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Figure 1 – a–c. *Anredera cordifolia* – a. aerial parts; b. tubers; c. flowers. Scale bars: a. 21 mm; b. 10 mm; c. 4 mm.
Ethnobotany

In several regions around the world, *A. cordifolia* has been described and used as a medicinal plant. Studies carried out in Asia, especially in Indonesia and neighboring regions, used ointments and gels made from extracts of the plant, which demonstrated antibacterial activity (Zulfa et al. 2017), and efficacy in wound healing (Istyastono & Yuliani 2016; Shrivastav et al. 2018) including wounds infected by *Staphylococcus aureus* (Paju et al. 2013). The gel aided in the healing of burns (Istyastono & Yuliani 2016; Prasetyo & Heri Hadi 2013) and in the reduction of diabetic ulcers in rats (Kintoko & Desmayanti 2018). In Uruguay, it has been described and used as a medicinal plant as well. In Colombia, it is used medicinally by parturients as postpartum tonic (Panyaphu et al. 2015; Fitriana et al. 2015; Prasetyo & Herihadi 2013) and for milk letdown, its ethanolic extract showed activity against *Candida albicans* (Kumalasari & Sulistyani 2011). The infusion of *A. cordifolia* leaves at high concentrations inhibited the growth of *Porphyromonas gingivalis* and *Prevotella intermedia* (Maharani et al. 2018). The n-hexane, ethyl acetate and ethanolic extracts of *A. cordifolia* leaves showed activity against *Mycobacterium tuberculosis* strains, and the hexane extract showed better activity (Pitaloka & Sukandar 2018).

In Africa, the plant is used as a medicinal agent (Magwede et al. 2018) for the treatment of sexually transmitted infections (Tshikalange et al. 2005) such as for the treatment of gonorrhea, in which the seeds are used (Mulaudzi et al. 2015; Mulia et al. 2017).

In Latin America, it is broadly used as a medicinal plant as well. In Colombia, it is used to treat diabetes, fractures, conjunctivitis, and cough (Bussmann et al. 2018). In Uruguay, it is utilized against poisonings and as eye wash (Paz et al. 1995). In northwestern Argentina, its stems are cut into thick slices and placed on the patient’s forehead to treat headaches, and on the cheeks to treat toothaches (Hilgert 2001). A mixture containing a handful of leaves in 2 liters of water is drunk as tea for nine days in a row to treat amenorrhea (Scarpa 2004). In addition, *A. cordifolia* is used against cough and ocular inflammatory disease in Argentina (Paccard 1905).

In Brazil, the plant is used as a medicinal herb, mainly in the southern region (Zank & Hanazaki 2012). For instance, in the state of Rio Grande do Sul, its fresh leaves are used to treat burns, wounds, onychomycosis, and insect bites (Heisler et al. 2012). In a village of artesanal fisherman, also in Rio Grande do Sul, in the Biological Reserve of Lami, it is used as a medicinal herb and as food source, its is leaves and stalks are used as aphrodisiac, and also against skin lesions and circulatory system disordes (Baptista et al. 2013).

Pharmacological assays

*In vitro*

Several studies have shown promising results against microorganisms (Tshikalange et al. 2005; Yan et al. 2011; Garmana et al. 2014; Souza et al. 2014). The ethanolic extract obtained from the stem demonstrated antifungal activity against *Candida albicans* (Kumalasari & Sulistyani 2011). The infusion of *A. cordifolia* leaves at high concentrations inhibited the growth of *Porphyromonas gingivalis* and *Prevotella intermedia* (Maharani et al. 2018). The n-hexane, ethyl acetate and ethanolic extracts of *A. cordifolia* leaves showed activity against *Mycobacterium tuberculosis* strains, and the hexane extract showed better activity (Pitaloka & Sukandar 2018).

Aqueous and chloroform extracts obtained from the roots inhibited the growth of several bacteria, including *Staphylococcus aureus* and *Pseudomonas*, in a screening in Africa in which six medicinal species were tested (Tshikalange et al. 2005). The growth of *Streptococcus mutans* was inhibited by ethanolic extract of leaves (Rimporok et al. 2015). *Bacillus cereus*, *Salmonella enteritidis* (Rahmawati & Bintari 2014), *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Bacillus subtilis* (Paz et al. 1995), also had their growth inhibited by aqueous leaf extracts of the plant. On the other hand, the methanolic extract prepared from *A. cordifolia* leaves did not inhibit the growth of *Staphylococcus aureus*, *Enterococcus faecalis*, *Escherichia coli*, and *Pseudomonas aeruginosa* (Amertha et al. 2012).

A phytherapeutic product with *A. cordifolia* seeds and other plants was efficient in inhibiting the growth of *Staphylococcus aureus*, *Klebsiella pneumoniae*, and *Neisseria gonorrhoeae*, and also in inhibiting HIV-1 reverse transcriptase, without causing mutagenic effects (Mulaudzi et al. 2015).

Besides the antimicrobial activity of *A. cordifolia*, the literature describes a considerable number of pharmacological studies on this species. Promising effects of leaf extracts have been described against cervical cancer (Yuliani et al. 2015), and reduction of a tumor necrosis factor and other inflammatory mediators in macrophage lines (Laksmiawati et al. 2017). Ethanolic leaf extract of *A. cordifolia* and *Centella asiatica* L. exhibited anti-inflammatory activity in human red blood cells in a membrane stabilization assay (Sutrisno et al. 2016). Leaf extract microemulsion at 0.5 % also demonstrated antiaging effects (Nazliniwaty et al. 2018).
In vivo assays

The literature describes a wide variety of in vivo pharmacological assays with raw extracts and fractions obtained from Anredera cordifolia. The oral administration, in Guinea pig (Cavia cobaya), of 50 mg leaf extract improved immunity and resistance during and after childbirth, also improving the blood parameters and quality of postpartum care (Wijayanti et al. 2016, 2017). Its leaf extract was also efficient in the wound healing of guinea pigs (Miladiyah & Prabowo 2012) and demonstrated vasodilatory properties in rabbits and toads (Sukandar et al. 2016a).

Tests with Wistar rats revealed that the ethanolic leaf extract of A. cordifolia works as an antiobesity medication (Sukandar et al. 2016b), has diuretic effects, and lowers blood pressure (Garmana et al. 2016), total cholesterol, and triglyceride levels (Lestari et al. 2015). Moreover, the ethanolic extract may be used to treat gout, as it reduces serum urate levels (Widyarini et al. 2015; Hendriani & Sukandar 2016).

Other assays indicated that the ethanolic extract was efficient in the treatment of kidney failure in Wistar rats (Sukandar et al. 2011, 2013), protected against the effects of ethanol on the renal proximal tubular epithelial cells of Sprague-Dawley albino rats (Asmariati et al. 2014). Also, the ethanolic extract exhibited analgesic activity in the “plantar test method” (Yuziani et al. 2014). The administration of ethanolic extract of A. cordifolia combined with that of black mulberry (Morus nigra L.) enhanced the lipid profile of rats (Sukandar et al. 2016c), and combined with the extract of Areca catechu L., it reduced the incidence of Ascaridia galli in Gallus gallus domesticus (Prastowo et al. 2017). The administration of A. cordifolia to Wistar rats for 3 days reduced cellular inflammation by 5% and increased fibroblast growth in bruises (Sumartiningsih 2011). A. cordifolia rhizomes contain ancardin, a protein that can inhibit trypsin and stimulate the cellular production of nitric oxide (Chuang et al. 2007).

Toxicity

Regarding toxic effects, Anredera cordifolia is not toxic to Wistar rats (Salasanti et al. 2014), and it does not have teratogenic effects on them (Sukandar et al. 2014). The cytoxic, genotoxic, and antimutagenic effects of Boussingaultia gracilis Miers var. pseudobaselloides Bailey were investigated in Salmonella typhimurium (Ames test) and in human lymphocytes (comet assay), and was found to be non-toxic (Yen et al. 2001).

Phytochemistry

Even though the pharmacological properties of Anredera cordifolia have been widely investigated, reports on the chemical compounds present in its extracts are limited to phytochemical screening, to a study on its volatile constituents, and to some compounds in particular, such as saponins and flavonoids.

Lin et al. (1988) isolated a new triterpenoid sapogenin, elucidated as ethyl 3β-hydroxy-30-noroleana-12,18-dien-29-oate, from Boussingaultia gracilis (A. cordifolia synonym). Their study also describes the isolation of another five sapogenins: laurreagenin A, 3β-hydroxy-30-noroleana-12,19-dien-28-oic acid and its ethyl ester, ursolic acid, 28-ethyl hydrogen 3β-hydroxyolean-12-ene-28,29-dioate.

Other compounds isolated from A. cordifolia leaf extracts include 3,5,3′,4′-tetrahydroxyflavone (Rahmawati et al. 2013) and the flavonoid 8-glucopyranosyl-4′,5,7-trihydroxyflavone (vitexin) (Djamil 2012). Vitexin exhibited antioxidant activity when tested with the 2,2-diphenyl-1-picrylhydrazyl (DPPH) method (Djamil 2012), and demonstrated in vitro α-glucosidase inhibitory activity and antidiabetic activity in alloxan-induced mice (Djamil 2012; Djamil et al. 2017). A new method for the extraction of this compound from A. cordifolia leaves, with a non-toxic and environmentally friendly solvent, was proposed (Mulia et al. 2017). Myricetin and morin were detected by high-performance liquid chromatography (HPLC), whereas kaempferol and quercetin were not found in A. cordifolia leaves extracts. The concentrations of polyphenols, flavonoids, and flavonols were determined by spectrophotometric methods, but anthocyanidins were not detected (Chao et al. 2014). On the other hand, Yang et al. (2008), in a work with 91 edible species, related the presence of quercetin in shoots of A. cordifolia.

The volatile constituents of the aerial parts were analyzed and the major compounds were phytol (15.33 %), α-pinene (9.0 %), and 6,10,14-trimethyl pentadecanone (6.12 %). In this work vitexin and isovitexin were also isolated (Abou-Zeid et al. 2007). The essential oil was analyzed by GC and GC-MS and 19 compounds were identified. Hydrocarbons were the main constituents (67.7 %) (Souza et al. 2014).
Lupeol and β-sitosterol (Basyuni et al. 2017), and ursolic acid (Yuliani & Istyastono 2013) were detected by thin-layer chromatography (TLC). Using TLC as a support, UV-VIS, and FTIR spectrophotometry, Ekaviantiwi et al. (2013) concluded that ethanolic extracts of leaves might contain p-coumaric acid. The presence of saponins was verified by general detection tests (foam formation), using TLC, and also by the analytical method (Astuti et al. 2011). The tests were positive for saponins in all plant parts.

Phytochemical screening was positive for flavonoids, saponins, steroids/terpenoids, and alkaloids (Ekaviantiwi et al. 2013; Rahmawati et al. 2013; Elya et al. 2015; Lestari et al. 2015, 2016; Sukandar et al. 2016c; Pitaloka & Sukandar 2018). Screening of alkaloids showed also negative results (Kumalasari & Sulistyani 2011; Garmana et al. 2014; Sukandar et al. 2016b; Kaunang & Semuel 2017) or positive ones only for Dragendorff’s reagent, with negative results for Bouchardat’s, Wagner’s, and Mayer’s reagents (Basyuni et al. 2017). Some authors found negative results in the screening test for tannins (Kumalasari & Sulistyani 2011; Elya et al. 2015; Lestari et al. 2015, 2016; Sukandar et al. 2016b) whereas some obtained positive results (Ekaviantiwi et al. 2013; Rahmawati et al. 2013; Garmana et al. 2016; Sukandar et al. 2016c; Kaunang & Semuel 2017; Pitaloka & Sukandar 2018). Polyphenols (Kumalasari & Sulistyani 2011; Sukandar et al. 2016b, c; Basyuni et al. 2017; Pitaloka & Sukandar 2018) and glucoside (Astuti et al. 2011; Elya et al. 2015) were also detected in screening tests. Some studies checked for the presence of quinones but all tests were negative (Garmana et al. 2014; Elya et

### Table 1 – Phytochemical screening test results for A. cordifolia described in the literature.

| Reference          | Saponins | Steroids/terpenoids | Flavonoids | Alkaloids | Tannins | Polyphenols | Glucosides | Quinones |
|--------------------|----------|---------------------|------------|-----------|---------|-------------|------------|----------|
| Astuti et al. (2011)| (+)      | (+)                 | ----       | (+)       | ----    | (+)         | ----       |          |
| Kumalasari & Sulistyani (2011)| (+) | ----               | (+)       | (-)       | (+)    | ----         | ----       |          |
| Ekaviantiwi et al. (2013)| (+) | (+)               | (+)       | (+)       | ----    | ----         | ----       |          |
| Rahmawati et al. (2013) | (+) | (+)               | (+)       | (+)       | (+)    | ----         | ----       |          |
| Garmana et al. (2014) | (+) | (+)               | (+)       | (-)       | ----    | ----         | ----       | (-)      |
| Elya et al. (2015)   | (+)      | (+)                 | (+)       | (+)       | (-)    | ----         | (+)        | (-)      |
| Lestari et al. (2015, 2016)| (+) | (+)             | (+)       | (+)       | (-)    | ----         | ----       | (-)      |
| Garmana et al. (2016) | (+) | (+)              | (+)       | ----      | (+)    | ----         | ----       |          |
| Sukandar et al. (2016b) | (+) | (+)               | (+)       | (-)       | (+)    | ----         | ----       | (-)      |
| Sukandar et al. (2016c) | (+) | (+)               | (+)       | (+)       | (+)    | ----         | ----       | (-)      |
| Basyuni et al. (2017) | (+) | (+)              | ----       | *(+)      | ----    | (+)          | ----       |          |
| *(+) = positive tests; (-) = negative tests; *(+) = with Dragendorf’s reagent; **(-) = with Mayer, Bouchardat and Wagner’s reagents. |
Therefore, vitexin, isovitexin, myricetin, morin, 3,5,3′,4′-tetrachloroflavan and ursolic acid; larreagenin A, 3β-hydroxy-30-noroleana-12,19-dien-28-oic acid and its ethyl ester, 28-ethyl hydrogen 3β-hydroxyolean-12-ene-28,29-dioate, and ethyl 3β-hydroxy-30-noroleana-12,18-dien-29-oate were isolated from A. cordifolia extracts. The probable presence of p-coumaric acid, lupeol, and β-sitosterol was verified by TLC using a reference standard.

The present review demonstrates the main uses, as well as the medicinal and nutritional properties, of A. cordifolia. This plant is an invasive species in several countries, and the problems caused by it and its management should be addressed. A. cordifolia is a promising medicinal plant, as several pharmacological assays corroborate its efficacy, especially its antimicrobial activity. Some flavonoids, such as vitexin, isovitexin, morin, and myricetin, in addition to sapogenins such as ursolic acid were isolated from its extracts. Phytochemical screening evidenced the presence of metabolites such as alkaloids, flavonoids, saponins, steroids, and terpenoids. The isolation and identification of other chemical compounds and the characterization of a marker for this species are essential for the development of a phytotherapeutic agent from A. cordifolia extracts.

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