Review on ethnobotany, phytochemistry and pharmacology of Malagasy medicinal *Aloe* L. (Asphodelaceae)

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Review

Abstract

Background: The genus *Aloe* L. (Asphodelaceae) represents a highly diverse group of succulent plants widely distributed in Africa and particularly rich in Madagascar. Despite their recognized importance in traditional medicine, cosmetics, and pharmacology, Malagasy *Aloe* spp. remains insufficiently studied, especially regarding their traditional uses, phytochemical composition and biological activities.

Methods: This study is based on a bibliographic review of published data on Malagasy medicinal *Aloe* and follows the PRISMA style. Scientific articles and books were collected from online databases such as Google Scholar and ResearchGate using targeted keywords. A total of 35 ethnobotanical, 15 phytochemical, and 12 pharmacological papers were compiled and analyzed. Data were organized into a database, and diseases were classified according to the International Classification of Diseases. A correspondence analysis was performed using the MO Excel and the software R to determine the relationship between biological activities and Malagasy *Aloe* species.

Results: The review identified 20 *Aloe* species used in traditional medicine in Madagascar. *Aloe vera* is the only naturalized species, eleven are endemic, and eight remain unidentified. These species are used to treat 112 ailments grouped into 17 disease categories. Digestive, infectious, and injury-related diseases are the most represented. Phytochemical investigations identified 26 endemic species and revealed 48 chemical compounds belonging to 6 families. However, only 13 endemic species have been pharmacologically evaluated, revealing 10 biological activities and highlighting a significant gap between traditional use and scientific validation.

Conclusions: This study highlights the richness of ethnobotanical knowledge on Malagasy *Aloe* alongside a critical lack of integrated phytochemical and pharmacological research. Urgent multidisciplinary efforts are required to explore under-studied species, validate their therapeutic potential, and ensure sustainable conservation of this unique biodiversity.

Keywords: Madagascar, medicinal *Aloe*, Ethnobotany, phytochemistry, pharmacology.

Background

Species of the genus *Aloe* L. (Asphodelaceae) are succulent plants found only in Africa, Madagascar and its neighboring islands as well as the Arabian Peninsula. The genus comprises 624 species (Grace *et al.* 2011), 290 of which are found in South Africa (Reynolds 2004), 200 in East Africa, 50 in the Arabian Peninsula and 50 in West and Central Africa (Cock 2015).

As part of the succulent plant group, most *Aloe* species are widely regarded as horticultural plants and extensively cultivated and traded in national and international markets due to their ornamental value (Grace 2011). In addition, many *Aloe* species are threatened by habitat loss (Vieilledent *et al.* 2018), excessive harvesting, ploughing, uprooting, extension of crop areas (Ratsimandresy *et al.* 2022) and illicit harvesting. These results in the decrease of the population of many species and the progressive loss of traditional knowledge related to endangered plants (Rakotonandrasana 2022). For these reasons, 22 species are listed in Appendix I of the Convention on International Trade of Endangered Species (CITES), and all other species are listed in Appendix II, except *Aloe vera* (L.) Burm.f. (Reynolds 2004).

Many species of the genus *Aloe* have been used in traditional medicine for many years (Dagne *et al.* 2000). Indeed, 121 of the identified species have been identified as having medicinal properties worldwide, while 35 are used in medical-magical rituals (Grace *et al.* 2013). Some species have also been used as protective charms (Fentaw *et al.* 2020), home protection (Bjorå *et al.* 2015), and funerals (Morris 1996). In Ethiopia, according to local beliefs, it is reported that *Aloe calidophila* Reynolds is associated with an increase in livestock herd size, which reflects prosperity in animal husbandry (Belayneh *et al.* 2020). In Kenya, several *Aloe* species are used for practical environmental and agricultural purposes. They are used as living fences and hedges, windbreaks, and for soil conservation to reduce erosion and protect farmland (Bjorå *et al.* 2015). Species of the genus *Aloe* also play an important role in the global economy. In Africa, gel extracts of *Aloe vera* (L.) Burm.f. are widely used in the cosmetic industry (Grace *et al.* 2011). One hundred liters of gel from this plant generate approximately 300 USD (Reynolds 2004). The global *Aloe vera* market has shown substantial economic growth in recent years. The global *Aloe vera* whole-leaf extract market was valued at approximately USD 506 million in 2023 and is projected to reach USD 880.78 million by 2030, with a compound annual growth rate (CAGR) of 8.24% during 2024-2030 (Virtual Market Research 2026). Similarly, the global *Aloe vera* market was valued at approximately USD 724.20 million in 2024 and is projected to reach USD 1,485.92 million by 2032, with a CAGR of 9.40% during 2025-2032 (Data Bridge Market Research 2026).

International trade data under HS code 130219, which covers vegetable saps and extracts not elsewhere specified and includes *Aloe vera* among a broad range of plant-derived extracts, indicate global exports of approximately 331,475 tons, with a total value of about USD 4.36 billion in 2025 (Trade Map 2026). Although these trade data are not specific to *Aloe vera*, they highlight the substantial global economic importance of plant-derived extracts. According to a database of vascular plants of Madagascar, *Aloe* consists of 133 species, 132 of which are endemic (Missouri Botanical Garden 2026). Despite this unique diversity and its economic and medicinal importance, phytochemical and pharmacological investigations are poorly documented. However, De Flacourt (1658) has already reported the medicinal use of an *Aloe* sp. by the tribe Tanala of Madagascar in his book entitled «Histoire de la grande isle de Madagascar». Two endemic species of *Aloe* in Madagascar are currently highly exploited, namely *Aloe macroclada* Baker (European Union Official Journal 2017) and *Aloe vaombe* Decorse & Poisson (Rasoanaivo 1990). The *Aloe macroclada* supply chain provides local collectors with a net income of 74.28 USD per month, an amount exceeding the Guaranteed Minimum Inter-professional Wage (SMIG) in Madagascar which stands at 57.67 USD/month (Andriamamisoa 2026).

For these reasons, the present bibliographic review has been undertaken in order to provide an account of the research carried out on Malagasy species of *Aloe*. The specific objectives are to document their phytochemical and pharmacological use studies that have been carried out.

Materials and Methods

A systematic literature review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

All information was obtained through a bibliographic review of published sources, including academic articles, scientific journals, and theses on medicinal *Aloe* species found in Madagascar. A comprehensive search was conducted using the following keywords: “Madagascar”, “*Aloe*”, “phytochemistry”, “pharmacology”, “traditional use”, “secondary metabolites”, “bioactive compounds”, “natural products”, “traditional medicine”, “chemical composition”, and “biological activities”.

The literature search was performed in multiple scientific databases, including Google Scholar, ScienceDirect, Scopus, Web of Science, SpringerLink, Wiley Online Library, ResearchGate, and Thèse Malagasy en ligne.

Eligibility criteria (PRISMA-based selection)

Studies were selected according to predefined inclusion and exclusion criteria.

Inclusion criteria: studies reporting medicinal *Aloe* species from Madagascar and providing ethnobotanical, phytochemical, or pharmacological data. Peer-reviewed articles and academic theses with full-text availability were included. Studies conducted in Madagascar were prioritized to ensure geographical relevance.

Exclusion criteria: studies not related to Madagascar or medicinal *Aloe* species, studies lacking relevant ethnobotanical, phytochemical, or pharmacological information, duplicate records, non-scientific publications, conference abstracts, editorials, and studies without full-text availability.

A total of 35 ethnobotanical studies, 15 phytochemical studies, and 12 pharmacological studies were identified and included in the analysis.

All extracted data were compiled and organized into a Microsoft Excel database for further analysis and processing.

Based on their traditional uses, diseases treated with medicinal *Aloe* species were classified according to the International Classification of Diseases (ICD-10), as published by the World Health Organization.

The scientific names and synonyms of the species were verified using authoritative taxonomic databases, including the Madagascar Catalogue of Vascular Plants (Missouri Botanical Garden 2026) and the African Plant Database (2026).

Statistical analysis

The numbers of plant species used in traditional medicine and diseases treated according to the ICD-10 (ethnobotanical parameter), phytochemically investigated species and chemical compounds classified by chemical families (phytochemical parameter), and pharmacologically investigated species (pharmacological parameter) were determined using Microsoft Excel.

Statistical processing

Data extracted from scientific publications were compiled in a Microsoft Excel spreadsheet. A binary contingency table (presence/absence) was constructed with biological activities as rows and *Aloe* species as columns. Data importation and preliminary processing were performed in R using the Rcmdr package.

Correspondence Analysis (CA) was conducted using the FactoMine R package to explore associations between *Aloe* species and their reported biological activities. The initial outputs included separate graphical representations of rows (biological activities) and columns (*Aloe* species). A combined biplot was then generated using the factoextra package. Finally, the package ggplot2 was used to improve figure readability, including text formatting, reduction of label overlap, and overall graphical aesthetics.

Results and Discussion

Ethnobotanical review

Thirty-five scientific publications reporting 20 species, 8 of which are not identified, were found to have medicinal uses (Table 1). While they represent 15.04% of the *Aloe* species encountered in Madagascar, eleven of them (8.27%) are endemic to Madagascar, and *Aloe vera* (L.) Burm.f. is the only introduced species identified.

Diseases treated with *Aloe* spp.

The results show that 112 ailments are treated with *Aloe* of Madagascar. They are categorized into 17 disease types according to the International Classification of Diseases (2008) (Figure 1).

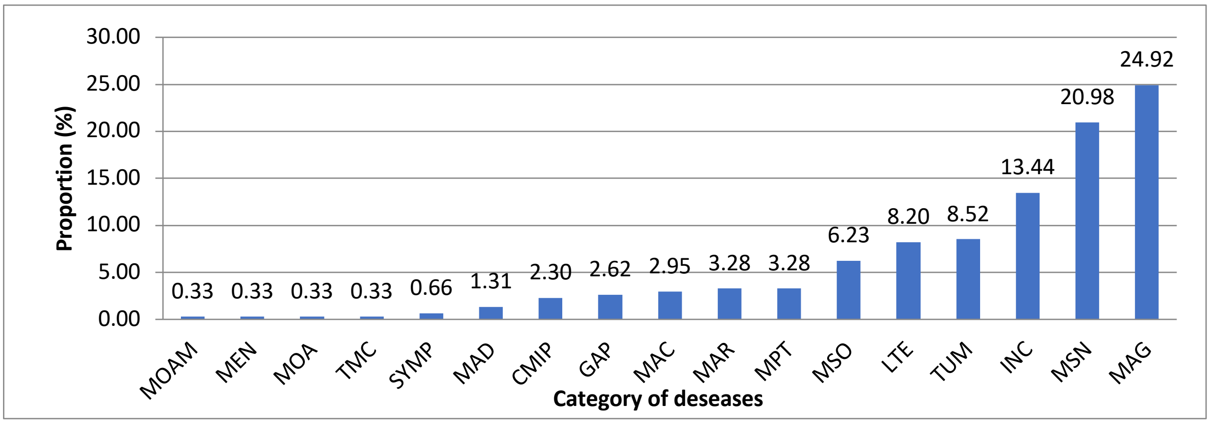

Figure 1. Categories of diseases treated with the medicinal *Aloe* spp. from Madagascar.

CMIP: Certain infectious and parasitic diseases; GAP: Pregnancy, childbirth and puerperal care; INC: Unclassifiable; LTE: Traumatic injuries, poisonings and some other consequences of external causes; MPT: Skin and sub-cellular tissue diseases cutaneous; MAC: Diseases of the circulatory system; MAD: Diseases of the digestive system; MAG: Diseases of the genitourinary tract; MAR: Diseases of the respiratory system; MOA: Diseases of the eye and its annexes; MOAM: Diseases of the ear and mastoid apophysis; MSN: Diseases of the nervous system; MSO: Diseases of the osteo-articular system, muscles and connective tissue; MEN: Endocrine, nutritional and metabolic diseases; SYMP: Symptoms, signs and abnormal results of clinical and laboratory examinations, not elsewhere classified; TMC: Mental and behavioural disorders; TUM: Tumours

The most treated diseases with *Aloe* species belong to Digestive Tract Diseases (MAD), Traumatic injuries, poisonings and some other consequences of external causes (LTE) and Certain infectious and parasitic diseases (CMIP).

Disease of the digestive system (MAD):

Eighteen therapeutic indications were recorded within the category of digestive system disorders. Stomach ailments are treated with *Aloe divaricata* A. Berger and *A. vaombe* Decorse & Poisson (Hervé *et al.* 2022; Norodiny 2011), *A. macroclada* Baker (Boiteau 1986; Rabearivony 2010; Rabemiafara 2014; Rakotoarivelo *et al.* 2019; Razafindrazaka 2012), and *A. occidentalis* (H. Perrier) L.E. Newton & G.D. Rowley (Rakotonandrasana *et al.* 2017). Stomach pain is treated using *A. capitata* Baker (Rabesa 1986), *A. deltoideodonta* Baker (Safidiniaina 2018), *A. divaricata* (Norodiny 2011), *A. occidentalis* (Rakotonandrasana *et al.* 2017), and *A. vaombe* (Gallé *et al.* 2014; Ratsimiala-Ramonta 2010). Constipation is managed with *A. divaricata* (Randrianarivony *et al.* 2017), *A. macroclada* (Rakotoarivelo *et al.* 2019), and *A. vaombe* (Gallé *et al.* 2014). These findings are consistent with previous reports indicating that many *Aloe* species are traditionally used as laxatives and for the treatment of gastrointestinal disorders (Akaberi *et al.* 2016; Amoo *et al.* 2014; Grace *et al*. 2008).

The importance of *Aloe* species in the treatment of digestive disorders may be related to the significant burden of these diseases in Madagascar. According to the Annuaire des statistiques du secteur santé de Madagascar 2022, digestive diseases are among the leading causes of morbidity, accounting for 353 reported cases, with 4.43% of hospitalization cases and a disease-specific lethality rate of 4.10% only for the others pathology digestives (Ministère de la Santé Publique 2023). Similar uses have been documented elsewhere in Africa. Several species, including *Aloe citrina* Carter & Brandham, *A. gilbertii* Reynolds ex Sebsebe & Brandham subsp. *gilbertii*, *A. harlana* Reynolds, *A. maculata* All., *A. marlothii* A. Berger, *A. mcloughlinii* Christian, *A. megalacantha* Baker subsp. *megalacantha*, *A. megalacantha* Baker subsp. *alticola*, *A. otallensis* Baker, *A. pirottae* A. Berger, *A. pubescens* Reynolds, and *A. trichosantha* subsp. *longiflora* Gilbert & Sebsebe, are traditionally used to treat digestive disorders (Belayneh *et al.* 2020; Fentaw *et al.* 2020; Grace *et al.* 2008). In Ethiopia, *A. gilbertii* subsp. *gilbertii*, *A. pubescens*, and *A. secundiflora* Engler are commonly employed to relieve stomachache (Belayneh *et al.* 2020; Bjorå *et al.* 2015; Wondimu *et al.* 2007), whereas *A. pulcherrima* Gilbert & Sebsebe and *A. steudneri* Schweinfurth are used to treat gastric ulcers, liver diseases, and other abdominal disorders (Fentaw *et al.* 2020). Likewise, *A. ferox* Mill., *A. secundiflora* Engler, and *A. trichosantha* subsp. *longiflora* Gilbert & Sebsebe are traditionally used for the treatment of constipation (Anywar *et al.* 2021; Belayneh *et al.* 2020). These widespread ethnomedicinal applications of the genus *Aloe* help explain why *Aloe*-based commercial products are predominantly marketed for the treatment and management of digestive tract disorders (Grace *et al.* 2013).

Injury, poisonings, and certain other consequences of external causes (LTE):
Seventeen therapeutic indications have been identified within this category of diseases. *Aloe conifera* H. Perrier is commonly reported in the treatment of wounds (Rakotondrafara *et al.* 2018), while *A. divaricata* A. Berger (Hervé *et al.* 2022; Norodiny 2011; Randrianarivony *et al.* 2017), *A. macroclada* Baker (Rabemiafara 2014; Ratsimiala-Ramonta 2010; Rakotondrafara *et al.* 2018), and *A. vaombe* Decorse & Poisson (Randrianarivony *et al.* 2017; Hervé *et al.* 2022) are also widely used for the same purpose. Sprains are traditionally treated using *A. divaricata* (Andriamparany *et al.* 2018), *A. macroclada* (Rakotondrafara *et al.* 2018), and *A. vaombe* (Randrianarivony *et al.* 2017), whereas burns are managed with *A. macroclada* (Rabemiafara 2014) and *A. vaombe* (Ratsimiala-Ramonta 2010).

Overall, traumatic injuries and poisoning represent major conditions treated in traditional medicine using Malagasy medicinal *Aloe* species. These conditions, which include musculoskeletal disorders, falls, and low back pain, are recognized by the World Health Organization as significant contributors to global morbidity (World Health Organization (WHO) 2026). In Madagascar, according to the Annuaire des statistiques du secteur santé de Madagascar 2022, traumatic wounds alone account for 4.92% of hospitalizations and are associated with a specific lethality of 9.20%, representing 52.62% of surgical interventions, while related conditions such as fractures, dislocations, and mild cranio-encephalic trauma account for 14.76% of cases (Ministère de la Santé Publique 2023). These conditions are closely linked to daily occupational activities, particularly among the Malagasy population, of which approximately 85% are engaged in agriculture.

In addition to their wound-healing properties, *Aloe* species are also traditionally used for pain relief (Amoo *et al.* 2014). The topical application of leaf mesophyll for the treatment of traumatic conditions is widely documented across Africa (Adjanohoun 1987; Githens 1979; ITFG and IITR 1996; Powell 1868; Reynolds 1950; Rood 2008).

A wide range of *Aloe* species have been documented for the treatment of traumatic injuries and poisoning, including *A. ankoberensis* Gilbert & Sebsebe, *A. calidophila* Reynolds, *A. camperi* Schweinfurth, *A. citrina* Carter & Brandham, *A. debrana* Christian, *A. gilbertii* Reynolds ex Sebsebe & Brandham subsp. gilbertii, *A. harlana* Reynolds, *A. macrocarpa* Todaro, *A. mcloughlinii* Christian, *A. megalacantha* Baker subsp. alticola, *A. otallensis* Baker, *A. percrassa* Todaro, *A. pirottae* A. Berger, *A. pubescens* Reynolds, *A. pulcherrima* Gilbert & Sebsebe, *A. sinana* Reynolds, *A. cf. steudneri*, *A. trigonantha* Leach, and *A. weloensis* Sebsebe (Belayneh *et al.* 2020; Fentaw *et al.* 2020). Specifically, *A. camperi* Schweinfurth and *A. sinana* Reynolds are also reported in the treatment of traumatic injuries (Fentaw *et al.* 2020).

Certain infectious and parasitic diseases (CMIP):
Infectious and parasitic diseases are widely managed using medicinal *Aloe* species in traditional medicine, particularly as anthelmintic plants in southern Africa (Grace *et al.* 2013). A total of eleven diseases has been recorded within this category, with microbial infections being the most commonly treated. These include diarrhea, sexually transmitted diseases, helminth infections, tuberculosis, poliomyelitis, and typhoid fever. They are treated using several species such as *Aloe capitata* Baker (Bost 1961; Randriamahefa and Rakotozafy 1979), *A. conifera* H. Perrier (Rakotondrafara *et al.* 2018), *A. divaricata* A. Berger (Hervé *et al.* 2022), *A. macroclada* Baker (Descheemacker 1979; Rakotoarivelo *et al.* 2019; Razafindrazaka 2012), *A. suarezensis* H. Perrier (Nicolas 2012), and *A. vaombe* Decorse & Poisson (Gallé *et al.* 2014; Hervé *et al.* 2022; Rabesandratana 1977).

Globally, this group of diseases accounts for approximately 5-8% of all deaths (WHO 2026). In Madagascar, the five leading causes of morbidity also fall within this category, including respiratory infections, malaria, diarrhea, influenza-like syndromes, and dysentery (Direction de la Veille Sanitaire et de la Surveillance Épidémiologique 2018). Furthermore, more than twenty-eight newly recorded disease cases in hospital settings in 2022 belonged to infectious and parasitic diseases (Ministère de la Santé Publique 2023). In 2019, diarrhea, acute respiratory infections, and helminth infections caused about 1.4 million deaths, with diarrhea alone accounting for 1.0 million deaths and the highest mortality rates occurring in the African region (WHO 2026). These data help explain the widespread use of Malagasy medicinal *Aloe* species in the treatment of this group of diseases.

Many other African *Aloe* species are also used to treat infectious and parasitic diseases. Among them, *A. ankoberensis* Gilbert & Sebsebe, *A. calidophila* Reynolds, *A. citrina* Carter & Brandham, *A. camperi* Schweinfurth, *A. gilbertii* subsp. *gilbertii* Reynolds ex Sebsebe & Brandham, *A. macrocarpa* Todaro, *A. percrassa* Todaro, *A. pirottae* A. Berger, *A. secundiflora* Engler, *A. sinana* Reynolds, *A. trigonantha* Leach, and *A. trichosantha* subsp. *longiflora* Gilbert & Sebsebe are used to treat malaria (Belayneh *et al.* 2020; Fentaw *et al.* 2020). Other infections and parasitic conditions such as sexually transmitted infections, gonorrhea, skin and hair fungal infections, tonsillitis, anthrax, and diarrhea are treated using species including *A. calidophila*

Reynolds, *A. harlana* Reynolds, *A. macrocarpa* Todaro, *A. mcloughlinii* Christian, *A. megalacantha* subsp. *alticola* Baker, *A. pirottae* A. Berger, *A. pubescens* Reynolds, *A. secundiflora* Engler, and *A. trichosantha* subsp. *longiflora* Gilbert & Sebsebe (Belayneh *et al.* 2020).

Phytochemical review

Phytochemical studies of 26 endemic species of Malagasy *Aloe* (*A. acutissima* H. Perrier, *A. antandroi* (R. Decary) H. Perrier, *A. bakeri* Scott Elliot, *A. bellatula* Reynolds, *A. capitata* Baker, *A. conifera* H. Perrier, *A. decaryi* Guillaumin, *A. deltoideodonta* Baker, *A. descoingsii* Reynolds, *A. divaricata* A. Berger, *A. fragilis* Lavranos & Röösli, *A. guillaumetii* Cremers, *A. haworthioides* Baker, *A. helenae* Danguy, *A. ibityensis* H. Perrier, *A. isaloensis* H. Perrier, *A. macroclada* Baker, *A. massawana* Reynolds, *A. millotii* Reynolds, *A. occidentalis* (H. Perrier) L.E. Newton & G.D. Rowley, *A. orientalis* (H. Perrier) L.E. Newton & G.D. Rowley, *A. rauhii* Reynolds, *A. suarezensis* H. Perrier, *A. vaombe* Decorse & Poisson, *A. vaotsanda* Decary, *A. viguieri* H. Perrier) appeared in 15 scientific publications (Table 2). Only nine of these species (*A. acutissima* H. Perrier, *A. capitata* Baker, *A. conifera* H. Perrier, *A. deltoideodonta* Baker, *A. divaricata* A. Berger, *A. macroclada* Baker, *A. occidentalis* (H. Perrier) L.E. Newton & G.D. Rowley, *A. suarezensis* H. Perrier and *A. vaombe* Decorse & Poisson) have traditional uses. The other phytochemical studies were dedicated to chemotaxonomical studies.

Forty-eight molecules belonging to six chemical families were isolated from these species. Anthrones (11 isolated molecules), carbohydrates (10 isolated molecules), and anthraquinones (9 isolated molecules) are the most represented chemical families found (Figure 2). Anthrones and carbohydrates are mostly identified in the leaves of Malagasy *Aloe* (Ahl *et al.* 2019; Grace *et al.* 2013; Jasso de Rodriguez *et al.* 2015; Radjabi *et al.* 1983; Vilkas and Radjabi-Nassab 1986) and anthraquinones in the roots (Van Wyk *et al.* 1995). These chemical families are commonly encountered in *Aloe* species (Diriba & Deresa 2022).

Aloins A and B are found in 11 species of Malagasy *Aloe*, namely *A. bellatula* Reynolds, *A. capitata* Baker, *A. divaricata* A. Berger, *A. guillaumetii* Cremers, *A. helenae* Danguy, *A. macroclada* Baker, *A. massawana* Reynolds, *A. occidentalis* (H. Perrier) L.E. Newton & G.D. Rowley, *A. orientalis* (H. Perrier) L.E. Newton & G.D. Rowley, *A. vaombe* Decorse & Poisson *and A. vaotsanda* Decary. However, nine species contain aloesin. These are *A. acutissima* H. Perrier, *A.capitata* Baker *A. conifera* H. Perrier, *A. fragilis* Lavranos & Röösli, *A. helenae* Danguy, *A. isaloensis* H. Perrier, *A. macroclada* Baker, *A. vaombe* Decorse & Poisson *and A. vaotsanda* Decary (Viljoen *et al.* 1998; Viljoen 1999).

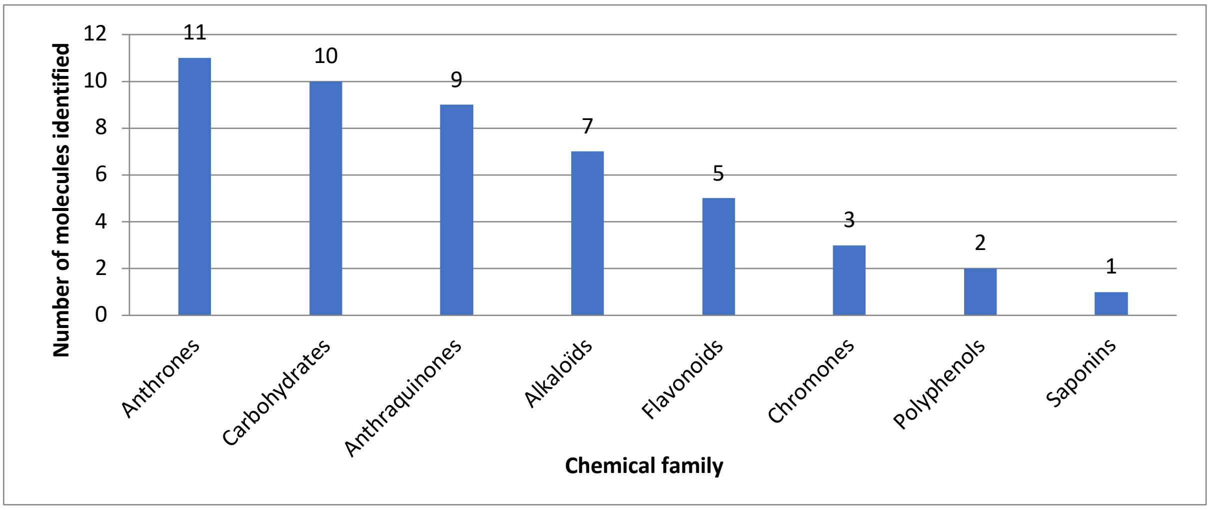

Figure 2. Chemical families found in the *Aloe* spp. medicinal from Madagascar

Chrysophanol was isolated from *A. acutissima* H. Perrier, *A. antandroi* (R. Decary) H. Perrier, *A. bakeri* Scott Elliot, *A. bellatula* Reynolds, *A. divaricata* A. Berger, *A. haworthioides* Baker, *A. millotii* Reynolds, *A. rauhii* Reynolds and *A. vaombe* Decorse & Poisson (Viljoen *et al.* 1998). Toxic substances such as conhydrine, coniine, N-methylconiine, pseudoconhydrine, and γ-coniceine were identified in *A. deltoideodonta* Baker, *A. descoingsii* Reynolds, *A. ibityensis* H. Perrier, *A. rauhii* Reynolds and *A. viguieri* H. Perrier (Dring *et al.* 1984; Hotti *et al.* 2017; Nash *et al.* 1992; Reynolds 2005).

Pharmacological review

Twelve scientific publications dealing with pharmacological studies, containing 13 species (Table 3), all endemic to Madagascar, were found. Four species (*A. conifera* H. Perrier, *A. divaricata* A. Berger, *A. macroclada* Baker and *A. vaombe* Decorse & Poisson) only have traditional uses. Ten types of biological activities are already known on these plants, namely anti-inflammatory, anti-malaria, anti-oxidant, mobility of bone marrow cells, anti-bacterial, anti-fungal, immunomodulatory, antigenic, phytomitogenic and anti-tumor. The biological properties of these 13 species are reported in Table 3. Five distinct groups of biological activities are shown in the factorial map of known biological activities and these 13 species (Figure 3).

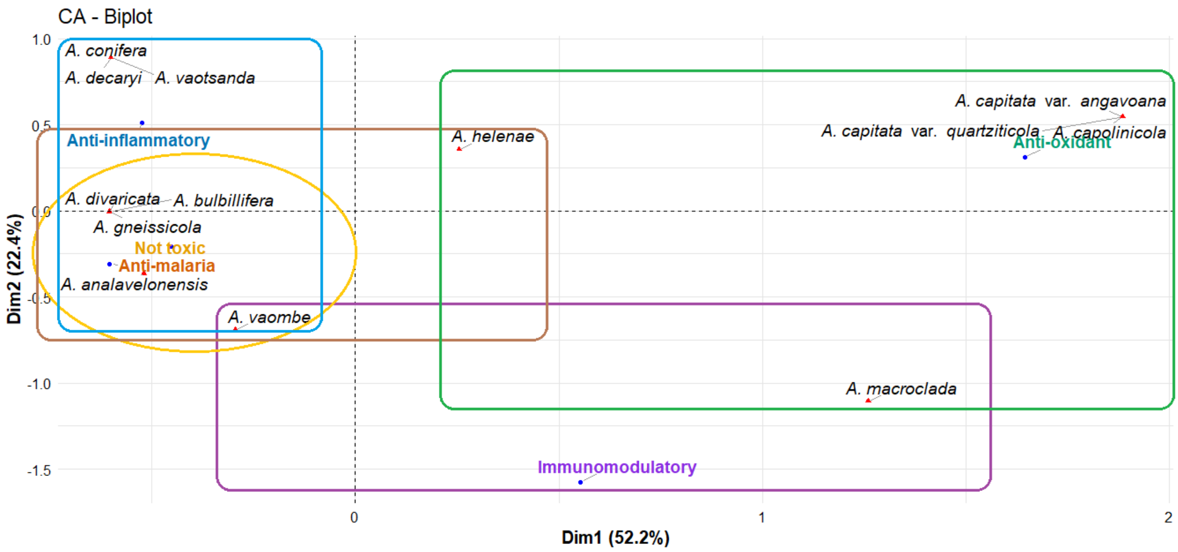

Figure 3. Factorial map of biological activities and the 13 species of *Aloe*.

Anti-inflammatory activities: group 1

Studies on anti-inflammatory activities were conducted by evaluating either cyclooxygenase inhibition (Lindsey *et al.* 2002) or lipopolysaccharide inhibitor (Ahl *et al.* 2023).

On the one hand, the ethanolic extract of leaves at a dose of 100 µg/ml from 6 species has anti-inflammatory activities by inhibiting cyclooxygenase. Three of them, *A. conifera* H. Perrier (48%), *A. divaricata* A. Berger (7%), *A. vaombe* Decorse & Poisson (35%) weakly inhibit cyclooxygenase with an inhibition percentage below 50%. However, higher inhibitions (greater than 80%) are found in *A. bulbillifera* H. Perrier (96%), *A. gneissicola* (H. Perrier) J.-B. Castillon & J.-P. Castillon (83%), *A. vaotsanda* Decary (93%) (Lindsey *et al.* 2002).

On the other hand, the gels of *A. decaryi* Guillaumin, *A. vaombe* Decorse & Poisson inhibit lipopolysaccharides at a dose of 50 µl of 2% of *Aloe* gel. In addition, *A. vaombe* Decorse & Poisson gel (2%) significantly reduced the activity of *NF-kB* induced by lipopolysaccharide, but no effect on fibroblast-stimulating lipopeptide using *J774-DualTM* cell lines (Ahl *et al.* 2023).

The occurrence of aloin A and B, aloesin, and chrysophanol in Malagasy *Aloe* species may partly explain their reported anti-inflammatory properties (Nalimu *et al.* 2021; Rauwald *et al.* 2021). This is consistent with their traditional use in the treatment of digestive disorders, traumatic injuries, and infectious diseases, conditions in which inflammation plays a central role.

Antioxidant activities: group 2

Antioxidant activities have been reported in *A. capitata* Baker var. *angavoana* J.-P. Castillon, *A. capitata* Baker var. *quartziticola* H. Perrier, *A. cipolinicola* (H. Perrier) J.-B. Castillon & J.-B. Castillon, *A. helenae* Danguy, and *A. macroclada* Baker (Letsara *et al.* 2020b; Rabarisoa *et al.* 2017). For *A. macroclada*, this activity was found to be lower during the dry season compared to the wet season (Rabarisoa *et al.* 2017). For example, 40 µl of gel mixed with 200 µl of a methanolic solution reduced DPPH radical scavenging activity by 15.16% to 50% at 0.25 M concentration.

The antioxidant activity of Malagasy *Aloe* species has been associated with the presence of bioactive compounds such as aloesin. This molecule has been reported to protect against oxidative stress, including in diabetes-related conditions (Yimam *et al.* 2015). Other phytochemical constituents, including phenolic and chromone derivatives, may also contribute to this activity.

Oxidative stress is closely involved in the pathophysiology of several conditions traditionally treated with Malagasy *Aloe* species, including stomach ailments, stomach pain, constipation, and their use as laxatives, as well as wound healing, sprains, burns, microbial infections, diarrhea, sexually transmitted diseases, helminth infections, tuberculosis, poliomyelitis, and typhoid fever. These traditional uses may therefore be partly related to the antioxidant properties and phytochemical composition of these species.

Antimalaria activities: group 3

Antimalarial activity has been reported for methanolic leaf extracts of *A. bulbillifera* H. Perrier, *A. divaricata* A. Berger, *A. gneissicola* (H. Perrier) J.-B. Castillon & J.-P. Castillon, and *A. vaombe* Decorse & Poisson, although the observed activity against *Plasmodium falciparum* was weak, with parasite survival rates ranging from 90.81% to 96.30% in the first cycle and 79.24% to 82.18% in the second cycle (Van Zyl and Viljoen 2002).

This weak activity may be partially related to the phytochemical composition of *Aloe* species, which generally includes anthraquinones, chromones, and phenolic compounds. Some of these secondary metabolites have been reported in the literature to exhibit antiplasmodial and antioxidant properties in related taxa; however, their levels and biological effectiveness can vary considerably among species.

Malaria remains among the infectious diseases traditionally treated with medicinal *Aloe* species in Madagascar, together with other conditions such as diarrhea, typhoid fever, tuberculosis, helminth infections, and sexually transmitted diseases. The low antiplasmodial activity observed in these extracts suggests that their traditional use against malaria may be associated with mild bioactive effects, possible synergistic interactions among compounds, or other mechanisms not yet fully elucidated, rather than strong direct antiparasitic activity.

Immune defense: group 4

Three activities have been studied in the area of immune defenses of *Aloe*: the immunomodulatory activities of *A. macroclada* Baker and *A. vaombe* Decorse & Poisson, the activities of *A. vaombe* Decorse & Poisson as immunostimulant and the antigenic activities.

For *A. vaombe* Decorse & Poisson, on the one hand, a dose of 2.5 to 10 mg of purified extract significantly ($p < 0.02$) causes a growth retardation of fibrosarcoma *McpC3H-5*, increases the survival time of infected mice significantly ($p < 0.001$), also causes regression and the cure of 40% of mice infected with *McC3-1* tumors.

Similarly, this dose causes growth retardation and a decrease in the number of lung metastases caused by *B16m* melanoma in treated mice. The activities are related to the presence of mannose, glucose, and a non-identified sugar in *A. vaombe* Decorse & Poisson gel. A dose of 2.5 mg of the raw extract lyophilized and purified by filtration results in an increase in the number of intraperitoneal macrophages of 4.10^6 macrophages per mL (Ralamboranto *et al.* 1983).

In addition, a dose of 0.025 ml and 0.050 ml or between 2.5 mg and 5 mg of lyophilized and purified raw extract shows maximum protective power (Solar *et al.* 1980) and can cure nearly 50% of mice infested with *Klebsiella pneumoniae* by several germs equal to or greater than 10^8 units (Brossat *et al.* 1981). According to Ralamboranto and colleagues (1983; 1987), a dose of 2.5 mg of lyophilized raw extract purified by filtration stimulates an increase in phagocytic powers of intraperitoneal macrophages. The dose of 5 to 24 mg/ml causes a transformation of 40 to 60% of lymphocytic cells, becoming maximum at a dose of 12.03 mg/ml.

As for *A. macroclada* Baker, the consumption of a dose of about 335 mg of gel allows:

- An increase in the number of bone marrow stem cells *CD45dim CD34+* by 3% after 60 min, 32% after 120 min, and 29% after 180 min, or 2.35 million cells/5L, in peripheral blood circulation.

- An increase in the number of bone marrow stem cells *CD34+ CD133+* by 23% after 60 min, 27% after 120 min and 41% after 180 min or 2.20 million cells/5L (Drapeau *et al.* 2015).

Malagasy ethnomedicinal practices also include the use of *Aloe macroclada* and *A. vaombe* in the management of conditions described as fibroma, tumors, and cancer. These uses are traditionally considered to be linked to systemic or immune-related disorders. Although these claims are not clinically validated, they may be discussed in relation to the immunomodulatory activities reported in experimental studies, such as macrophage activation and modulation of immune responses.

Toxicity: group 5

A dose of up to 50 mg of lyophilized extract and re-dissolved in a physiologic serum (Solar *et al.* 1980), a maximum dose of 10 to 12.03 mg of lyophilized and purified raw extract (Brossat *et al.* 1981; Ralamboranto *et al.* 1987) of *A. vaombe* Decorse & Poisson do not show toxicity in mice. In addition, methanolic extracts from leaves of *A. bulbillifera* H. Perrier*, A. divaricata* A. Berger*, A. gneissicola* (H. Perrier) J.-B. Castillon & J.-P. Castillon and *A. vaombe* Decorse & Poisson are not toxic to human liver cells at a dose between 0.5 and 50 µg ml^{-1} (Van Zyl and Viljoen 2002). Letsara *et al.* (2020b) states that *A. analavelonensis* Letsara, Rakotoaris. & Almeda and *A. helenea* ethanol extracts at 1200 mg/kg body mass in mice demonstrate the same effect.

The absence of toxicity may be related to the phytochemical composition of these species, which is characterized by the presence of anthraquinones, chromones, and phenolic compounds, as well as polysaccharide-rich fractions commonly reported in the genus *Aloe*, many of which are known to exhibit low cytotoxicity in experimental models.

Conclusion

Aloe is among the most species-rich genera in Madagascar, comprising approximately 133 species, most of which are endemic. It is also one of the most important medicinal plant genera used in Malagasy traditional medicine. This review provides a comprehensive synthesis of the ethnobotanical, phytochemical, and pharmacological knowledge currently available for Malagasy *Aloe* species by compiling and analyzing 35 ethnobotanical, 15 phytochemical, and 12 pharmacological studies published between 1903 and 2022.

The review demonstrates that Malagasy *Aloe* species constitute an important medicinal resource, with 20 species traditionally used to treat 112 ailments grouped into 17 disease categories, particularly digestive disorders, infectious diseases, and injuries. However, despite the exceptional diversity and endemism of the genus in Madagascar, scientific knowledge remains fragmented. Only 26 endemic species have been investigated phytochemically and only 13 pharmacologically, revealing a clear imbalance between the wealth of traditional knowledge and its experimental validation. Although 48 phytochemical compounds and several biological activities, including anti-inflammatory, antioxidant, antimalarial, and immunomodulatory effects, have been reported, these findings concern only a small proportion of the Malagasy *Aloe* flora.

The synthesis also highlights important research gaps. Most endemic species remain poorly investigated despite their documented or potential medicinal value, whereas scientific attention has been concentrated on only a few taxa. This uneven distribution of research limits our understanding of the therapeutic potential, chemical diversity, and biological properties of Malagasy *Aloe* species as a whole. Nevertheless, species such as *Aloe macroclada* deserve particular attention because of their wide distribution in the Malagasy Highlands, their availability, and their increasing socio-economic importance, making them suitable models for more comprehensive multidisciplinary studies.

This review is based exclusively on published literature and is therefore constrained by the limited availability of phytochemical and pharmacological data for many endemic species. Consequently, the current synthesis probably underestimates the medicinal potential of the genus and identifies important priorities for future investigations.

Future research should adopt an integrated approach combining ethnobotany, phytochemistry, pharmacology, ecology, and conservation biology to better understand the diversity and medicinal values of Malagasy *Aloe*. Priority should be given to under-investigated and threatened species, while studies addressing chemical variability, biological validation, ecological requirements, and sustainable resource management should be encouraged. In parallel, conservation measures, including population monitoring, sustainable harvesting practices, cultivation and domestication programmes, and stronger implementation of conservation policies consistent with CITES, are essential to ensure the long-term preservation and sustainable use of Malagasy *Aloe* diversity.

Overall, this review demonstrates that the remarkable medicinal importance of Malagasy *Aloe* species is not yet matched by the current level of scientific knowledge. Strengthening interdisciplinary research while integrating conservation into valorization strategies will not only support evidence-based traditional medicine and future drug discovery but will also contribute to safeguarding one of Madagascar's most distinctive components of plant biodiversity.

Table 1. Malagasy *Aloe* species with their traditional uses

Taxa	Local name	Indication	Part used	References
Aloe acutissima H. Perrier	Kisahondra	Purgative	Leaves	Boiteau 1979a
Aloe andringitrensis H. Perrier	Kisahondra	Purgative	Leaves	Boiteau 1979b
Aloe betsileensis H. Perrier	Kisahondra	Purgative	Leaves	Boiteau 1979b
Aloe capitata Baker	Kisahondra, Sahondra, Vahona, Vahotsahondra	Purgative, gastralgia, cough, Heresy-syphilis, Syphilis, Cathartic, Hydropisis, Insect bite, Stomach aches, Ascites, Venereal diseases, Breasts, scabies, dandruff, psychosis	Leaves	Boiteau 1979b; Bost 1961; Pernet 1957; Rabesa 1986; Rakotonandrasana *et al.* 2025; Randriamahefa and Rakotozafy 1979
Aloe conifera H. Perrier	Vahona	Dandruff, Vermicide, diarrhea, swelling, wound	Leaves	Rakotondrafara *et al.* 2018
Aloe deltoideodonta Baker	Kisahondra, vahona	Purgative, Child weaning, Ascites, Stomach pain	Leaves	Boiteau 1979b; Heckel 1903; Razafindrazaka 2012
Aloe divaricata A. Berger	Vahondrandro, Vahomafaitra, Vohandranjo, Vahona, Vahontsoy	Sprain, Gastric sprains, Purgatives, Cathartic, Consolidation of fractures, Oxytocin, Diarrhea, Eye diseases, Stomach pain, Wound, Swelling, Fractures, Flu, Hemorrhage, Lumbago, Stomach aches, Stomach upset, Sore, Colic, constipation, Epilepsy, Infected wound	Leaves	Andriamparany *et al.* 2014; Boiteau *et al.* 1999; Boiteau 1975; Boiteau 1986; Debray *et al.* 1971; Hervé *et al*. 2022, Norodiny 2011; Rabesandratana 1977; Randrianarivony *et al*. 2017
Aloe macroclada Baker	Aloesy, Vahona, Kisahondra, Sahondra, Vahombe,	Purgative, Gastric Disorders, Polio, Vermicide, Child Weaning, Ascites, Hydropisis, Gastric Pain, Amenorrhea, Asthenia, Constipation, Fever, Gonorrhea, Jaundice, Stomach Upset, Urinary Retention, Cough, Urticaria, Entorse, Alopecia, Death, Ascites, Hydropsy, Laxative, Breasts, Caries, Cellulitis, Periodontal Diseases, Burning, wound, Acne, Sunburn, Wrinkles, Facial care, Injury, Bowel and liver diseases, Stomach diseases, Internal pain, Abscess, Asthma, Cholesterol, Hair growth, Diabetes, Eczema, Skin rash, Weakness, Gout, Hypertension, Smoothing, strengthens the vigor and brings more energy, Hair care, All forms of tumour and cancer, Arthritis, Asthma, Bronchitis, Inflammation, Pancreatic diseases, Dandruff, Rheumatism, Cough, worm	Leaves	Boiteau 1979b; Boiteau 1986; Descheemacker 1979; Heckel 1903; Pernet 1957; Rabearivony 2010; Rakotoarivelo *et al.* 2019; Rakotondrafara *et al.* 2018; Randriamahefa and Rakotozafy 1979; Ranjarisoa *et al.* 2016; Ratsimiala-Ramonta 2010; Rabemiafara 2014; Razafindrazaka 2012
Aloe occidentalis (H. Perrier) L.E. Newton & G.D. Rowley	Sakoakenky	Diabetes, Stomach pain, Rheumatism, Fatigue, Stomach pain	Leaves	Rakotonandrasana *et al.* 2017

Taxa	Local name	Indication	Part used	References
Aloe sp.	Vahona	Typhoid fever, Diarrhea, Fatigue, Fever	Flowers, Root, Leaves	Gallé *et al.* 2014; Riondato *et al.* 2019
Aloe sp.1	Vaho	Colic, Constipation, Back pain, Infected wound, Recovery after childbirth	Leaves, Root	Randrianarivony *et al.* 2017
Aloe sp.2	Sakoakekina	Umbilical pain	Leaves	Rakotoarison-Ramiliarisoa 1993
Aloe sp.3	Manasivato, Sakoakainky	Swelling	Leaves	Rakotobe *et al.* 1993
Aloe sp.4	Vahona	Dandruff		Debray *et al.* 1971
Aloe sp.5	Manasivato, Sakoakainky	Colic	Leaves	Rakotobe *et al.* 1993
Aloe sp.6	Vahona	Stomach ache	Leaves	Razafiarisoa 2016
Aloe sp.7	Manasivato	Ear diseases	Leaves	Schmitt 1971
Aloe suarezensis H. Perrier	Sakoakenkigny	Diabetes, Intestinal worms	Leaves	Nicolas 2012
Aloe vaombe Decorse & Poisson	Vahona, Vaho, Vahombe	Postpartum care, Joint pain, Back pain, Stomach pain, Typhoid fever, Asthma, Constipation, Cough, Tuberculosis, Stomach ulcer, Fibrosis, Injury, Diarrhea, Eye strain, Eye diseases, Stomach aches, Migraine, Tumors, Colic, Conjunctivitis, Diarrhea, Hemorrhage, Sprain, Remove the rest of the placenta from the mother's uterus, Cough, Epilepsy, Burning, Contraception, Boils, Back pain, Stomach ache, Ulcer	Leaves, Root, stem	Gallé *et al*. 2014; Hervé *et al*. 2022; Rabesandratana 1977; Randrianarivony *et al*. 2017; Ratsimiala-Ramonta 2010
Aloe vera (L.) Burm. f.	Vahona, Sakoakenkigny	Diabetes, Burn, Intestinal Worms, Dermatosis, Infected Wounds, External Care, Ringworm, Gastritis, Stomach Ulcer, Abortive, Cancer, Jaundice, Wounds	Leaves	Nicolas 2012; Ranarijaona *et al*. 2013

Table 2. Identified molecules and their chemical families within *Aloe* spp.

Taxa	Part used	Chemical families	Isolated product	Reference
Aloe acutissima H. Perrier	Root	Anthraquinones	Aloesaponol I, Aloesaponol II, Asphodeline, Chrysophanol	Van Wyk *et al.* 1995
	Leaves	Chromones	Aloesin	Viljoen 1999
Aloe antandroi (R. Decary) H. Perrier	Root	Anthraquinones	Aloesaponarin I, Aloesaponarin II, Aloesaponol I, Aloesaponol II, Asphodelin, Chrysophanol, Laccaic-acid-d-methylester	Van Wyk *et al.* 1995
	Leaves	Anthrone	Anthrone	Viljoen 1999
		Flavonoid	7-o-methylaloeresin	
Aloe bakeri Scott Elliot	Leaves	Alkaloïd	N-methyl-tyramin	Nash *et al.* 1992
	Root	Anthraquinones	Chrysophanol	Van Wyk *et al.* 1995
	Flowers	Anthrone	Aloeemodinanthrone	Sigler and Rauwald 1994
	Leaves	Flavonoid	Dihydroisorhamnetin, Flavonones	Viljoen *et al.* 1998; Viljoen 1999
Aloe bellatula Reynolds	Leaves	Alkaloïd	N-methyl-tyramin	Nash *et al.* 1992
	Root	Anthraquinones	Aloechrysone, Aloesaponarin I, Aloesaponarin II, Aloesaponol I, Aloesaponol II, Asphodelin, Chrysophanol, Laccaic-acid-d-methylester	Van Wyk *et al.* 1995
	Leaves	Anthrone	Barbaloin, Aloin A & B, Microdontin	Reynolds 1985; Viljoen 1999
		Flavonoid	Flavonones	Viljoen 1999
Aloe capitata Baker	Leaves	Anthrone	Aloin A & B	Viljoen 1999
		Chromones	Aloesin	
		Flavonoid	7-o-methylaloeresin	
Aloe conifera H. Perrier	Leaves	Anthrone	Homonataloin A & B	Viljoen 1999
		Chromones	Aloeresin A, Aloesin	
Aloe decaryi Guillaumin	Leaves	Glucid	Mannan, pectin	Ahl *et al.* 2019
Aloe deltoideodonta Baker	Leaves	Alkaloïd	γ-conicein, Pseudoconhydrin	Dring *et al.* 1984; Hotti et *al.* 2017; Reynolds 1985
Aloe descoingsii Reynolds	Leaves	Alkaloïd	Conhydrin, Coniin	Hotti *et al.* 2017; Nash *et al.* 1992
Aloe divaricata A. Berger	Leaves	Alkaloïd		Debray *et al.* 1971
	Root	Anthraquinones	Aloesaponarin I, Aloesaponarin II, Aloesaponol I, Aloesaponol II, Asphodelin, Asphodelin, Chrysophanol, Laccaic-acid-d-methylester	Van Wyk *et al.* 1995
	Leaves	Anthrone	Barbaloin, Aloin A & B	Reynolds 1985; Viljoen 1999
		Chromones	Aloeresin A	Viljoen 1999
		Flavonoid	7-o-methylaloeresin	
		Saponin	Saponin	Debray *et al.* 1971

Taxa	Part used	Chemical families	Isolated product	Reference
Aloe fragilis Lavranos & Röösli	Leaves	Chromones	Aloesin	Viljoen 1999
Aloe guillaumetii Cremers	Leaves	Anthrone	Aloin A & B	Viljoen 1999
			Aloinoside	
		Flavonoides	7-o-methylaloeresine	
Aloe haworthioides Baker	Root	Anthraquinones	Aloesaponarin I, Aloesaponarin II, Aloesaponol I, Aloesaponol II, Asphodelin, Chrysophanol	Van Wyk *et al.* 1995
Aloe helenae Danguy	Leaves	Anthrone	Aloin A & B	Viljoen 1999
		Chromones	Aloesin	
		Flavonoid	Flavonones	
Aloe ibityensis H. Perrier	Leaves	Alkaloïd	γ-conicein	Dring *et al.* 1984; Reynolds 1985
Aloe isaloensis H. Perrier	Leaves	Anthrone	8-O-methyl-7-hydroxyaloin, Homonataloin A & B	Viljoen 1999
		Chromones	Aloesin	
Aloe macroclada Baker	Leaves	Anthrone	Aloin A & B	Viljoen 1999
		Chromones	Aloesin	
		Flavonoid	7-o-methylaloeresin	
		Polyphenol	Laccic acid	Rabarisoa *et al.* 2017
Aloe massawana Reynolds	Leaves	Anthrone	Aloin A & B	Viljoen 1999
		Chromones	Aloeresine D	
Aloe millotii Reynolds	Root	Anthraquinones	Aloechrysone, Aloesaponarin I, Aloesaponarin II, Aloesaponol I, Aloesaponol II, Asphodelin, Chrysophanol	Van Wyk *et al.* 1995
	Leaves	Anthrone	8-O-methyl-7-hydroxyaloin	Viljoen 1999
Aloe occidentalis (H. Perrier) L.E. Newton & G.D. Rowley	Leaves	Anthrone	Aloin A & B	Viljoen 1999
		Flavonoides	Flavones	
Aloe orientalis (H. Perrier) L.E. Newton & G.D. Rowley	Leaves	Anthrone	Aloin A & B	Viljoen 1999
	Leaves	Flavonoid	Flavones	
Aloe rauhii Reynolds	Leaves	Alkaloïd	N-methyl-2-(4-methoxyphenyl)-ethylamin, N-methyl-tyramin	Nash *et al.* 1992
	Root	Anthraquinones	Aloechrysone, Aloesaponarin I, Aloesaponarin II, Aloesaponol I, Aloesaponol II, Asphodelin, Chrysophanol, Laccaic-acid-d-methylester	Van Wyk *et al.* 1995
Aloe suarezensis H. Perrier	Leaves	Anthrone	Barbaloin	Reynolds 1985

Taxa	Part used	Chemical families	Isolated product	Reference
Aloe vaombe Decorse & Poisson	Root	Anthraquinones	Aloesaponarin I, Aloesaponarin II, Aloesaponol I, Aloesaponol II, Asphodelin, Chrysophanol, Laccaic-acid-d-methylester	Van Wyk *et al.* 1995
	Leaves, Flowers	Anthrone	7-Hydroxyaloin A & B, 8-O-methyl-7-hydroxyaloine, Aloeemodinanthrone, Chrysophanolanthrone, Aloin A & B	Sigler & Rauwald 1994; Viljoen *et al.* 1998; Viljoen 1999
	Leaves	Chromones	Aloesin	Viljoen *et al.* 1998
		Flavonoid	Dihydroisorhamnetin, Naringenin	
		Glucid	Mannan, Pectin, Glucose, Mannose, Xylose, Arabino-galactan, Glucomannan, Glucomannan acetylated, Polysaccharid, Rhamnogalactunomans,	Ahl *et al.* 2019; Grace *et al.* 2013; Jasso de Rodriguez *et al.* 2015; Radjabi *et al.* 1983; Vilkas & Radjabi-Nassab 1986
Aloe vaotsanda Decary	Leaves	Anthrone	Aloin A & B	Viljoen 1999
		Chromones	Aloesin	
		Flavonoid	Flavonones	
Aloe viguieri H. Perrier	Leaves, Root	Alkaloïd	γ-conicein	Dring *et al.* 1984; Hotti *et al.* 2017; Reynolds 1985
			Coniin	
			N-methylconiin	

Table 3. Pharmacological activities of *Aloe* spp.

Taxa	Part used	Extract	Toxicity	Biological activities	Percentage of activity	Strain	Reference
Aloe analavelonensis Letsara, Rakotoaris. & Almeda	Leaves	Methanolic extract	Not toxic to mice at the dose of 1200 mg/kg				Letsara *et al.* 2020a
Aloe bulbillifera H. Perrier	Leaves	Methanolic extract		Inhibition of cyclooxygenase	96% inhibition		Lindsey *et al.* 2002
				Anti-inflammatory			Amoo *et al.* 2014
				Anti-malaria		*Plasmodium falciparum*	Amoo *et al.* 2014
				Low anti-malarial activity (Parasite growth at 50µg/ml: 96.30% in Single cycle; 90.78% in Double cycle)		*Plasmodium falciparum*	Van Zyl & Viljoen 2002
Aloe capitata Baker *var angavoana* J.-P. Castillon	Leaves	Aqueous extract of powder of Leaves		Anti-oxidant			Letsara *et al.* 2020b
Aloe capitata Baker *var quartziticola* H. Perrier	Leaves			Anti-oxidant			Letsara *et al.* 2020b
Aloe cipolinicola (H. Perrier) J.-B. Castillon & J.-P. Castillon	Leaves			Anti-oxidant			Letsara *et al.* 2020b
Aloe conifera H. Perrier	Leaves	Methanolic extract		Inhibition of cyclooxygenase	48% inhibition		Lindsey *et al.* 2002
Aloe decaryi Guillaumin	Leaves			Anti-inflammatory by lipopolysaccharide inhibition at a dose of 50 µl of 2% *Aloe* gel		J774-Dual™ cell line	Ahl *et al.* 2023
Aloe divaricata A. Berger	Leaves	Methanolic extract		Inhibition of cyclooxygenase	7% inhibition		Lindsey *et al.* 2002
				Low anti-malarial activity (Parasite growth at 50µg ml-1: 93.72% in Single cycle; 80.77% in Double cycle)		*Plasmodium falciparum*	Van Zyl & Viljoen 2002
Aloe gneissicola (H. Perrier) J.-B. Castillon & J.-P. Castillon	Leaves	Methanolic extract		Inhibition of cyclooxygenase	83% inhibition		Lindsey et *al.* 2002
				Anti-inflammatory			Amoo *et al.* 2014
				Anti-malaria		*Plasmodium falciparum*	Amoo *et al.* 2014
				Low anti-malarial activity (Parasite growth at 50µg ml-1: 96.09% in Single cycle; 79.24% in Double cycle)		*Plasmodium falciparum*	Van Zyl & Viljoen 2002

Taxa	Part used	Extract	Toxicity	Biological activities	Percentage of activity	Strain	Reference
Aloe helenae Danguy	Leaves			Anti-inflammatory by lipopolysaccharide inhibition at a dose of 50 µl of 2% *Aloe* gel		J774-Dual™ cell line	Ahl *et al.* 2023
		Methanolic extract	Not toxic to mice at the dose of 1200 mg/kg				Letsara *et al.* 2020a
				Anti-oxidant			Letsara *et al.* 2020b
Aloe macroclada Baker	Leaves	*Aloe macroclada* Baker pellets		Triggers a transient mobilisation of bone marrow stem cells	Increases the number of circulating CD45dim CD34+ and CD34+ CD133+ stem cells by up to 53% within 2 hours of consumption.		Drapeau *et al.* 2015
		GBE extract		Anti-oxidant	50%		Rabarisoa *et al.* 2017
		Raw gel			15.16%		Rabarisoa *et al.* 2017
		Vahona Alcohol-Free			29.78%		Rabarisoa *et al.* 2017
		Honey Vahona			15.67-30.17%		Rabarisoa *et al.* 2017
		Vahona Nature Lemon			50%		Rabarisoa *et al.* 2017
Aloe vaombe Decorse & Poisson	Leaves			Anti-inflammatory by lipopolysaccharide inhibition at a dose of 50 µl of 2% *Aloe* gel		J774-Dual™ cell line	Ahl et *al.* 2023
		Gel extract purified using Sephadex G50	Not toxic to mice at the maximum doses tested (10 mg F 1 /mouse i.v.)	Anti-malaria	50% survival rate following injection of 0.1 ml of blood containing bacteria	*Plasmodium berghei*	Brossat *et al.* 1981
				Anti-bacterial	100% survival rate with bacterial inoculations of less than 10^7 and nearly 50% with bacterial inoculations of 10^8 or more	*Listeria monocytogene s*	Brossat *et al.* 1981
				Anti-bacterial	25% survival rate following injection of 400 bacilli	*Yersinia pestis*	Brossat et *al.* 1981
				Antifungal	50% survival rate following injection of 10^7 yeast cells	*Candida albicans*	Brossat *et al.* 1981
		Methanolic extract		Inhibition of cyclooxygenase	35% inhibition		Lindsey *et al.* 2002

Taxa	Part used	Extract	Toxicity	Biological activities	Percentage of activity	Strain	Reference
Aloe vaombe Decorse & Poisson	Leaves	Gel extract purified using Sephadex G50		To reduce the number of lung metastases		Melanoma B16m	Ralamboranto *et al.* 1983
				Inhibiting the growth of non-metastatic B16m melanoma		Melanoma B16m	Ralamboranto *et al.* 1983
				Slowing the growth of McpC3H-5 fibrosarcoma		McpC3H-5 fibrosarcoma	Ralamboranto *et al.* 1983
				Slowing the growth of McC3-1 fibrosarcoma		McC3-1 fibrosarcoma	Ralamboranto *et al.* 1983
				Antigenic		*Klebsiella pneumoniae*	Ralamboranto *et al.* 1983
		6 to 12 mg/ml of Gel extract purified using Sephadex G50		Phytomitogenic	40-60% of cells are transformed, corresponding to a stimulation index of 43.87%. Maximum stimulation: 48,195 cpm		Ralamboranto *et al.* 1987
	Leaves	Freeze-dried gel extract solubilised in saline solution (ES)		Non-specific immunostimulant			Solar *et al.* 1980
		Freeze-dried gel extract solubilised in 95% alcohol (ERa)		Non-specific immunostimulant			Solar *et al.* 1980
		Sephadex G50-purified gel extract, 6-12 mg/ml (F1)		Non-specific immunostimulant			Solar *et al.* 1980
		Methanol extract		Anti-inflammatory			Amoo *et al.* 2014
				Anti-malaria		*Plasmodium falciparum*	Amoo *et al.* 2014
				Low anti-malarial activity (Parasite growth at 50µg ml-1: 90.81% in Single cycle; 82.18% in Double cycle)		*Plasmodium falciparum*	Van Zyl & Viljoen 2002
Aloe vaotsanda Decary	Leaves	Methanol extract		Inhibition of cyclooxygenase	91% inhibition		Lindsey *et al.* 2002
				Anti-inflammatory			Amoo *et al.* 2014

Declarations

List of abbreviations: DPPH: 2,2-diphényl-1-picrylhydrazyle**,** MBG: Missouri Botanical Garden; UE Official Journal: European Union Official Journal, CITES: Convention on International Trade of Endangered Species

Ethics approval and consent to participate: The study protocol was reviewed and validated by the Scientific Committee of Orientation of the Centre National d'Application de Recherches Pharmaceutiques (CNARP), Madagascar. As the study was based exclusively on published and secondary data sources, no additional ethical clearance or participant consent was required.

Consent for publication: Not applicable

Availability of data and materials: A database of medicinal *Aloe* used in this work is available at the Department of Ethnobotany and Botany of the Centre National d'Application de Recherches Pharmaceutiques.

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Literature cited

Adjanohoun E. 1987. Médecine traditionnelle et pharmacopée: Contribution aux études ethnobotaniques et floristiques au Togo. Agence de Coopération Culturelle et Technique, Paris, France.

African Plant Database. 2026. African Plant Database. Conservatoire et Jardin botaniques de la Ville de Genève. Available at: [African Plant Database] (accessed 2026).

Ahl LI, Al-Husseini N, Al-Helle S, Staerk D, Grace OM, Willats WGT, Mravec J, Jørgensen B, Rønsted N. 2019. Detection of seasonal variation in *Aloe* polysaccharides using carbohydrate-detecting microarrays. Frontiers in Plant Science 10: 512. doi: 10.3389/fpls.2019.00512

Ahl LI, Schoeneburg MP, Harth L, Barnes CJ, Woetmann A, Rønsted N. 2023. Leaf gel from several *Aloe* species shows anti-inflammatory properties through inhibition of LPS-mediated activation of TLR4 signaling. Phytomedicine Plus 3: 100397.

Akaberi M, Sobhani Z, Javadi B, Sahebkar A, Emami SA. 2016. Therapeutic effects of *Aloe* spp. in traditional and modern medicine: A review. Biomedicine & Pharmacotherapy 84: 759-772.

Amoo SO, Aremu AO, Van Staden J. 2014. Unraveling the medicinal potential of South African *Aloe* species. Journal of Ethnopharmacology 153: 19-41.

Andriamamisoa V. 2026. Ecologie, utilisation et perspective de gestion durable de *Aloe macroclada*, Mémoire de Master en Génie Rural, Ecole Supérieure Polytechnique d'Antananarivo, Université d'Antananarivo, Madagascar.

Andriamparany JN, Brinkmann K, Jeannoda V, Buerkert A. 2014. Effects of socio-economic household characteristics on traditional knowledge and usage of wild yams and medicinal plants in the Mahafaly region of south-western Madagascar. Journal of Ethnobiology and Ethnomedicine 10: 82.

Anywar G, Tugume P, Kakudidi AK. 2021. A review of *Aloe* species used in traditional medicine in East Africa. South African Journal of Botany 000: 1-15.

Belayneh A, Demissew S, Bussa NF, Bisrat D. 2020. Ethnomedicinal and biocultural importance of aloes from south and east of the Great Rift Valley floristic regions of Ethiopia. Heliyon 6(6): 1-12.

Bjorå CS, Wabuyele E, Grace OM, Nordal I, Newton LE. 2015. The uses of Kenyan aloes: an analysis of implications for names, distribution and conservation. Journal of Ethnobiology and Ethnomedicine 11: 82. doi:10.1186/s13002-015-0060-0.

Boiteau P, Boiteau M, Allorge-Boiteau L. 1999. Dictionnaire des noms malgaches de végétaux, Vol. IV. Alzieu, Grenoble, France.

Boiteau P. 1975. Dictionnaire des noms malgaches de végétaux. Fitoterapia 46: 201-239.

Boiteau P. 1979a. Dictionnaire des noms malgaches de végétaux. Fitoterapia 48: 25-47.

Boiteau P. 1979b. Dictionnaire des noms malgaches de végétaux. Fitoterapia 50: 73-96.

Boiteau P. 1986. Médecine traditionnelle et pharmacopée: Précis de matière médicale malgache. ACCT.

Bost R. 1961. Pharmacopée malgache. Mémoires de l'Institut Scientifique de Madagascar, Série B 10(2): 161-234.

Brossat JY, Le Deaut JY, Ralamboranto L, Rakotovao LH, Solar S, Gueguen A, Coulanges P. 1981. Étude des propriétés immunostimulantes d'un extrait isolé à partir d'*Aloe vahombe.* Archives de l'Institut Pasteur de Madagascar 48(1): 11-34.

Cock IE. 2015. The genus *Aloe*: Phytochemistry and therapeutic uses including treatments for gastrointestinal conditions and chronic inflammation. Progress in Drug Research 70: 179-235. doi:10.1007/978-3-0348-0927-6_6.

Dagne E, Bisrat D, Viljoen A, Van Wyk BE. 2000. Chemistry of *Aloe* species. Current Organic Chemistry 4(10): 1055-1078. doi:10.2174/1385272003375932.

Data Bridge Market Research. 2026. Global *Aloe* Vera Market Size, Share, and Trends Analysis Report - Industry Overview and Forecast to 2032. Available at: https://www.databridgemarketresearch.com/reports/global-aloe-vera-market.

de Flacourt E. 1658. Histoire de la grande isle Madagascar. Lesselin, Paris, France.

Debray M, Jacquemin H, Razafindrambao R. 1971. Contribution à l'inventaire des plantes médicinales de Madagascar. Travaux et Documents de l'ORSTOM 8. ORSTOM, Paris, France.

Descheemacker A. 1979. Ravimaitso. Fianarantsoa, Madagascar. 84 p.

Direction de la Veille Sanitaire et de la Surveillance Épidémiologique (DVSSE). 2018. Bulletin mensuel de surveillance épidémiologique de Madagascar (BMSEM), n°3. Ministère de la Santé Publique, Madagascar, 10 p.

Diriba TF, Deresa EM. 2022. Botanical description, ethnomedicinal uses, phytochemistry, and pharmacological activities of genus *Kniphofia* and *Aloe*: A review. Arabian Journal of Chemistry 15: 104-111.

Drapeau C, Benson KF, James J, Jensen GS. 2015. *Aloe macroclada* from Madagascar triggers transient bone marrow stem cell mobilization. Journal of Stem Cell Research & Therapy 5: 287.

Dring JV, Nash RJ, Roberts MF, Reynolds T. 1984. Hemlock alkaloids in aloes: Occurrence and distribution of γ-coniceine. Planta Medica 50: 442-443.

European Union Official Journal. 2017. Commission Implementing Regulation (EU) 2017/2470 of 20 December 2017 establishing the Union list of novel foods in accordance with Regulation (EU) 2015/2283 of the European Parliament and of the Council on novel foods. Official Journal of the European Union L 351: 72-201.

Fentaw E, Dagnea K, Wondimu T, Demissew S, Bjora CS, Grace OM. 2020. Uses and perceived sustainability of *Aloe* L. (Asphodelaceae) in the central and northern Highlands of Ethiopia. South African Journal of Botany 00: 1-9.

Gallé JB, Groeber G, Ledoux A, Nicolas JP. 2014. Quelques plantes employées dans le Sud-Ouest de Madagascar: Ethnobotanique. Éditions Jardins du Monde, Saint-Thonan, France.

Githens TS. 1979. Drug Plants of Africa. University of Pennsylvania Press, Philadelphia, USA.

Grace OM, Simmonds MSJ, Smith GF, Van Wyk AE. 2008. Therapeutic uses of *Aloe* (Asphodelaceae) in southern Africa. Journal of Ethnopharmacology 119: 604-614.

Grace OM. 2011. Current perspectives on the economic botany of the genus *Aloe.* South African Journal of Botany 77: 980-987.

Grace OM, Dzajic A, Jäger AK, Nyberg AT, Önder A, Rønsted N. 2013. Monosaccharide analysis of succulent leaf tissue in *Aloe.* Phytochemistry 93: 79-87.

Heckel E. 1903. Les plantes médicinales et toxiques de Madagascar avec leurs noms et leurs emplois indigènes. Annales du Musée Colonial de Marseille 1(2): 1-148.

Hervé D, Randriamalala JR, Randriambanona H, Razanaka S, Rakotoarimanana V, Ranaivoson RE, Rafidison V, Carrière SM, eds. 2022. Valoriser les forêts sèches: Valorisation durable des forêts sèches de l'Océan Indien. IRD, UE/COI-Biodiversity, Éditions Antso, Antananarivo, Madagascar. 396 p.

Hotti H, Häkkinen ST, Seppänen-Laakso T, Rischer H. 2017. Polyketide-derived alkaloids and anthraquinones in *Aloe* plants and cell cultures. Journal of Plant Biotechnology Research 1(1): 1-15.

International Trade Centre (ITC). 2026. Trade Map: Trade statistics for international business development. Geneva, Switzerland. Available at: https://www.trademap.org/. Accessed 2026.

ITFG, IITR. 1996. Ethnoveterinary medicine in Kenya: A field manual of traditional animal health care practices. Intermediate Technology Kenya and International Institute for Rural Reconstruction, Nairobi, Kenya.

Jasso de Rodriguez D, Angulo-Sanchez JL, Teixeira da Silva JA, Aguilar-Gonzalez CN. 2015. Review of *Aloe* species' medicinal: properties and bioactive compounds. In: Floriculture, Ornamental and Plant Biotechnology, Vol. IV. Global Science Books, UK. p. 460-471.

Letsara R, Andrianantenaina R, Ashande CM, Mawi CF, Saragih MY, Ngbolua KTN, Rahelivololoniaina BR. 2020a. Acute toxicity evaluation of the Malagasy endemic *Aloe helenae* and *A. analavelonensis* in mice. Budapest International Research in Exact Sciences Journal 2: 452-457.

Letsara R, Andrianantenaina R, Bongo GN, Ashande CM, Matondang MIS, Ngbolua KTN, Rahelivololoniaina BR. 2020b. TLC profiling of leaves extracts of some *Aloe* threatened species endemic to Madagascar for their antioxidant activity. Britain International of Exact Sciences Journal 2(3): 653-662.

Lindsey KL, Jäger AK, Viljoen AM. 2002. Cyclooxygenase inhibitory activity of *Aloe* species. South African Journal of Botany 68: 47-50.

Ministère de la Santé Publique (MSANP). 2023. Annuaire des statistiques du secteur santé de Madagascar 2022. Antananarivo, Madagascar: Ministère de la Santé Publique. Available from: MSANP - Annuaire des statistiques du secteur santé de Madagascar 2022

Missouri Botanical Garden (MBG). 2026. Madagascar Catalogue: Catalogue of the Vascular Plants of Madagascar. Available at: https://www.efloras.org/madagascar/. Accessed September 1, 2026.

Morris B. 1996. Chewa medical botany: A study of herbalism in southern Malawi. International African Institute, London, United Kingdom.

Nalimu F, Oloro J, Kahwa I, Ogwang PE. 2021. Review on the phytochemistry and toxicological profiles of *Aloe vera* and *Aloe* ferox. Future Journal of Pharmaceutical Sciences 7: 145.

Nash RJ, Beaumont J, Veitch NC, Reynolds T, Benner J, Hughes CNG, Dring JV, Bennett RN, Dellar JE. 1992. Phenylethylamine and piperidine alkaloids in *Aloe* species. Planta Medica 58: 84-87.

Nicolas JP. 2012. Plantes médicinales du nord de Madagascar: Ethnobotanique Antakarana et informations scientifiques. Éditions Jardins du Monde, Saint-Thonan, France. 296 p.

Norodiny. 2011. Valorisation des filières potentielles en matière de biodiversité: Les plantes médicinales dans l'aire protégée communautaire "Tsinjoriake", sud-ouest de Madagascar. Mémoire de DEA en biodiversité et environnement, Faculté des Sciences, Université de Toliara, Madagascar.

Pernet RB. 1957. Les plantes médicinales malgaches. Mémoires de l'Institut Scientifique de Madagascar, Série B 7: 1-144.

Powell BH. 1868. Handbook of products of the Punjab with a combined index and glossary of technical vernacular words. Vol. 1. Economic raw produce. Thomason Civil Engineering College Press, Roorkee, India.

Rabarisoa H, Rakotomanana H, Rahantamalala A, Rasoarahona F, Farasoa HR, Rasambaritafika L, Rasoarahona J, Raonizafinimanana B. 2017. Contribution à l'étude des propriétés pharmacologiques du vahona *Aloe macroclada* Baker. In: Actes du forum de la recherche, 14-16 juin 2017, Antananarivo, Madagascar.

Rabearivony DA. 2010. Étude ethnobotanique des espèces médicinales à Ambalabe-Vatomandry et évaluation de leur structure écologique. Mémoire de DEA, Faculté des Sciences, Antananarivo, Madagascar.

Rabemiafara MV. 2014. Ethnobotanique, écologie et statut de conservation de *Aloe macroclada* Baker dans la région d'Analamanga. Mémoire de DEA en Ecologie Végétale, Faculté des Sciences, Université d'Antananarivo, Madagascar.

Rabesa ZA. 1986. Pharmacopée de l'Alaotra. Éditions Fanantenana, Antananarivo, Madagascar. 260 p.

Rabesandratana RN. 1977. Résultats d'enquête et de localisation de plantes médicinales de la région de Tuléar. Annales de l'Université de Madagascar, Série Sciences de la Nature et des Mathématiques 13: 131-150.

Radjabi F, Amar C, Vilkas E. 1983. Structural studies of the glucomannan from *Aloe vahombe*. Carbohydrate Research 116(1): 166-170.

Rakotoarison-Ramiliarisoa B. 1993. L'agriculture traditionnelle et les utilités des plantes dans le nord-est malgache. Thèse de doctorat en biologie végétale tropicale, Université Paris 6, France.

Rakotoarivelo NH, Randrianarivony TN, Rakotoarivony F, Randrianasolo A. 2019. "Mangidy": Malagasy folk beverages sold in Madagascar's marketplaces. Ethnobotany Research and Applications 18(29): 1-14.

Rakotobe EA, Rasolomanana CJC, Randrianasolo SS. 1993. Pharmacopées de l'Ambongo et de Boina. CIDST, Antananarivo, Madagascar.

Rakotonandrasana SR, Rakotondrafara A, Rakotondrajaona R, Rasamison V, Ratsimbason M. 2017. Plantes médicinales des formations végétales de la baie de Rigny, Antsiranana, Madagascar. Bois et Forêts des Tropiques 331: 55-65.

Rakotonandrasana SR. 2022. Contribution à l'étude des plantes médicinales et aromatiques de Madagascar: ethnobotaniques, taxonomie, constituants chimiques et activités biologiques. Mémoire d'Habilitation à Diriger des Recherches, Université d'Antananarivo. Vol. I, 230 p.

Rakotonandrasana SR, Rakotonirina CM, Rakotoarisoa FM, Rakotondrafara A, Rakotoarimanana V, Andrianarivelo MH, Rasamison VE, Rakotosaona R. 2025. Diversity and uses of medicinal flora in the vegetation of the Ankaratra Massif, Madagascar. Bioactive Secondary Metabolites from Medicinal Plants of Africa. Singapore: Springer, 479-533. doi:10.1007/978-981-96-8590-5_15

Rakotondrafara A, Rakotondrajaona R, Ratsimbason M, Rasamison V, Rakotonandrasana SR. 2018. Ethnobotany of medicinal plants used by the Zafimaniry clan in Madagascar. Journal of Phytopharmacology 7(6): 483-494.

Ralamboranto L, Rakotovao LH, Le Deaut JY, Chaussoux D, Salomon JC, Fournet B, Montreuil J, Rakotonirina-Randriambeloma PJ, Dulat C, Coulanges P. 1983. Étude des propriétés immunomodulatrices d'un extrait isolé et partiellement purifié à partir de *Aloe vahombe*. Archives de l'Institut Pasteur de Madagascar 50: 227-256.

Ralamboranto L, Rakotovao LH, Coulanges P, Corby G, Janot C. 1987. Induction of lymphoblastic transformation by a polysaccharide extract of a native Madagascar plant *Aloe vahombe*: ALVA. Archives de l'Institut Pasteur de Madagascar 53: 227-231.

Ranarijaona HLT, Tsitomotra A, Ravoniarisoa JB, Andrianarisetra GS. 2013. Les plantes magiques traditionnelles les plus réputées des femmes de la ville de Mahajanga. Université de Mahajanga, Mahajanga, Madagascar, 20 p.

Randriamahefa M, Rakotozafy A. 1979. Tari-dalàna ahafantarana ny raokandro malagasy. Boky voalohany. Antananarivo. Madagascar. 404 p.

Randrianarivony TN, Ramarosandratana AV, Andriamihajarivo TH, Rakotoarivony F, Jeannoda VH, Randrianasolo A, Bussmann RW. 2017. The most used medicinal plants by communities in Mahaboboka, Amboronabo, Mikoboka, southwestern Madagascar. Journal of Ethnobiology and Ethnomedicine 13(1): 19.

Ranjarisoa LN, Razanamihaja N, Rafatro H. 2016. Use of plants in oral health care by the population of Mahajanga, Madagascar. Journal of Ethnopharmacology 193: 179-194.

Rasoanaivo P. 1990. Rain forests of Madagascar: Sources of industrial and medicinal plants. Ambio 19(8): 421-424.

Ratsimandresy F, Rafidison VM, Rakotondrafara A, Rakotonandrasana SR. 2022. Plantes médicinales comme moteur de développement mais menacées d'extinction. Communication orale au Symposium International « Bien-être et santé », Première édition sur le thème « Médecine traditionnelle et pharmacopée », 30 novembre au 3 décembre 2022, Centre National d'Application de Recherches Pharmaceutiques, Antananarivo, Madagascar. 69 p.

Ratsimiala-Ramonta I. 2010. Contribution de l'ethnobotanique dans la médecine traditionnelle malgache. Mémoire d'HDR, Faculté des Sciences, Antananarivo, Madagascar.

Rauwald HW, Maucher R, Dannhardt G, Kuchta K. 2021. Dihydroisocoumarins, naphthalenes, and further polyketides from *Aloe vera* and *A. plicatilis*: Isolation, identification and their 5-LOX/COX-1 inhibiting potency. Molecules 26: 4223.

Razafiarisoa VH. 2016. État de lieux environnemental des environs du massif de Vohimbohitra en vue d'un plan de conservation. Mémoire de master, Faculté des Sciences, Université d'Antananarivo, Madagascar.

Razafindrazaka RM. 2012. Les plantes sauvages les plus utilisées dans la région Analamanga: Inventaire ethnobotanique dans les communes rurales d'Ankadinandriana, d'Ambohitrandriamanitra et de Miadanandriana. Mémoire CAPEN, École Normale Supérieure, Université d'Antananarivo, Madagascar.

Reynolds GW. 1950. The aloes of South Africa. The Aloes of South Africa Book Fund, Johannesburg, South Africa.

Reynolds T. 1985. Observations on the phytochemistry of *Aloe* leaf-exudate compounds. Botanical Journal of the Linnean Society 90: 179-199.

Reynolds T, ed. 2004. Aloes: The genus *Aloe.* CRC Press, Boca Raton, USA.

Reynolds T. 2005. Hemlock alkaloids from Socrates to poison aloes. Phytochemistry 66: 1399-1406.

Riondato I, Donno D, Roman A, Razafintsalama VE, Petit T, Mellano MG, Torti V, De Biaggi M, Rakotoniaina EN, Giacoma C, Beccaro GL. 2019. First ethnobotanical inventory and phytochemical analysis of plant species used by indigenous people living in the Maromizaha forest, Madagascar. Journal of Ethnopharmacology 232: 73-89. doi: 10.1016/j.jep.2018.12.002

Rood B. 2008. Rooi kos uit die veldkombuis. Protea Boekhuis, South Africa.

Safidiniaina A. 2018. Plantes médicinales des formations herbeuses de la commune rurale de Ramainandro, district de Faratsiho. Mémoire de licence professionnelle en gestion de l'environnement, mention biologie, Institut d'Enseignement Supérieur Antsirabe-Vakinankaratra, Madagascar.

Schmitt JP. 1971. Contribution à l'inventaire des plantes médicinales de Madagascar. ORSTOM, Section des plantes médicinales V, Tananarive, Madagascar. 84 p.

Sigler A, Rauwald HW. 1994. First proof of anthrone aglycones and diastereomeric anthrone-C-glycosyls in flowers and bracts of *Aloe* species. Biochemical Systematics and Ecology 22(3): 287-290.

Solar S, Zeller H, Rasolofonirina N, Coulanges P, Ralamboranto L, Andriantsimahavandy AA, Rakotovao LH, Le Deaut JY. 1980. Mise en évidence et étude des propriétés immunostimulantes d'un extrait isolé et partiellement purifié à partir de *Aloe vahombe*. Archives de l'Institut Pasteur de Madagascar 47(1): 9-39.

Van Wyk BE, Yenesew A, Dagne E. 1995. Chemotaxonomic survey of anthraquinones and pre-anthraquinones in roots of *Aloe* species. Biochemical Systematics and Ecology 23(3): 267-275.

Van Zyl RL, Viljoen AM. 2002. In vitro activity of *Aloe* extracts against *Plasmodium falciparum*. South African Journal of Botany 68: 106-110.

Vieilledent G, Grinand C, Rakotomalala FA, Ranaivosoa R, Rakotoarijaona JR, Allnutt TF, Achard F. 2018. Combining global tree cover loss data with historical national forest-cover maps to look at six decades of deforestation and forest fragmentation in Madagascar. Biological Conservation 222: 189-197. doi:10.1016/j.biocon.2018.04.008.

Viljoen AM, Van Wyk BE, Van Heerden FR. 1998. Distribution and chemotaxonomic significance of flavonoids in *Aloe* (Asphodelaceae). Plant Systematics and Evolution 211: 31-42.

Viljoen A. 1999. A chemotaxonomic study of phenolic leaf compounds in the genus *Aloe*. PhD thesis, Faculty of Sciences, Rand Afrikaans University, South Africa.

Vilkas E, Radjabi-Nassab F. 1986. The glucomannan system from *Aloe vahombe* (Liliaceae) III: Comparative studies on the glucomannan components isolated from the leaves. Biochimie 68(9): 1123-1127.

Virtual Market Research. 2026. *Aloe* Vera Whole Leaf Extract Market: Size, Share, Growth, 2024-2030. Available at: https://virtuemarketresearch.com/report/aloe-vera-whole-leaf-extract-market. Accessed September 1, 2026.

Wondimu T, Asfaw Z, Kelbessa E. 2007. Ethnobotanical study of medicinal plants around Debre Libanos, North Shewa Zone of Oromia Region, Ethiopia. Journal of Ethnopharmacology 112(1): 152-161. doi:10.1016/j.jep.2007.02.014.

World Health Organization (WHO). 2026. World health statistics 2026: monitoring health for the SDGs, sustainable development goals. Geneva: World Health Organization. 59 p. ISBN: 978-92-4-012248-2. Available at: https://www.who.int/publications/i/item/9789240122482 (accessed 2026).

Yimam M, Brownell L, Jia Q. 2015. Aloesin as a medical food ingredient for systemic oxidative stress of diabetes. World Journal of Diabetes 6: 1097-1107.