Ethnobotanical survey of antimalarial and mosquito-repellent plants in the Centre and Hauts-Bassins Regions of Burkina Faso

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Research

Abstract

Background: In Burkina Faso, traditional medicine remains a key component of primary healthcare, particularly for malaria management. This study aimed to identify plant species with antimalarial and mosquito-repellent properties used in the Centre and Hauts-Bassins regions, to guide future pharmacological investigations.

Methods: From September to November 2022, an ethnobotanical survey was conducted among 161 traditional practitioners in urban (Ouagadougou, Bobo-Dioulasso) and rural (Nasso, Matourkou) areas. The study assessed practitioners' knowledge of antiplasmodial and repellent plants across different localities. Data analysis using Excel and R included chi-square tests, citation frequency, and confirmatory factor analysis to reveal regional differences in knowledge.

Results: Most practitioners were illiterate (59%) but had extensive experience (1–85 years). A total of 83 plant species from 35 families were recorded as antimalarial remedies. The most frequently cited species were *Terminalia leiocarpa* (18.2%), *Sarcocephalus latifolius* (17.6%), and *Cochlospermum planchonii* (16.98%). The Fabaceae family was most represented, followed by Combretaceae and Rubiaceae. Decoction (83%) and oral administration (55%) were predominant, with leaves being the most used part (68%). For mosquito repellents, 16 species were identified, notably *Ocimum americanum* (19.98%), with leaves again most used (71%). Drying (84%) and fumigation (86%) were the main application methods.

Conclusions: This study provides valuable insight into traditional knowledge of antimalarial and mosquito-repellent plants in Burkina Faso. The documented species represent promising candidates for phytochemical and pharmacological validation, supporting the development of plant-based therapies in malaria control.

Keywords: Ethnobotanical survey; malaria; antimalarial and mosquito-repellent plants

Background

Malaria remains one of the most persistent global health challenges, despite decades of control efforts. According to the World Health Organization (WHO), it is a life-threatening parasitic disease transmitted to humans by *Anopheles* mosquitoes, typically presenting with fever and other nonspecific symptoms. In 2023, an estimated 263 million cases and 597,000 deaths were reported worldwide (WHO 2024). Burkina Faso, a highly malaria-endemic country, accounted in 2023 for about 3.1% of global malaria cases and 2.7% of malaria-related deaths (WHO 2024). Malaria remains the leading cause of consultations, hospitalizations, and deaths across the country. To reduce transmission and mortality, the country has implemented a full range of WHO-recommended strategies, including large-scale distribution of insecticide-treated nets, indoor residual spraying, environmental management, intermittent preventive treatment for pregnant women, and seasonal malaria chemoprevention for children (WHO 2022). Recently, the RTS,S/AS01 (Mosquirix) and R21/Matrix-M vaccines have been introduced as complementary tools in high-risk populations (WHO 2023). Treatment mainly relies on Artemisinin-based Combination Therapies (ACTs) for uncomplicated cases and intravenous artesunate for severe malaria, sometimes supported by blood transfusions (WHO 2023). However, growing resistance of both *Plasmodium* parasites and *Anopheles* mosquitoes to drugs and insecticides threatens the effectiveness of existing control measures (Ranson & Lissenden 2016). In this context, there is growing interest in natural products with both antiplasmodial and antivectorial properties (Jansen *et al*. 2010). Medicinal plants have long been central to malaria management, both in treatment and prevention, providing a rich source of bioactive compounds (Soh & Benoit-Vical 2007). Several plant-derived molecules already play a key role in malaria control: quinine from *Cinchona* spp. (Rubiaceae), artemisinin from *Artemisia annua* L. (Asteraceae) (Willcox 2011), and pyrethroids—synthetic analogs of pyrethrins from *Chrysanthemum cinerariaefolium* (Asteraceae) (Hitmi *et al*. 2000). Other species, such as *Azadirachta indica* A.Juss. (neem) (Meliaceae), *Cymbopogon citratus* (DC.) Stapf (lemongrass) (Poaceae), and *Ocimum* spp. (basil) (Lamiaceae), are traditionally used for their antiplasmodial or mosquito-repellent effects. These examples underscore the dual therapeutic and preventive potential of medicinal plants. In Burkina Faso, where universal health coverage is far from achieved (WHO 2015), medicinal plants remain the cornerstone of healthcare for both rural and urban populations (WHO 2013). Rural communities, often with limited access to health facilities and costly pharmaceuticals, rely almost entirely on locally available plants and on knowledge passed orally through generations, often mediated by traditional healers. In contrast, urban populations have better access to biomedical care and frequently combine plant-based remedies with modern drugs, though knowledge of medicinal flora tends to be less extensive and increasingly dependent on market-supplied preparations (N'do *et al*. 2024). Previous ethnobotanical studies in Burkina Faso and across West Africa highlighted this enduring reliance on medicinal plants. In Burkina Faso, Jansen *et al*. (2010) reported strong antiplasmodial activity in *Dicoma tomentosa* Cass. (Asteraceae) and *Psorospermum senegalense* Spach (Clusiaceae), while Ouattara *et al*. (2014) identified *Combretum fragrans* F. Hoffm. and *Combretum collinum* Fresen as promising species for further pharmacological studies. Similar findings have been documented in neighboring countries: *Argemone mexicana* L. decoctions are widely used in Mali (Keïta *et al*. 2020), and in Nigeria common remedies include *Mangifera indica* L., *Enantia chlorantha* Oliv., *Alstonia boonei* De Wild., *C. citratus*, and *Nauclea latifolia* Sm. (Evbuomwan *et al*. 2023). These studies underscore both the therapeutic potential of indigenous plants and the regional diversity of traditional phytotherapeutic practices. They further draw attention to the growing threat of knowledge erosion, a phenomenon particularly pronounced in rapidly urbanizing contexts. Against this backdrop, this study aimed to document medicinal plants used against malaria and mosquitoes in four localities of Burkina Faso, and to compare knowledge across regions and localities in order to assess the influence of ecological and cultural factors on traditional practices. By documenting and analyzing ethnobotanical knowledge, this work seeks to identify species with antimalarial and mosquito-repellent properties, provide a foundation for pharmacological research, and contribute to the scientific valorization of traditional practices within malaria management strategies.

Materials and Methods

Study area

This study was conducted in four localities distributed across two climatic zones of Burkina Faso: three in the Sudanian zone (Hauts-Bassins region) and one in the Sudano-Sahelian zone (Centre region), located in the western part of the African continent (Fig. 1). The sites include Bobo-Dioulasso and Ouagadougou, representing urban areas, and Nasso and Matourkou, representing rural localities within the Hauts-Bassins region (9°–11°30′ N) and the Centre region (11°30′–14° N), respectively

(Fig. 1). In the selected regions, the climate is tropical with a dry season (from October to April) and a rainy season (from May to September) (Fontès & Guinko 1995). According to the Köppen–Geiger climate classification (Peel *et al*. 2007), the study area encompasses two main climate types: the tropical savanna climate (Aw) in the Sudanian zone and the hot semi-arid climate (BSh) in the Sudano-Sahelian zone. These climates are characterized by a distinct rainy season and a long dry season. The mean annual rainfall currently varies between approximately 600 and 900 mm in the Sudano-Sahelian zone and between 900 and 1,000 mm in the Sudanian zone (Zampaligré *et al*. 2014) (Fig. 1). The vegetation of the South Sudanian zone consists of a mosaic of savanna, dry forest, and patches of gallery forests (Sambaré *et al*. 2011)and is marked by Sudanian and Guinean species, whereas the Sudano-Sahelian zone is dominated by savanna with annual grasses, trees, and shrubs (Fontès & Guinko 1995, Sambaré *et al*. 2011). Malaria is endemic in these two regions, with a long seasonal transmission zone lasting four to six months corresponding to the Sudano-Sahelian part of the country, and a permanent transmission zone characterized by an increase during the rainy season corresponding to the Sudanian part (Sangaré *et al*. 2022).

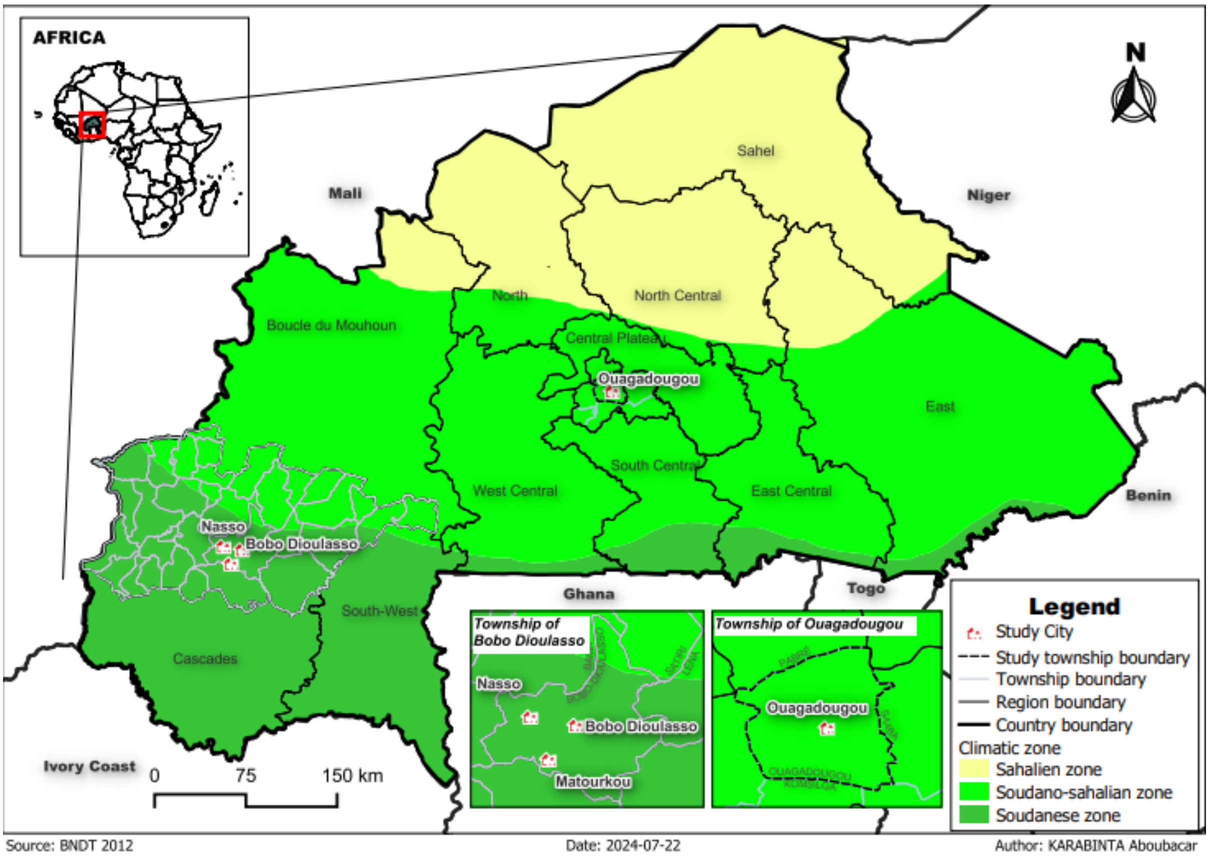

Figure 1. Map of the study areas indicating southern and northern Sudanese zones in Burkina Faso

Data collection

Data were gathered between September and November 2022 through interviews with a total of 159 participants: 63 in Bobo-Dioulasso, 32 in Nasso, 35 in Matourkou, and 29 in Ouagadougou. The observed imbalance in participant distribution across the study areas may be attributed to the reluctance of practitioners in the Sudano-Sahelian zone to take part in the study. Participants included both traditional healers and herbalists. Traditional healers diagnose and treat illnesses using plant-based remedies and ancestral knowledge, whereas herbalists primarily engage in the collection, preparation, and sale of medicinal plants. However, in areas with limited access to modern healthcare, herbalists may also assist in diagnosing ailments and advising patients, thereby complementing the role of traditional healers in community healthcare systems. Semi-structured interviews were conducted in French, Dioula, and Mooré, using open-ended questions. The discussions focused on six key aspects: (i) traditional practitioners' and herbalists' knowledge of malaria symptoms and antimalarial plants; (ii) knowledge of mosquito-repellent plants; (iii) local plant names and parts used; (iv) preparation methods; (v) modes of administration; and (vi) availability of species in the study areas. The availability of each plant species was determined based on participants' reports and field observations. Practitioners indicated whether species were abundant, scarce, or absent in their locality. This method provided insights into local ecological distribution and accessibility, reflecting both environmental conditions and cultural familiarity with each species.

Plant identification

The identification of medicinal plants was conducted using a rigorous methodology to ensure data reliability. First, the vernacular names reported by participants were recorded. Each plant was then compared with reference images from our verified medicinal plant database, which compiles photographs and botanical information validated by experts based on prior studies of Burkina Faso's medicinal flora. To further confirm identification, consultations were conducted with a botanist from the Université Nazi BONI herbarium (Bobo-Dioulasso, Burkina Faso), following the procedures described by Thiombiano *et al*. (2012). It should be noted that vernacular names may vary between practitioners and across regions, which could introduce identification bias. However, the combination of a verified database and expert botanical validation minimizes this risk and ensures a high level of confidence in the species identification.

Data Analysis

Survey data were entered in Excel 2016 and analyzed using R (v.4.2.1) to assess regional (Hauts-Bassins vs. Centre) and local (Bobo-Dioulasso, Nasso, Matourkou, Ouagadougou) variations in medicinal plant knowledge and use. Chi-square tests evaluated whether differences in citation frequencies were statistically significant ($p < 0.05$), highlighting patterns of local or regional preference. Citation frequency (FC) for each species was calculated as: $FC = Nc/ Nt \times 100$ where Nc represents the number of citations for a given plant and Nt the total number of traditional healers interviewed in the considered region or locality. This index identified the most commonly used or representative species at each site. Confirmatory Factor Analysis (CFA) was employed to explore the structure of ethnobotanical knowledge across regions. This multivariate approach allowed visualization of species clusters by agro-climatic zone, statistical confirmation of species-locality associations, and identification of "discriminant" species characteristic of specific regions or widely shared across sites. Together, these analyses quantified usage patterns and revealed the underlying structure of traditional medicinal plant knowledge.

Ethical considerations

This study was approved by the Ministère de la Santé et de Hygiène Publique (N°2022/O210/MSHP/ RHBS/DRSHP). Free, written and informed consent was obtained from each traditional practitioner before the start of the study. Confidentiality of participants and data was maintained throughout the study.

Results

Socio-demographic profile of traditional healers and herbalists

The socio-demographic characteristics of participants are summarized in Table 1. The majority of respondents were illiterate (59%), while the remainder reported varying levels of formal education. Across the four study localities, healers belonged to seven main ethnic groups: Bôbô (predominant in the Hauts-Bassins), Mossi (dominant in the Centre), as well as Dioula, Dafing, Gourounsi, Senoufo, and San. Participants ranged in age from 18 to 100 years, reflecting a wide generational span. Their professional experience in traditional medicine varied from 1 to 85 years, with all respondents having practiced for at least one year. Among them, 53 healers (33%) reported being affiliated with a traditional healers' association.

Table 1. Socio-demographic data of the traditional healers interviewed in four localities

Characteristics	**Percentage (%)**
Ethnicity	
Bôbô	0.44
Mossi	0.30
Dioula	0.05
Senoufo	0.006
Dafing	0.04
San	0.01
Gourounssi	0.07
Others	0.08
Age classes	
Youngs (18-38 years)	0.22
Adults (39-59 years)	0.50
Olds (≥ 60 years)	0 .28
Gender	
Men	0.44
Women	0.60

Education level of the traditional healers	
Illiterate	0.58
Primary	0.31
Secondary	0.09
Superior	0.01
Experience as healer (years)	
1 to 20	0.64
21 to 40	0.26
41 to 60	0.09
Above 60	0.01
Member of the traditional healers' association	
Yes	0.34
No	0.66
Healer of malaria	
Yes	1
No	0
Knowledge of plants used as mosquito repellent	
Yes	0.40
No	0.60

Antiplasmodial plants

This section presents traditional knowledge on plants used for the treatment of malaria. It details the most frequently cited species by traditional healers and herbalists, their citation frequencies, the plant parts used, preparation methods, and routes of administration, while highlighting regional and local differences. This overview provides a comprehensive understanding of the structuring and dissemination of ethnobotanical knowledge related to malaria treatment.

Medicinal plants used against malaria

Across the four surveyed localities, 83 plant species belonging to 35 families were documented for traditional malaria treatment (Fig. S1, Table 2). Statistical analysis revealed highly significant differences (P < 0.0001) in citation frequencies among species and families**,** indicating that certain plants and families are much more frequently used by traditional healers than others. In particular, the three most frequently cited species were *Terminalia leiocarpa* (18.2 %), *Sarcocephalus latifolius* (17.6 %), and *Cochlospermum planchonii* (16.98 %), reported in all localities and climatic zones, highlighting their central role in Burkina Faso's traditional malaria pharmacopoeia. At the family level, Fabaceae was the most represented (36.14 %), followed by Combretaceae (20.48 %) and Rubiaceae (19.27 %). The predominance of Fabaceae was observed in all localities: 17.46 % in Bobo-Dioulasso, 22.85 % in Matourkou, 18.75 % in Nasso, and 17.24 % in Ouagadougou.

Medicinal plants used against malaria according to two regions

In total, 80 medicinal plant species were recorded in the Hauts-Bassins region (Bobo-Dioulasso, Nasso, and Matourkou) compared to 20 species in the Central region (Ouagadougou). The distribution of plant citations differed significantly between the two climatic zones (P < 0.0001). As illustrated in Fig. S2, the most frequently cited antimalarial species in the Hauts-Bassins were *T. leiocarpa* (21.53%) and *S. latifolius* (20.76%). In contrast, the Central region was characterized by the predominant use of *C. planchonii* (48.27%), followed by *Carica papaya* L. (10.34%), *Senegalia macrostachya* (Rchb. Ex DC.) Kyal. & Boatwr (10.34%), and *Cassia nigricans* Vahl (10.34%). These findings highlight clear regional differences in species preference, likely reflecting both ecological availability and cultural practices.

Medicinal plants used against malaria according to four localities

Statistical analysis revealed a significant variation in plant use between the four study sites (P < 0.0001). Overall, 63 species were recorded in Bobo-Dioulasso, 37 in Nasso, 33 in Matourkou, and 20 in Ouagadougou (Fig. 2). In Bobo-Dioulasso, the most frequently cited species were *S. latifolius* (23.8%), *Guiera senegalensis* J.F. Gmel. (19.0%), and *T. leiocarpa* (17.5%). In Nasso, plant use was strongly dominated by *Mitragyna inermis* (Willd.) Kuntze (43.8%), followed by *T. leiocarpa* (40.6%) and *Combretum micranthum* G.Don (34.4%). In Matourkou, *S. latifolius* (25.7%) remained the most cited species, while *Citrus limon* (L.), *Senna siamea* (Lam.) H.S. Irwin & Barneby, *Psidium guajava* L., and *Keetia venosa* (Oliv.) Bridson were equally represented (22.9% each). In Ouagadougou, *C. planchonii* dominated (48.3%), whereas *C. papaya*, *S. macrostachya*, and *C. nigricans* were cited less frequently (10.3% each). These patterns illustrate clear local differences in species preference, reflecting the combined effects of ecological availability, cultural traditions, and healer practices.

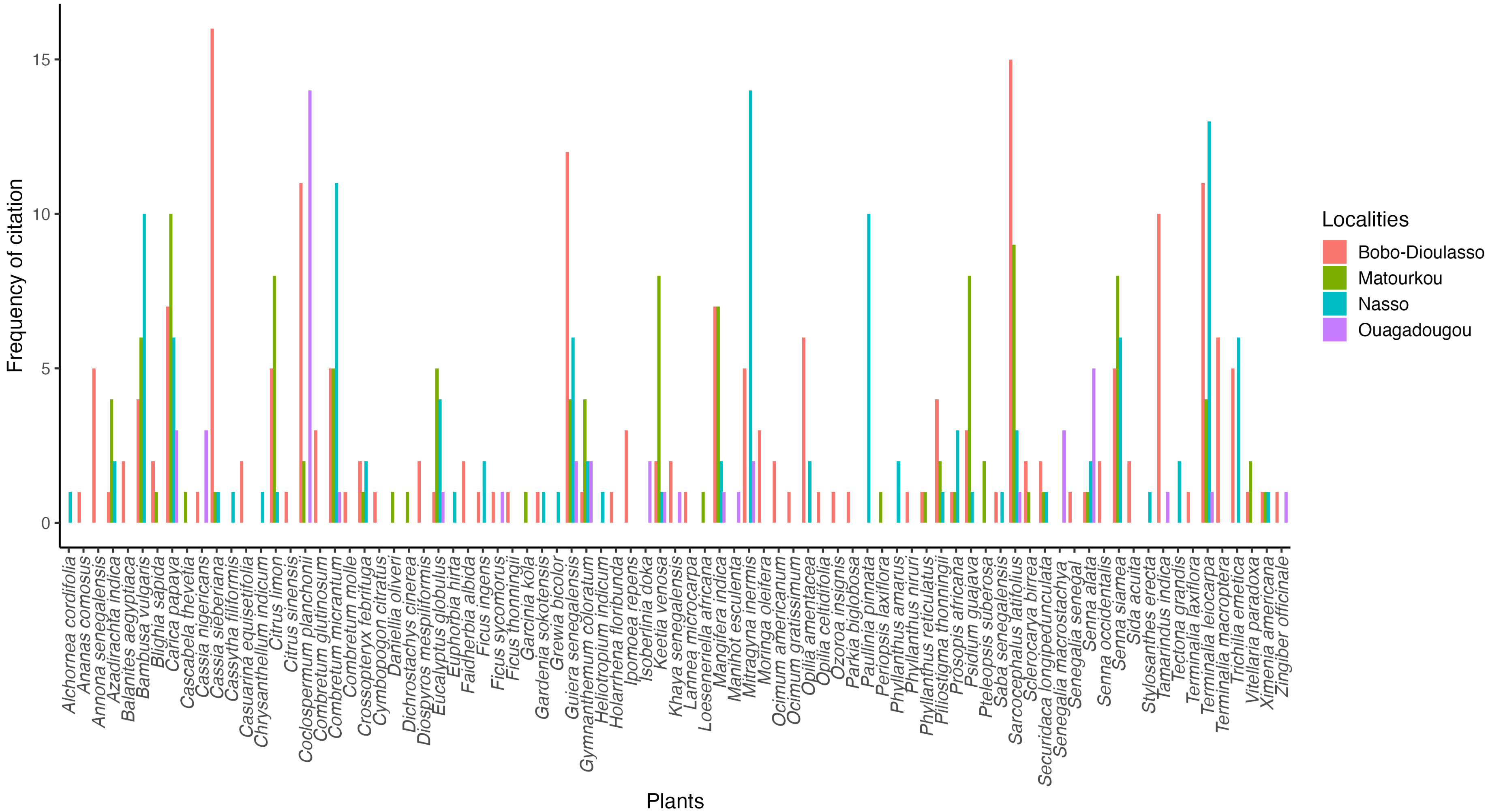

Figure 2. Distribution of plant species according to their number of citations in the four localities

Table 2. Identified medicinal plants used to treat malaria in the studied localities combined (D = Dioula, M = Mooré, F = French)

Families and Scientific name	Vernacular name	Biological type	Parts used	Preparation method	Method of use	Availability	Total citation Frequency
Euphorbiaceae							
Alchornea cordifolia (Schum. & Thonn.) Müll. Arg.	**Djéka** (F) **Koyiran Boulou** (D)	Shrub	Leaves	Decoction	Oral administration, Bath	Average	0.6
Bromeliaceae							
Ananas comosus (L.) Merr.	**Ananas** (F)	Herbaceous	Leaves	Decoction	Oral administration, Bath	Abundant	0.6
Annonaceae							
Annona senegalensis Pers.	**Barkoudouga** (M) **Mandessoussou** (D)	Tree	Leaves	Decoction	Oral administration, Bath, Inhalation	Abundant	3.1
Meliaceae							
Azadirachta indica A.Juss.	**Neem** (F)	Tree	Leaves	Decoction	Oral administration, Bath	Abundant	4.4
Zygophyllaceae							
Balanites aegyptiaca (L.) Delile	**Zèguènèyiri** (D)	Shrub	Roots	Decoction	Oral administration, Bath	Abundant	1.2
Poaceae							
Bambusa vulgaris Schrad. ex J.C. Wendl.	**Bobourouyiri** (D)	Herbaceous	Leaves	Decoction Maceration	Oral administration, Bath	Average	12.5
Sapindaceae							
Blighia sapida K.D.Koenig	**Toubaboufissanyiri** (D)	Tree	Leaves	Decoction	Oral administration, Bath	Abundant	1.8
Caricaceae							
Carica papaya L.	**Papayier** (F)	Tree	Leaves	Maceration, Decoction	Oral administration, Bath	Abundant	16
Apocynaceae							
Cascabela thevetia (L.) Lippold	**Petit avocat** (F)	Shrub	Leaves, Seeds	Decoction	Oral administration, Bath	Abundant	0.6
Fabaceae							

Cassia nigricans Vahl	**Dougouman djalan** (D)	Herbaceous	Leaves	Decoction, Infusion	Oral administration	Abundant	2.5
Cassia sieberiana DC.	**Sindjan** (D)	Shrub	Leaves, Roots	Decoction, Infusion	Oral administration, Bath	Abundant	11.3
Lauraceae							
Cassytha filiformis L.	**Alla-djon** (D)	Herbaceous	Leaves	Decoction	Oral administration, Bath	Abundant	0.6
Casuarinaceae							
Casuarina equisetifolia L.	**Filaho** (F)	Tree	Leaves	Decoction	Oral administration, Bath	Abundant	1.2
Asteraceae							
Chrysanthellum indicum DC.	**Mon père café** (F)	Herbaceous	Leaves	Decoction	Oral administration, Bath	Abundant	0.6
Rutaceae							
Citrus limon (L.) Burm. f.	**Lebouroucoumouyiri** (D)	Shrub	Leaves	Decoction	Oral administration, Bath	Abundant	8.8
Citrus sinensis (L.)	**Lebouroubayiri** (D)	Shrub	Leaves	Decoction	Oral administration, Bath	Abundant	0.6
Cochlospermaceae							
Cochlospermum planchonii Hook.f. ex Planch.	**N'dribala/ Sossa** (D)	Shrub	Roots, Leaves	Decoction Infusion Maceration	Oral administration, Bath	Abundant	16.98
Combretaceae							
Combretum glutinosum Perr. ex DC.	**Djadjona** (D)	Shrub	Leaves	Decoction	Oral administration, Bath	Abundant	1.8
Combretum micranthum G.Don	**Faux kekeliba** (F) **N'golobgè** (D)	Shrub	Leaves	Decoction	Oral administration, Bath	Abundant	13.8
Combretum molle R. Br. ex G.Don	**Uaniaka** (D)	Shrub	Leaves	Decoction	Oral administration, Bath	Abundant	0.6
Rubiaceae							
Crossopteryx febrifuga (Afzel. ex G.Don) Benth.	**Kongodoun/ Baboyiri** (D)	Shrub	Leaves	Decoction	Oral administration, Bath	Abundant	3.1

Poaceae							
Cymbopogon citratus (DC.) Stapf	**Citronnelle** (F)	Herbaceous	Leaves	Infusion, Decoction	Oral administration	Abundant	0.6
Fabaceae							
Daniellia oliveri (Rolfe) Hutch. & Dalziel	**Sanagué** (D)	Tree	Leaves, Roots	Decoction, maceration	Oral administration, Bath	Abundant	0.6
Dichrostachys cinerea (L.) Wight & Arn.	**Triqui** (D)	Shrub	Roots	Infusion	Oral administration	Abundant	0.6
Ebenaceae							
Diospyros mespiliformis Hochst. ex A.DC.	**Sounsoun fing** (D)	Tree	Leaves	Decoction	Oral administration, Bath	Abundant	1.2
Myrtaceae							
Eucalyptus globulus Labill.	**Gommier** (F)	Tree	Leaves	Decoction	Oral administration, Bath, Inhalation	Abundant	6.9
Euphorbiaceae							
Euphorbia hirta L.	**Tougani sindji** (D)	Herbaceous	Leaves	Decoction	Oral administration, Bath	Abundant	0.6
Fabaceae							
Faidherbia albida (Delile) A.Chev.	**Woniguè / Zâanga** (D)	Tree	Leaves	Decoction	Oral administration, Bath	Average	1.2
Moraceae							
Ficus ingens (Miq.) Miq.	**Djatiguifagayiri** (D)	Shrub	Leaves	Decoction	Oral administration, Bath	Average	1.8
Ficus sycomorus L.	**Tolo yiri** (D)	Tree	Leaves Roots	Decoction	Oral administration, Bath	Average	1.2
Ficus thonningii Blume	**Doubalé** (D)	Tree	Leaves	Decoction	Oral administration, Bath	Abundant	0.6
Clusiaceae							

Garcinia kola Heckel	**Petit cola** (F)	Tree	Leaves Seeds	Decoction	Oral administration, Bath	Abundant	0.6
Rubiaceae							
Gardenia sokotensis Hutch.	**Toukonongré** (D)	Shrub	Leaves	Decoction	Oral administration, Bath	Abundant	1.2
Malvaceae							
Grewia bicolor Juss.	**Nogo-die** (D)	Shrub	Roots	Decoction	Oral administration, Bath	Abundant	0.6
Combretaceae							
Guiera senegalensis J.F. Gmel.	**Koungouè** (D)	Shrub	Leaves	Decoction	Oral administration, Bath, Fumigation	Abundant	15
Asteraceae							
Gymnanthemum coloratum (Willd.) H.Rob. & B.Kahn	**Kossafina** (D)	Shrub	Leaves	Decoction, maceration	Oral administration, Bath	Abundant	5.6
Boraginaceae							
Heliotropium indicum L.	**Nongossikou** (D)	Herbaceous	Leaves	Decoction	Oral administration, Bath	Abundant	0.6
Apocynaceae							
Holarrhena floribunda (G.Don) T. Durand & Schinz	**Yaabraogo** (M)	Shrub	Leaves	Decoction	Oral administration, Bath	Average	0.6
Convolvulaceae							
Ipomoea repens Lam.	**Forogofaraka** (D)	Herbaceous	Leaves	Decoction	Oral administration, Bath	Average	1.8
Fabaceae							
Isoberlinia doka Craib & Stapf ex Holland	**Kasalka** (M)	Tree	Leaves	Decoction, maceration, infusion	Oral administration, Bath	Abundant	1.2
Rubiaceae							
Keetia venosa (Oliv.) Bridson	**Ladji fofana** (D)	Shrub	Leaves, Roots	Decoction	Oral administration, Bath, Inhalation	Abundant	7.5
Meliaceae							

Khaya senegalensis (Desr.) A. Juss.	**Djala yiri** (D)	Tree	Barks, Roots	Maceration	Oral administration	Abundant	1.8
Anacardiaceae							
Lannea microcarpa Engl. & K.Krause	**Pecouyiri** (D)	Tree	Barks	Decoction	Oral administration, Bath	Abundant	0.6
Celastraceae							
Loeseneriella africana (Willd.) R. Wilczek	**Zibri** (M)	Shrub	Leaves	Decoction	Oral administration, Bath	Average	0.6
Anacardiaceae							
Mangifera indica L.	**Manguier** (F)	Tree	Barks, Leaves	Decoction	Oral administration, Bath, Inhalation	Abundant	10
Euphorbiaceae							
Manihot esculenta Crantz	**Manioc** (F)	Shrub	Leaves	Decoction	Oral administration, Bath	Average	0.6
Rubiaceae							
Mitragyna inermis (Willd.) Kuntze	**Yilga (M) / Djun** (D)	Shrub	Leaves	Decoction	Oral administration, Bath	Abundant	13.2
Moringaceae							
Moringa oleifera Lam.	**Aldjanayiri** (D)	Tree	Leaves	Decoction	Oral administration, Bath	Abundant	1.8
Lamiaceae							
Ocimum americanum L.	**Basilic** (F) **/ Soukonan** (D)	Herbaceous	Leaves	Decoction	Oral administration, Bath	Abundant	1.2
Ocimum gratissimum L.	**Soukonanba** (D)	Herbaceous	Leaves	Decoction	Oral administration, Bath	Abundant	0.6
Opiliaceae							
Opilia amentacea Roxb.	**Naimbochi** (D)	Shrub	Leaves	Decoction	Oral administration, Bath	Abundant	5
Opilia celtidifolia (Guill. & Perr.) Endl. ex Walp.	**Wagasalga** (M)	Shrub	Leaves	Decoction	Oral administration, Bath	Abundant	0.6
Anacardiaceae							

Ozoroa insignis Delile	**Nebnoya** (M)	Shrub	Leaves, Roots	Decoction	Oral administration, Bath, Inhalation	Abundant	0.6
Fabaceae							
Parkia biglobosa (Jacq.) R. Br. ex G.Don	**Néré** (D)	Tree	Leaves	Decoction	Oral administration, Bath	Abundant	0.6
Sapindaceae							
Paullinia pinnata L.	**Djaranonfon** (D)	Tree	Leaves	Decoction	Oral administration, Bath	Average	6.3
Fabaceae							
Pericopsis laxiflora (Benth. ex Baker) Meeuwen	**Kotokoroyiri** (D)	Tree	Leaves, Roots	Decoction	Oral administration, Bath, Inhalation	Average	0.6
Phyllanthaceae							
Phyllanthus amarus Schumach. & Thonn.	**Débanbou** (D)	Herbaceous	Leaves	Decoction	Oral administration, Bath	Average	1.2
Phyllanthus niruri L.	**Garga** (M)	Herbaceous	Leaves	Decoction	Oral administration, Bath	Average	0.6
Phyllanthus reticulatus Poir.	**Balanbalan** (D)	Shrub	Flowers Leaves	Decoction	Oral administration	Average	1.2
Fabaceae							
Piliostigma thonningii (Schumach.) Milne-Redh	**Faroyiri** (D) **/Bâguin-râaga** (M)	Tree	Leaves	Decoction	Oral administration, Bath	Abundant	4.4
Prosopis africana (Guill. & Perr.) Taub.	**Gbéré** (D) **Seinga** (M)	Tree	Leaves	Decoction maceration	Oral administration, Inhalation	Abundant	3.1
Myrtaceae							
Psidium guajava L.	**Goyavier** (F)	Shrub	Leaves	Infusion, Decoction	Oral administration	Abundant	7.5
Combretaceae							
Pteleopsis suberosa Engl. & Diels	**Gnondéyiri** (D)	Shrub	Stems	Decoction	Oral administration	Abundant	1.2
Apocynaceae							

Saba senegalensis (A. DC.) Pichon	**Zamba yiri** (D)	Shrub	Leaves	Decoction	Oral administration, Bath	Abundant	1.2
Rubiaceae							
Sarcocephalus latifolius (Sm.) E.A. Bruce	**Gwîinga** (M)/ **Bati** (D)	Shrub	Leaves, Roots	Decoction	Oral administration, Bath	Abundant	17.6
Anacardiaceae							
Sclerocarya birrea (A. Rich.) Hochst.	**Noobga** (M)	Tree	Barks	Decoction	Oral administration, Bath	Abundant	1.8
Polygalaceae							
Securidaca longepedunculata Fresen.	**Saflayiri /Djoro** (D)	Shrub	Leaves, Roots	Decoction, maceration	Oral administration, Bath, Inhalation	Abundant	2.5
Fabaceae							
Senegalia macrostachya (Rchb. Ex DC.) Kyal. & Boatwr.	**Zamnin** (D) **Zâmanega** (M)	Shrub	Leaves	Infusion	Oral administration	Average	1.88
Senegalia senegal (L.) Britton	**Wani gouè** (D)	Shrub	Leaves	Decoction	Oral administration	Abundant	0.6
Senna alata L. Roxb.	**Kôtaba** (M)	Shrub	Flowers, Leaves	Decoction	Oral administration, Bath	Abundant	5.6
Senna occidentalis (L.) Link	**Lohomaba** (D)	Herbaceous	Leaves	Decoction	Oral administration, Bath	Abundant	1.2
Senna siamea (Lam.) H.S. Irwin & Barneby.	**Cassia du Siam** (F)	Tree	Flowers, Leaves, Seeds	Decoction	Oral administration, Bath, Inhalation	Abundant	11.9
Malvaceae							
Sida acuta Burm.f.	**Tchèguanaflana** (D)	Herbaceous	Leaves	Decoction	Oral administration, Bath	Abundant	1.2
Fabaceae							
Stylosanthes erecta P.Beauv.	**Sissègni** (D)	Herbaceous	Leaves	Decoction	Oral administration, Bath	Average	0.6

Tamarindus indica L.	**Pousga** (M)	Tree	Leaves	Decoction	Oral administration, Bath	Abundant	6.9
Lamiaceae							
Tectona grandis L.f.	**Tèqueyiri** (D)	Tree	Leaves	Decoction	Oral administration, Bath	Abundant	1.2
Combretaceae							
Terminalia laxiflora Engl.	**Kondré** (M)	Tree	Leaves	Decoction	Oral administration, Bath	Abundant	0.6
Terminalia Leiocarpa (DC.) Baill.	**Kérêkêtêyiri** (D) **Siiga** (M)	Tree	Leaves	Decoction	Oral administration, Bath	Abundant	18.2
Terminalia macroptera Guill. & Perr.	**Wolon yiri** (D)	Tree	Roots	Decoction	Oral administration, Bath, Inhalation	Abundant	3.7
Meliaceae							
Trichilia emetica Vahl	**Soulafissan** (D)	Tree	Leaves, Roots	Decoction	Oral administration, Bath	Abundant	6.9
Sapotaceae							
Vitellaria paradoxa C. F. Gaertn.	**Chiyiri** (D) **Karité** (F)	Tree	Leaves	Infusion	Oral administration, Bath	Abundant	1.8
Olacaceae							
Ximenia americana L.	**N'donguè/ Minigoni** (D)	Shrub	Roots	Decoction	Oral administration, Bath	Abundant	1.8
Zingiberaceae							
Zingiber officinale Roscoe	**Gimgimbre** (F)	Herbaceous	Rhizome	Grind	Suppository	Abundant	1.2

Confirmatory factor analysis

The confirmatory factor analysis (CFA) clearly demonstrated that the medicinal plant knowledge varied significantly between localities and ecological zones (Fig. 3). In the Sudanian zone, the most characteristic and frequently cited species included *T. leiocarpa*, *C. papaya*, *Cassia sieberiana* DC., *C. limon*, *C. planchonii*, *C. micranthum*, *G. senegalensis*, *S. latifolius*, *M. indica*, *M. inermis* and *S. siamea.* By contrast, in the Sudano-Sahelian zone, the most representative species were *S. macrostachya*, *C. papaya*, *C. nigricans*, *C. planchonii*, *G. senegalensis*, *Isoberlinia doka* Craib & Stapf ex Holland and *Senna alata* L. Roxb. Notably, some species such as *C. planchonii*, *G. senegalensis*, and *M. inermis* were cited in both ecological zones, suggesting their broad adaptability and widespread recognition in traditional medicine across Burkina Faso.

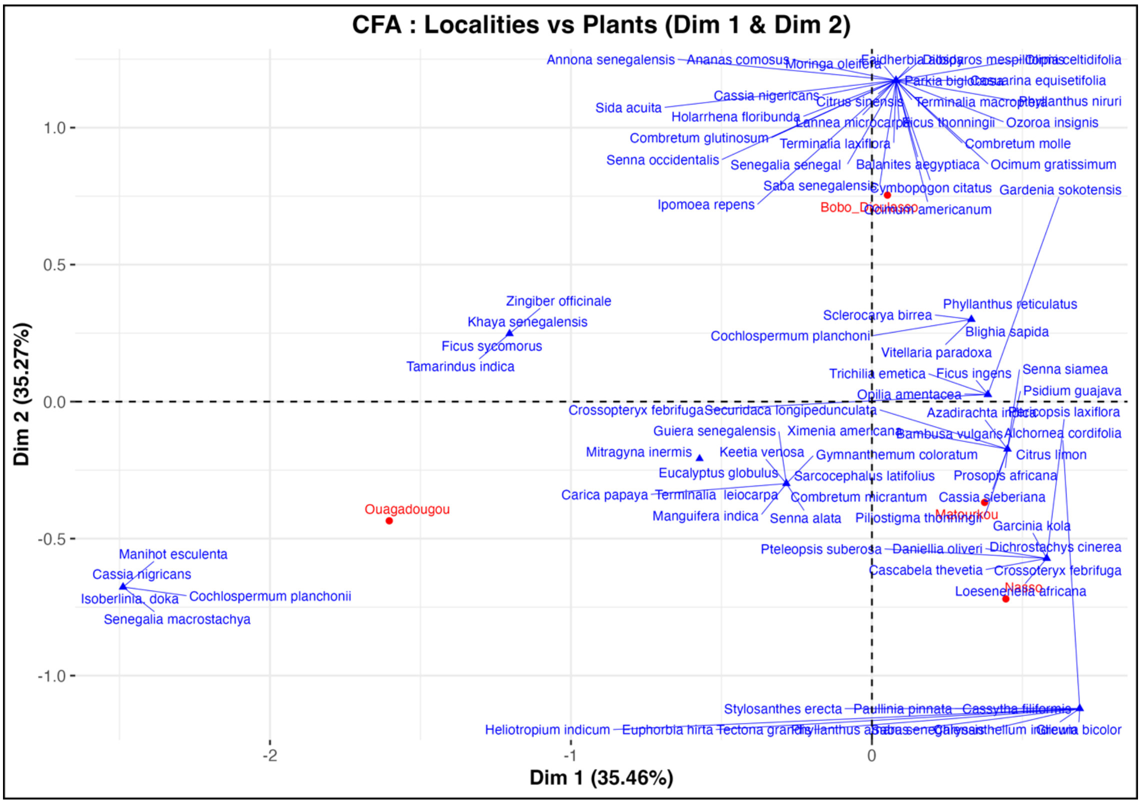

Figure 3. Confirmatory factor analysis (CFA) of different medicinal plants in two phytogeographical zones of Burkina Faso

Plant parts, method of preparation and administration of medicinal plant extracts

The plant parts used varied significantly between localities (P = 0.010; Fig. 4). Overall, leaves, roots, and barks were the predominant parts reported across the four sites. Leaves were the most frequently employed, particularly in Nasso (91%; P = 0.004), followed by Bobo-Dioulasso (67%; P = 0.0045), Matourkou (56%; P = 0.011), and Ouagadougou (57%; P = 0.017).

Regarding methods of preparation, four main techniques were cited by traditional practitioners: decoction, maceration, infusion, and grinding. Among these, decoction was overwhelmingly dominant in all localities, being reported by 90% of respondents in Bobo-Dioulasso, 98% in Nasso, 89% in Matourkou, and 56% in Ouagadougou (Fig. 5).

As for the routes of administration, five modes were identified: bathing, drinking, inhalation, purging, and suppositories. Oral administration by drinking was the most common across all sites, representing 51% in Bobo-Dioulasso, 50% in Nasso, 51% in Matourkou, and up to 70% in Ouagadougou (Fig. 6). Other practices, such as bathing or inhalation, were less frequently mentioned and tended to serve as complementary treatments.

Mosquito-Repellent plants

A total of 16 plant species with reported antivectorial properties were documented across the surveyed localities (Fig. 7), all traditionally employed for mosquito repellence (Table 3). Statistical analysis indicated that the frequency of citation did not differ significantly between species (P = 0.23). Among them, *Ocimum americanum* L. emerged as the most frequently reported repellent species. Its use was cited by 8.8% of healers in Bobo-Dioulasso, 8.17% in Matourkou, and 1.25% in Nasso, but it was not reported in Ouagadougou. Interestingly, in Ouagadougou the only plant recorded for repellent purposes was

Vitellaria paradoxa C.F. Gaertn., which was specifically mentioned for the use of its husks or roots in fumigation practices (Fig. 7).

The plant parts used as repellents varied significantly across species (P = 0.001). Overall, leaves and the whole aerial plant were the most frequently employed (Fig. 8A). In terms of preparation methods, the dominant practices were drying and grinding, which serve to preserve and concentrate volatile compounds with repellent properties (Fig. 8B). Regarding modes of application, these plants were mainly used through fumigation, by burning dried material to release aromatic smoke, and through tapping, which involved waving or tapping bundles of leaves or crushed material to diffuse odors and repel mosquitoes in the immediate environment (Fig. 8C).

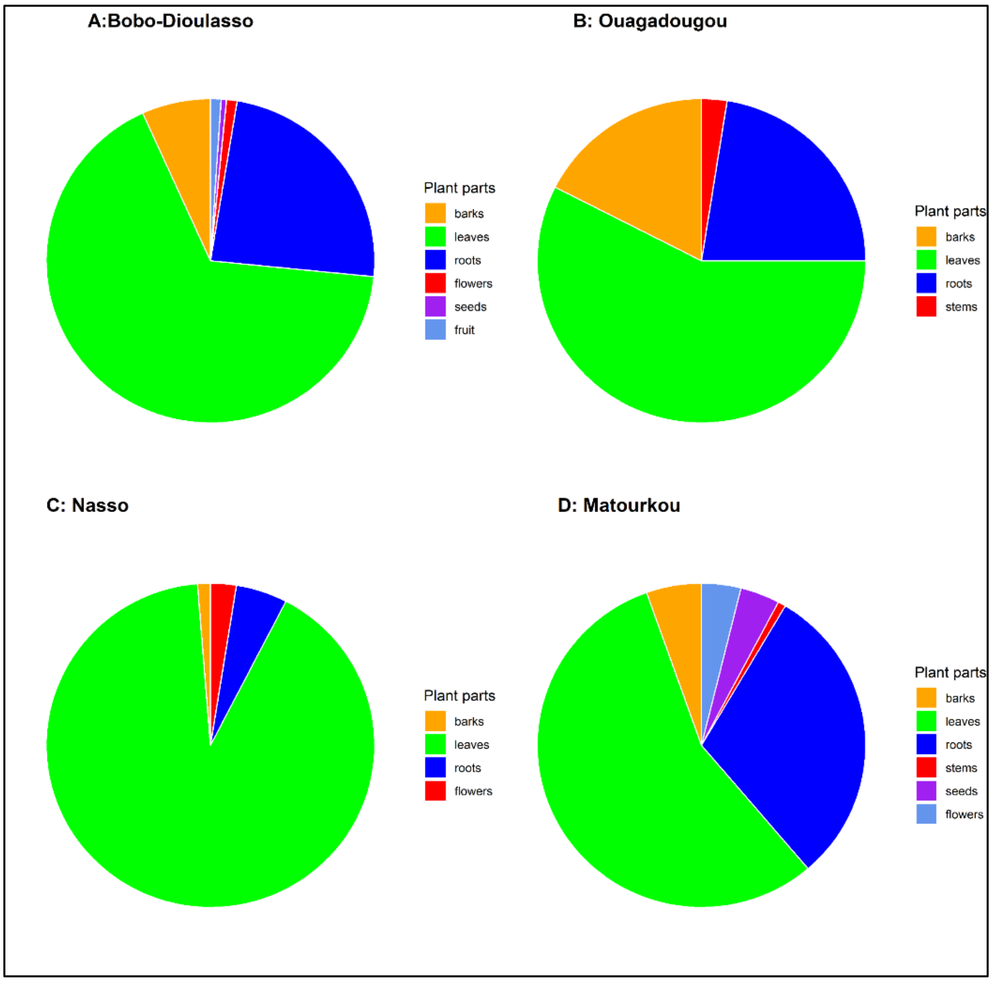

Figure 4. Parts of plants used by traditional healers for the treatment of malaria

Discussion

Medicinal plants remain a cornerstone of healthcare in Africa, particularly for the management of infectious diseases such as malaria. The emergence of drug resistance in *Plasmodium* spp. and insecticide resistance in *Anopheles* mosquitoes may increase community reliance on plant-based remedies and natural repellents, highlighting the importance of preserving and transmitting ethnobotanical knowledge. The sociodemographic profile of traditional healers shows a majority of practitioners in the Hauts-Bassins region, reflecting accessibility and recruitment strategy rather than the true practitioner density, as administrative data indicate a high concentration in the Centre region (INSD 2014, Ministry of Health 2024). Ethnic composition and education levels directly influence species selection, vernacular naming, and galenic forms (Ouattara *et al*. 2021; Ouoba *et al*. 2023). The predominance of women, particularly in the Centre, reflects urban dynamics and a gradual transfer of traditional knowledge to female practitioners (Yanogo & Nikiema 2023; Ouoba *et al*. 2023). Low association membership highlights structural and regulatory limitations in the traditional medicine sector (Ouoba *et al*. 2023). Antimalarial plant use shows marked variability across regions and localities. *Terminalia leiocarpa*, *Sarcocephalus latifolius*, and *Cochlospermum planchonii* are widely recognized, but their relative importance reflects both ecological availability and traditional knowledge. These patterns align with other West African observations, where local flora and cultural traditions guide therapeutic choices (Ncube *et al*. 2012; Mbuni *et al*. 2020). The predominance of Fabaceae, Combretaceae, and Rubiaceae families rich in bioactive compounds is consistent with regional ethnobotanical studies (Sanon *et al*. 2003; Bonkian *et al*. 2017). Environmental conditions strongly influence plant selection. *T. leiocarpa* and *S. latifolius* thrive in the wetter Sudanian zone, whereas *C. planchonii* is adapted to the drier Sudano-Sahelian zone, illustrating how local availability and ecological adaptation shape traditional practices (Jago *et al*. 2007; Denney *et al*. 2020). Confirmatory factor analysis suggests ecological structuring, with species clusters characteristic of each zone and a few versatile species present across multiple regions. These patterns may indicate that some species are ecologically specialized, while others possess traits enabling adaptation to diverse environments, which could contribute to their widespread use and prominent role in traditional pharmacopoeia. Plant parts used, preparation methods, and routes of administration are relatively consistent. Leaves are preferred due to ease of harvest and richness in active compounds, with decoction and oral administration being predominant. These practices correspond to patterns observed throughout Burkina Faso and neighboring countries, reflecting a long-standing adaptation balancing efficacy and sustainability (Nadembega *et al*. 2011; Kim *et al*. 2012). The use of roots for some species, such as *C. planchonii*, raises conservation concerns, underscoring the need for sustainable harvesting strategies. Repellent plants, treated separately in our study, show greater diversity in rural areas, with *Ocimum americanum* being the most cited, whereas urban areas rely mainly on *Vitellaria paradoxa*. Traditional preparation and application methods fumigation and tapping effectively exploit the aromatic properties of leaves and aerial parts, consistent with practices reported across sub-Saharan Africa (Kweka *et al*. 2008; Youmsi *et al*. 2017). Overall, these findings highlight the complex interplay between ecology, culture, and traditional knowledge in medicinal plant use. While certain species are widely recognized for their antimalarial or repellent properties, local availability, climate, and practitioner experience strongly influence which plants are prioritized. Integrating ecological, ethnobotanical, and conservation perspectives is essential to support sustainable use and the potential pharmacological development of these vital plant resources.

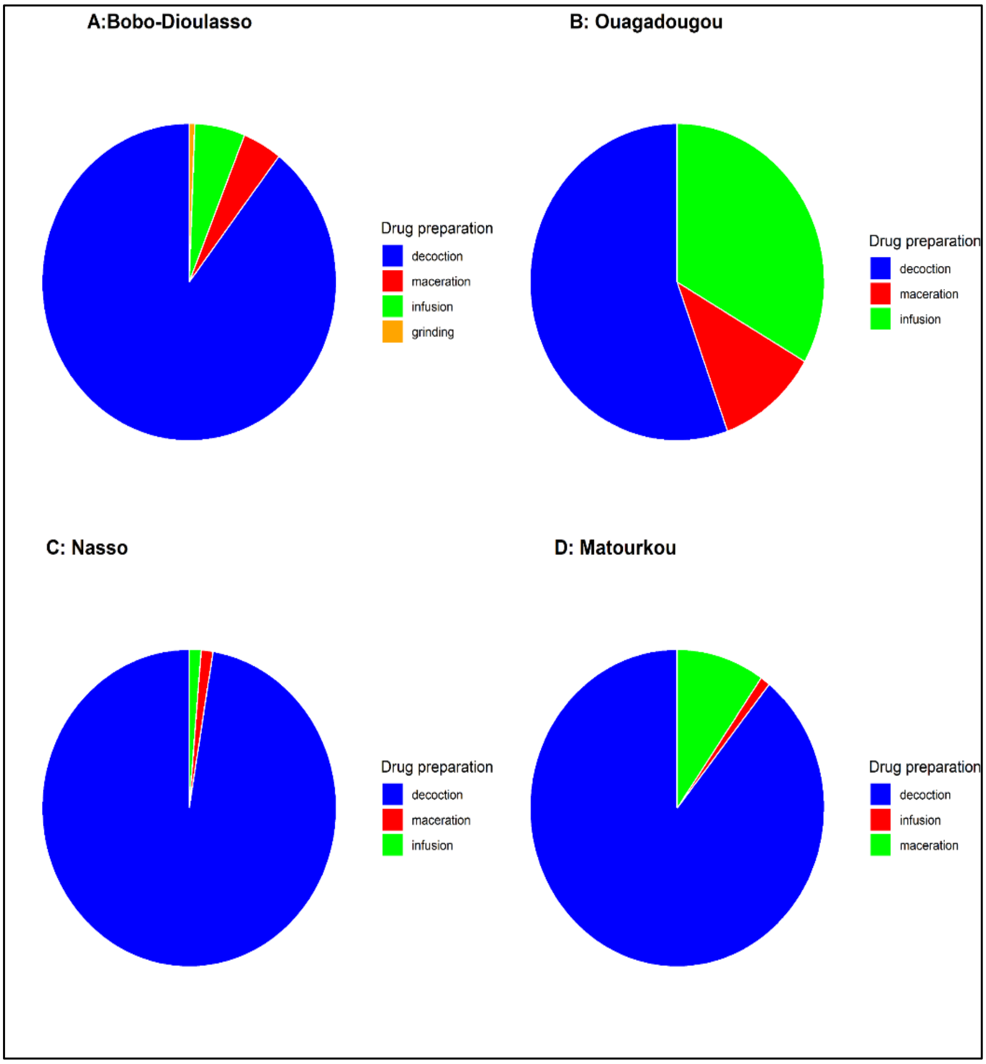

Figure 5. Method of drug preparation for the treatment of malaria

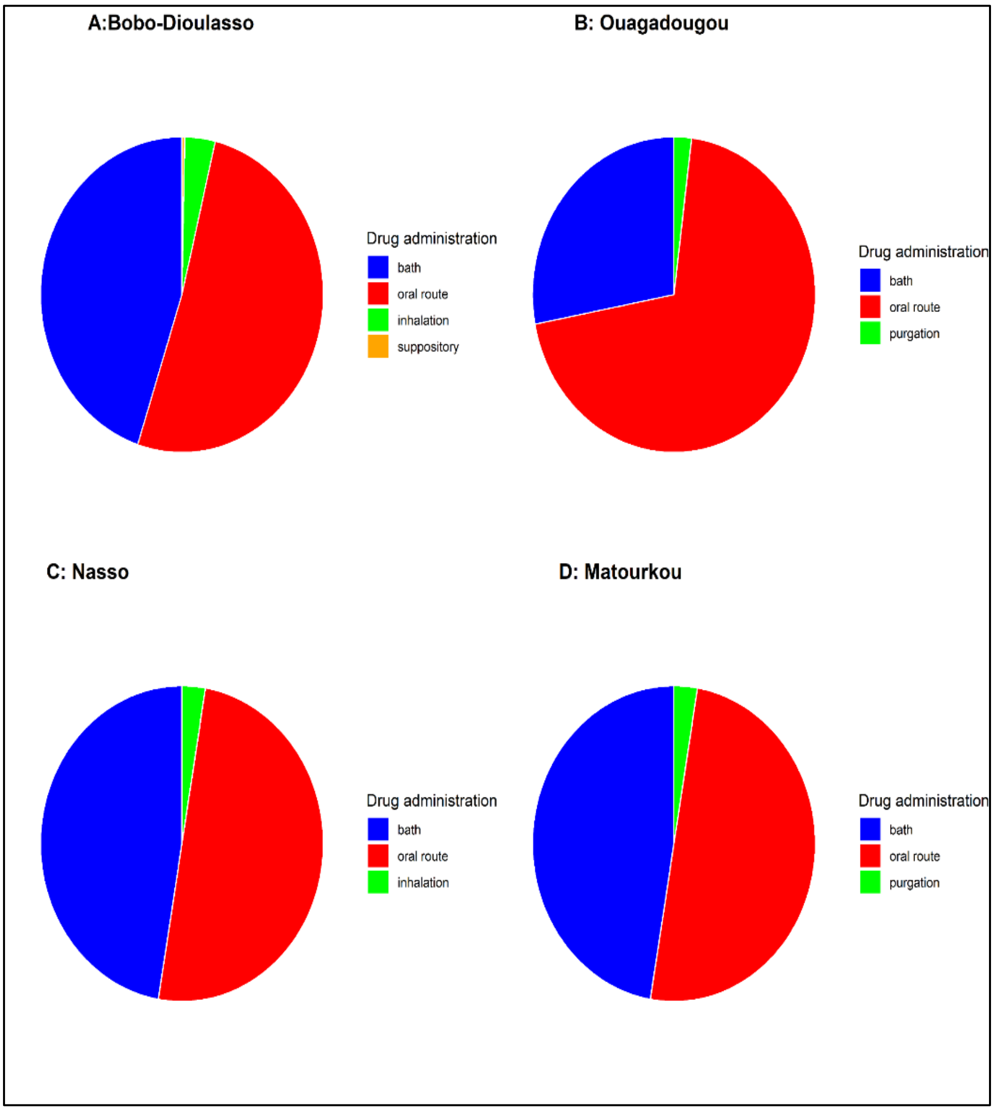

Figure 6. Method of administration of traditional antimalarial remedies

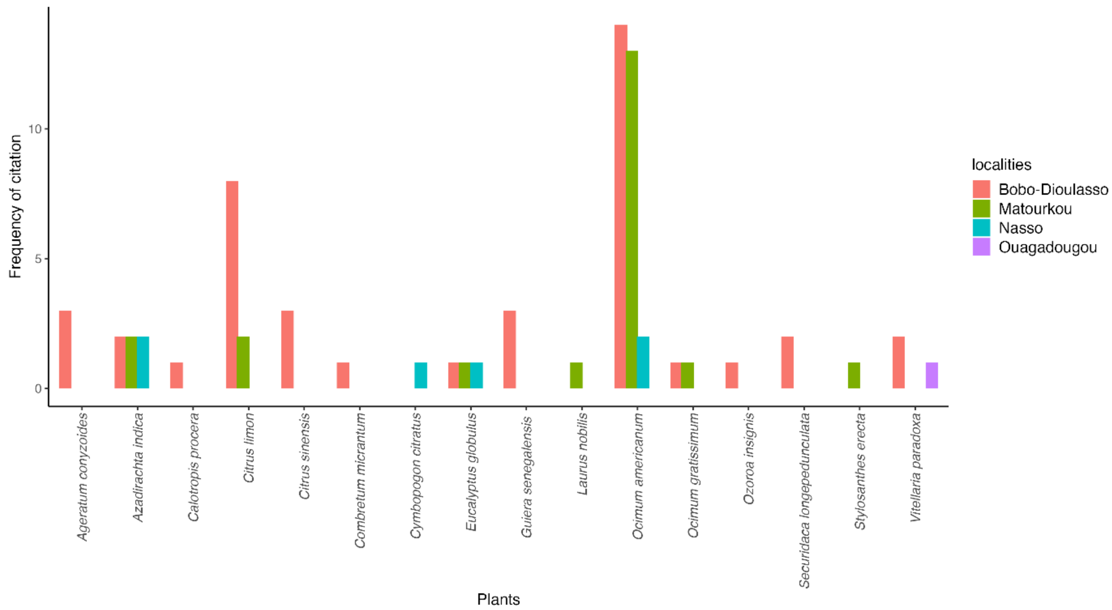

Figure 7. Distribution of mosquito repellent plant species

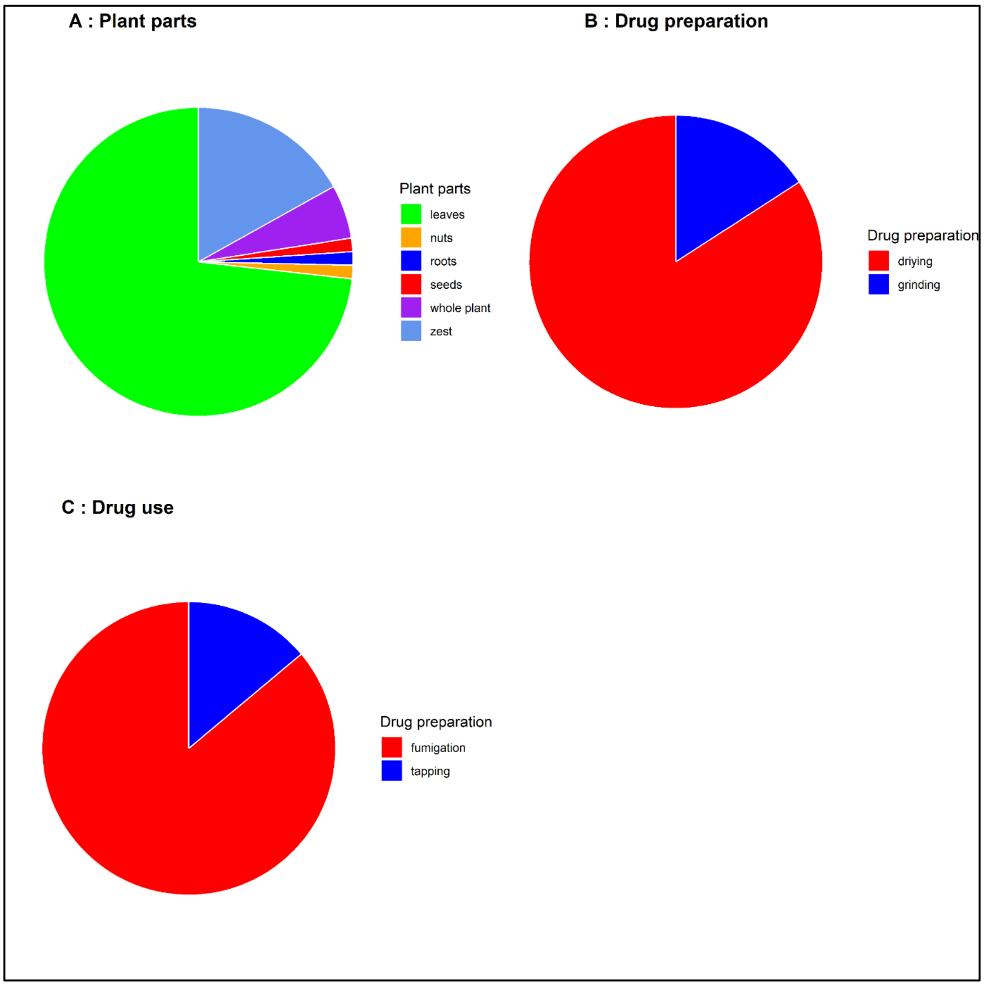

Figure 8. Parts of repellent plants used (A), method of preparation (B) and method of use (C)

Conclusion

In summary, the analysis of ethnobotanical practices highlights the richness and specificity of traditional knowledge related to malaria management in Burkina Faso. These practices, closely linked to local ecological and cultural contexts, provide an essential foundation for pharmacological research and the sustainable valorization of plant resources. This study presents a comprehensive inventory of medicinal plants used in the Hauts-Bassins and Central regions of Burkina Faso for malaria treatment and mosquito-repellent purposes. Although the survey aimed for the broadest possible coverage within the study areas, this list should be viewed as representative of local knowledge, which may vary across regions and participants. The findings confirm and strengthen the importance of these plants in traditional medicine for malaria management, with the Fabaceae family emerging as the most frequently cited. However, these data remain preliminary and warrant further exploration to better promote and valorize these species. Assessing their trophozoitocidal, schizonticidal, and transmission-blocking activities against malaria vector mosquitoes could open promising perspectives for the development of new, more effective control strategies. Medicinal plants thus represent a credible and complementary alternative in malaria management, particularly in addressing the growing resistance of *Plasmodium* to conventional antimalarial drugs.

Table 3. Medicinal plants used to repel mosquitoes (D = Dioula, M = Mooré, F = French)

Families and Scientific name	**Vernacular name**	**Growth form**	**Plant Parts**	**Use**	**Availability**	**Frequency**
Asteraceae						
Ageratum conyzoides L.	**Rõbré** (M) / **Noungou** (D)	Herbaceous	Leaves	Fumigation, Tapping	Abundant	1.88
Meliaceae						
Azadirachta indica A.Juss.	**Neem** (F)	Tree	Leaves, Roots	Fumigation	Abundant	3.77
Apocynaceae						
Calotropis procera (Aiton) W. T.Aiton	**Fogofoyiri** (D)	Shrub	whole plant	Tapping	Abundant	0.6
Rutaceae						
Citrus limon (L.) Burm. f.	**Lebouroucoumou** (D)	Shrub	Zeste	Fumigation	Abundant	6.28
Citrus sinensis (L.)	**Lebouroubayiri** (D)	Shrub	Zeste	Fumigation	Abundant	1.88
Combretaceae						
Combretum micranthum G.Don	**Faux kekeliba / N'golobgè** (D)	Shrub	Leaves	Fumigation	Abundant	0.6
Poaceae						
Cymbopogon citratus (DC.) Stapf	**Citronnelle** (F)	Herbaceous	Leaves	Fumigation	Abundant	0.6
Myrtaceae						
Eucalyptus globulus Labill.	**Gommier** (F)	Tree	Leaves	Fumigation	Abundant	1.88
Combretaceae						
Guiera senegalensis J.F. Gmel.	**Koungouè** (D)	Shrub	Leaves	Fumigation	Abundant	1.88
Lauraceae						
Laurus nobilis L.	**Laurier** (F)	Shrub	Leaves	Fumigation	Abundant	0.6
Lamiaceae						
Ocimum americanum L.	**Basilic** (F) / **Soukonan** (D)	Herbaceous	Leaves	Fumigation, Tapping	Abundant	19.98
Ocimum gratissimum L.	**Soukonanba** (D)	Herbaceous	Leaves	Fumigation, Tapping	Abundant	1.25
Anacardiaceae						
Ozoroa insignis Delile.	**Nebnoya** (M)	Shrub	Leaves	Fumigation	Average	0.6
Polygalaceae						
Securidaca longepedunculata Fresen.	**Saflayiri /Djoro** (D)	Shrub	Leaves	Fumigation	Abundant	1.25
Fabaceae						
Stylosanthes erecta P. Beauv.	**Sissègni** (D)	Herbaceous	Leaves	Fumigation	Average	0.6
Sapotaceae						
Vitellaria paradoxa C. F. Gaertn.	**Chiyiri** (D)	Tree	Seeds	Fumigation	Abundant	1.88

Declarations

List of abbreviations: ACTs - Artemisinin-based Combination Therapies; CFA - Confirmatory factor analysis; D – Dioula; Eos - Essential Oils; F – French; FC - Frequency of citations; INSD - Institut National de la Statistique et de la Démographie; M – Mooré; mg/kg - milligram by kilogram; Nc - Number of citations; Nt - total number of traditional healers; WHO - World Health Organization

Ethics approval and consent to participate: Informed consent was obtained verbally prior to the survey.

Consent for publication: Verbal consent was obtained from all the participants involved in this study.

Availability of data and materials: Not applicable

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Author contributions: M.Y., D.F.H., S.I.B. and O.G. conceived and performed the study. M.Y., S.I.B. and O.G. analyzed the data and wrote the main manuscript text. M.Y., S.I.B., D.F.H., P.S.L.P., T.L., K.R.D., K.B.K., N.T.R.M., R.S.Y. and O.G. review and wrote the paper. All authors read and approved the final manuscript.

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Appendix

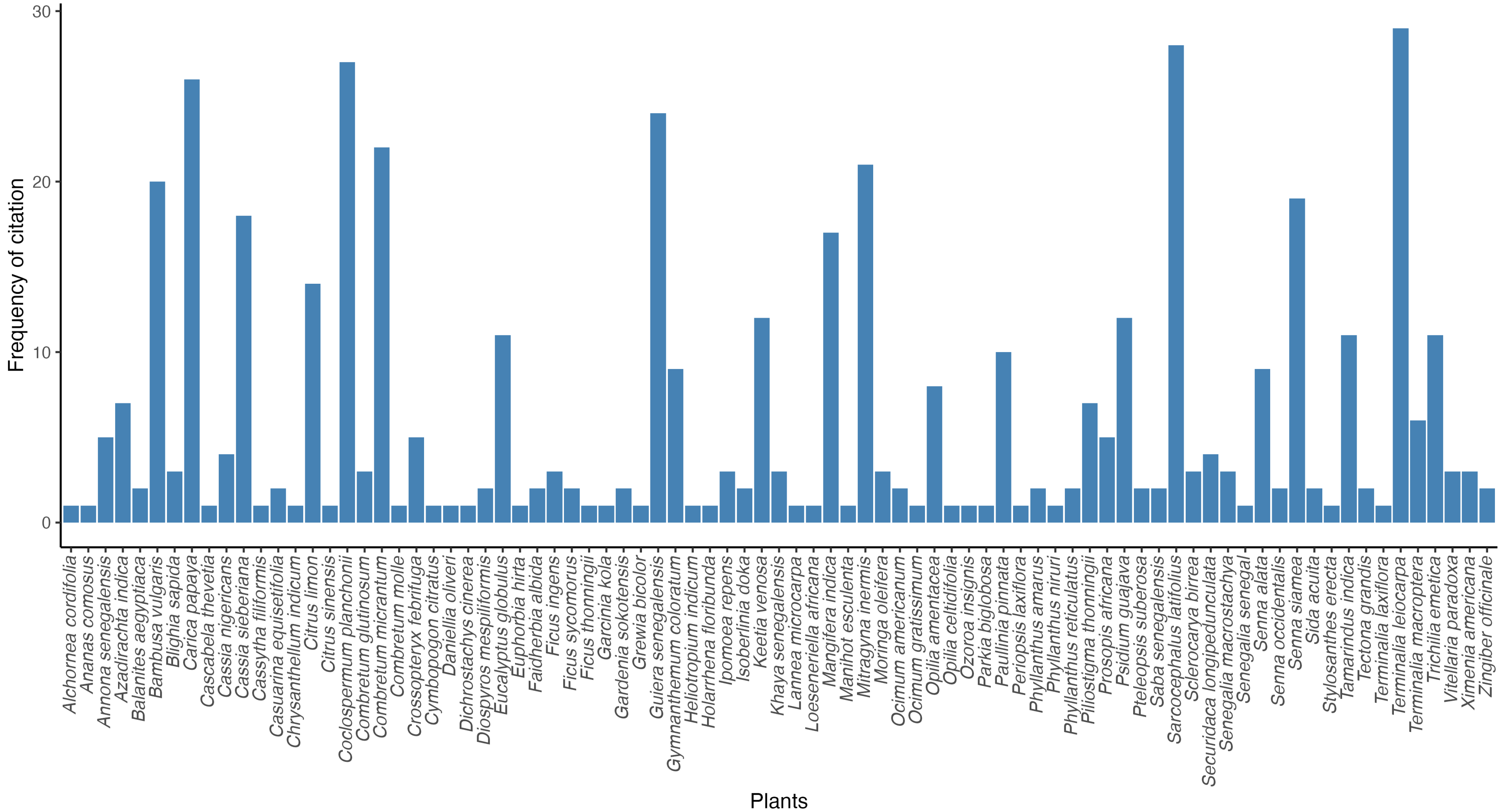

Figure S1. Distribution of plant species according to their frequency of citations in the localities investigated

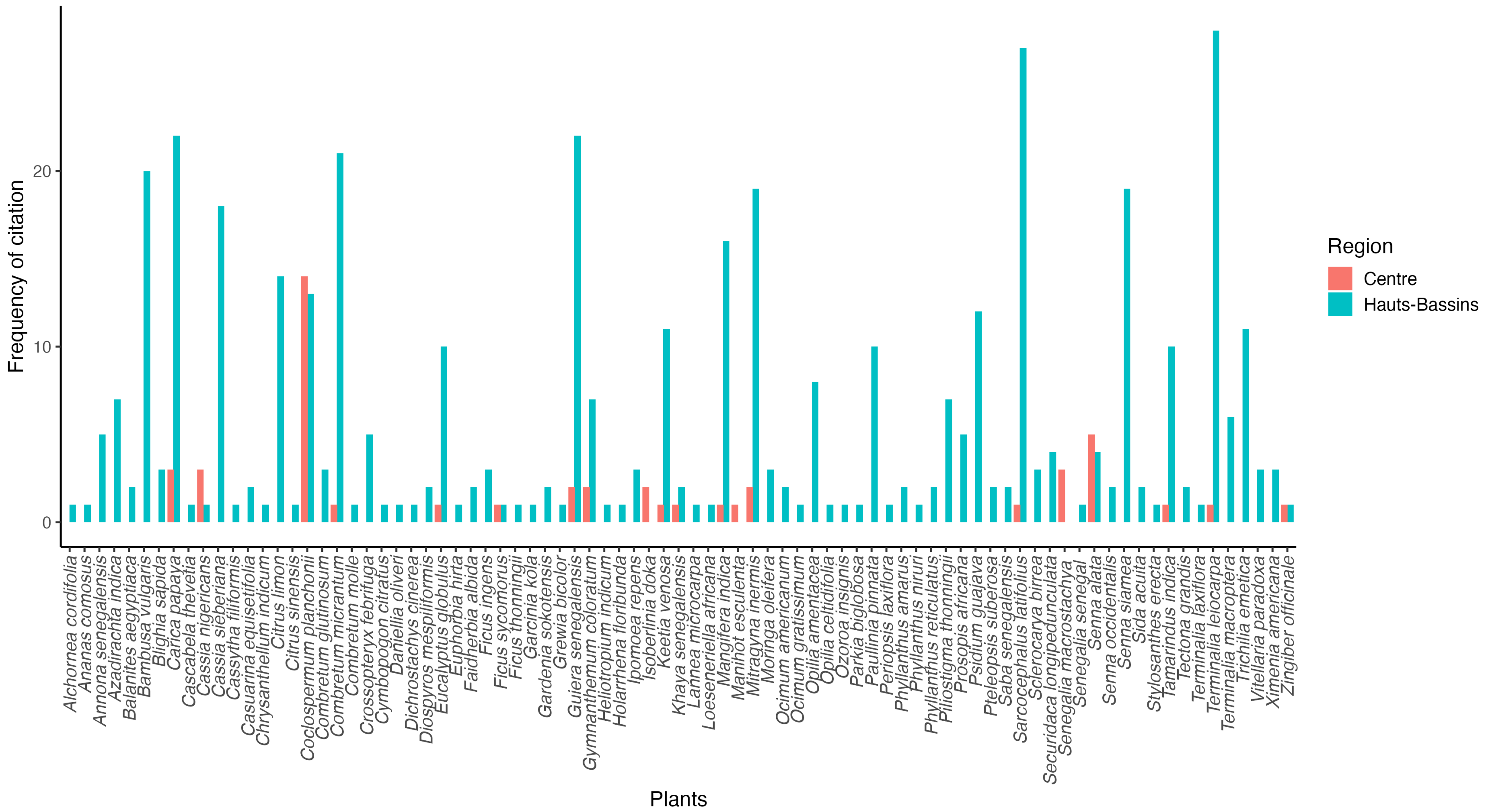

Figure S2. Distribution of medicinal plants used in the Hauts-Bassins and Centre regions