

# Traditional Uses of Seven Medicinal Plants for Malaria Treatment in Bobo-Dioulasso, Burkina Faso

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## Abstract

**Objective:** Malaria remains the leading cause of consultation, hospitalization and mortality in Burkina Faso's health facilities. To treat this disease, the majority of the global population uses medicinal plants. The aim of this study was to investigate the traditional use of *A. leiocarpus*, *C. sieberiana*, *C. planchonii*, *S. longepedunculata*, *T. emetica*, *X. americana* and *Z. zanthoxyloïdes* by traditional healers for malaria treatment in Bobo-Dioulasso, to provide effective guidance for phyto-pharmacological studies. **Material and methods:** The plants were identified and authenticated by a botanist and specimens were used to conduct an ethnobotanical survey using a semi-structured, open-ended questionnaire. The survey focused on healers' socio-demographic profile and malaria knowledge, and on each plant's ethnomedical uses for malaria treatment. The Relative Frequency Citation (RFC) index was used to calculate the frequency of plant use. **Results:** 48 traditional healers with good knowledge of medicinal plants and malaria symptoms were surveyed. *A. leiocarpus* (100%), *C. planchonii* (100%), *C. sieberiana* (77.1%) and *T. emetica* (56.25) were the plants most frequently cited as antimalarial drugs by the healers. For malaria treatment with each plant, healers used *C. planchonii* dried root decoction or maceration, *C. sieberiana* dried root decoction, all collected during the dry season, and *A. leiocarpus* and *T. emetica* fresh leaves decoction, collected during the rainy season. Treatments were administered orally. All the

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plants are also used to treat various other pathologies. **Conclusions:** The results of this study could serve as a basis for pharmacological investigations of these plants for malaria treatment.

## Keywords

Ethnobotanical Survey, Traditional Healers, Malaria, Bobo-Dioulasso, Burkina Faso

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## 1. Introduction

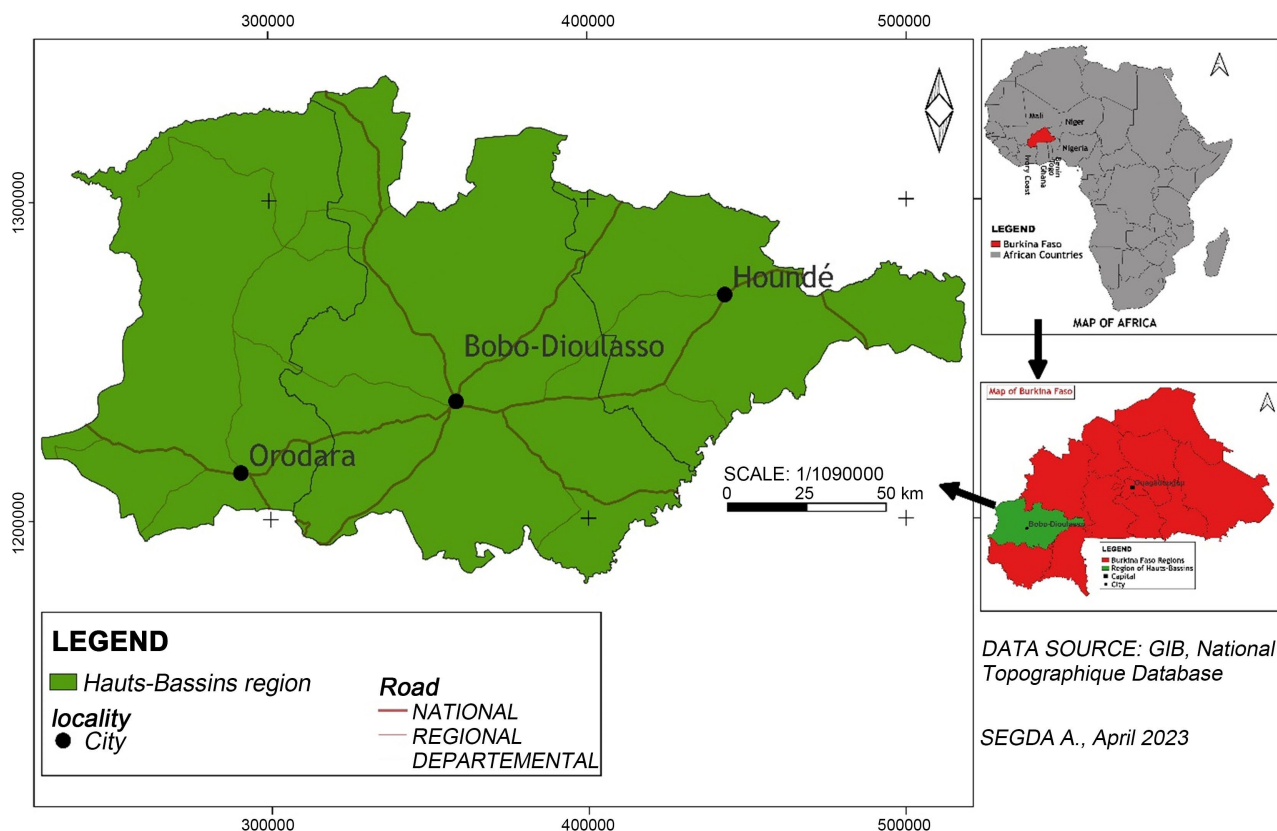
Malaria is a major public health problem in WHO African region. More than 233 million cases and 580,000 deaths, including 78% of children under 5 years old, were reported in this region in 2023 [1]. In Burkina Faso, malaria remains the leading cause of consultations, hospitalisation and mortality, with 11.1 million cases and 4243 deaths, including 2925 children under 5 years old in 2022 [2]. The Hauts-Bassins region alone accounted for 1.1 million cases and 427 deaths, including 273 children under 5 and 21 pregnant women [2]. Since 2005, the main treatment for malaria in Burkina Faso is artemisinin-based combination therapy (ACT) [3] [4]. Several studies have documented excellent efficacy of ACTs in Burkina Faso [5]-[7]. Unfortunately, decades of drug pressure have selected resistant parasites to almost all the antimalarial drugs available, even artemisinin and its partner drugs [8]-[14]. Emergence of chemoresistance to artemisinin is a major concern in malaria control [15]. Many studies suggest that African medicinal plants with potential antimalarial effects could be an alternative in new drug development [16]-[18]. Medicinal plants were widely prescribed in traditional medicine in Africa [19]-[22]. In Burkina Faso, 85% of the global population uses traditional medicines to solve their health problems [23]. Few studies, in Burkina Faso, have shown the antimalarial effect of these medicinal plants. Our study surveyed knowledge, attitude and practice of local healers towards *Anogeissus leiocarpus* (DC) Guill et Perr, *Cassia sieberiana* DC, *Cochlospermum planchonii* Hook f. ex Planck, *Securidaca longepedunculata* Fres. *Trichilia emetica* Vahl, *Ximenia americana* L. and *Zanthoxylum zanthoxyloides* (Lam.) Zep et Timl. used as antimalarial drugs [24]. Few studies on the anti-plasmodial efficacy of these medicinal plants have been conducted in the region. This study therefore aims to provide effective guidance for future pharmacological research into these plants.

## 2. Materials and Methods

Considering the informal nature of most traditional healers' activities and the lack of documentation permitting an exact estimate of their numbers in Bobo-Dioulasso, a non-probability sampling method was chosen. This was snowball sampling, which was performed from July to August 2019 in Bobo-Dioulasso, Burkina Faso.

## 2.1. Study Area

Bobo-Dioulasso is located in western Burkina Faso and covers an area of 1805 km<sup>2</sup>, with South Sudanese vegetation. There are 4 classified forests and numerous gallery forests. Its climate is South Sudanese, with a long dry season lasting 5 to 6 months (November/December to April) and a rainy season lasting 6 to 7 months (May to October/November). The dry season consists of a cold period (November to January) and a hot period (February to April). Rainfall is relatively abundant, but unevenly distributed in time and space. Average temperatures vary between 24°C - 30°C [25] **Figure 1**.



**Figure 1.** Bobo-Dioulasso localisation [26].

## 2.2. Plants Identification

All plants were identified and authenticated by a botanist from the Ki-ZERBO University in Ouagadougou named Hermann Y. OUOBA. Specimens (leafy stems, bark and roots) were collected in the classified forest of Dinderesso. The local names (Dioula/Bambara and Mooré) and scientific names of each plant were identified and reported in **Table 1**.

## 2.3. Ethics

This study was approved by the national ethics committee (reference N°20189-118). The socio-demographic data of all participants was kept confidential.

**Table 1.** Medicinal plant names.

Scientific names	Families	Local names (Bambara/mooré)
<i>Anogeissus leiocarpus</i> (DC) Guill et Perr.	Combretaceae	N'galama/Siiga
<i>Cassia sieberiana</i> DC	Fabaceae	Sindjan/Koumbrissaka
<i>Cochlospermum planchonii</i> Hook f. ex Planck	Cochlospermaceae	N'dribala/Sonsé
<i>Securidaca longepedunculata</i> Fres.	Polygalaceae	Djoro/Pelga
<i>Trichilia emetica</i> Vahl	Meliaceae	Soulafissan/Kikristaaga
<i>Ximenia americana</i> L.	Olacaceae	N'donguè/Leenga
<i>Zanthoxylum zanthoxyloides</i> (Lam.) Zep et Timl.	Rutaceae	Wo/Rapeoko

## 2.4. Study Population and Data Collection Methods

The study population was all traditional healers, who worked in the area of Bobo-Dioulasso. The data collection consisted of identifying the first healer to be interviewed, and this was the President of the Traditional Health Practitioners Association “Reelwend-Djiguisèmè du Houet”. Following the interview with him, he provided contacts with other healers who used medicinal plants to treat diseases and were likely to participate in this study. The process was repeated until the sample size was reached. Healers were encountered at home and at medicinal plant markets in Bobo-Dioulasso. To ensure reliable statistical tests, the aim was to survey around 50 healers.

Interviews were conducted using a semi-structured, open-ended questionnaire. Key aspects of the survey included the healers' socio-demographic profile and their knowledge of malaria symptoms, as well as the ethnomedical uses of each plant for malaria and other diseases (Appendix). Plant specimens and local names were used for each interview.

## 2.5. Statistical Analysis

Stata version 16 was used to analyze the data and to determine the traditional healers' socio-demographic profile, knowledge of malaria and ethnomedical characteristics of medicinal plants. To evaluate the survey parameters, the Relative Frequency of Citation (RFC) was calculated. The RFC permits assessment of the frequency of use of a given survey parameter [27].

$$RFC = \frac{FC}{N} \times 100$$

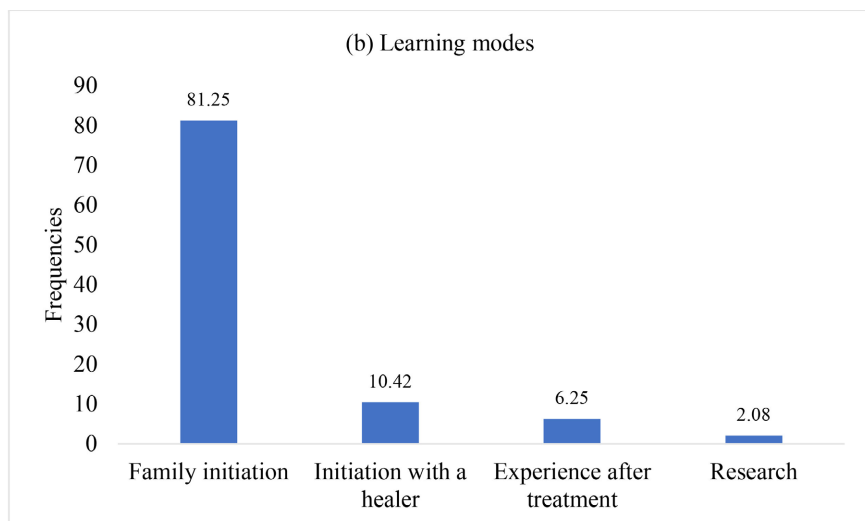
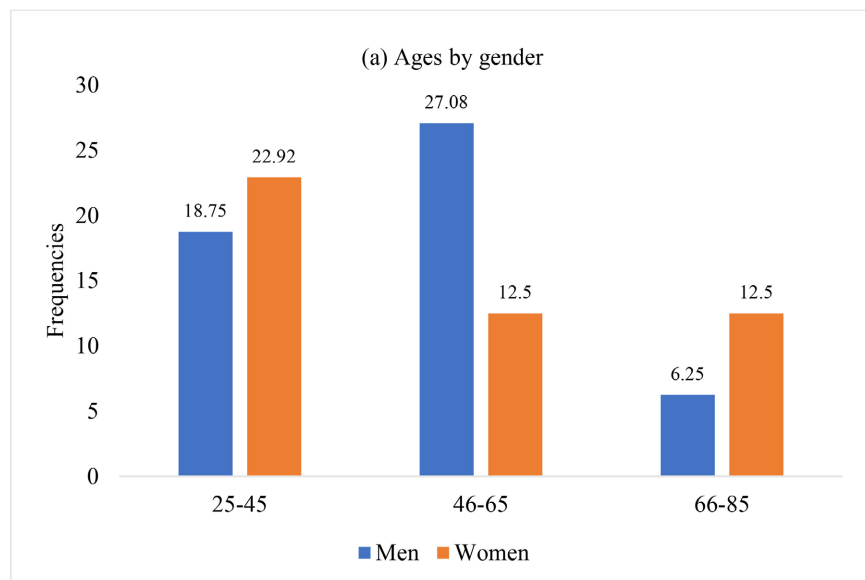
FC is the number of mentions of use or knowledge of a survey parameter, and N is the total number of healers surveyed using this parameter. The figures were generated using Excel 2016.

## 3. Results and Discussion

### 3.1. Socio-Demographic Data of Traditional Healers

Overall, 48 traditional healers were interviewed in this study. Among them, 25

were men (52%) and 23 were women (48%) with a mean age of  $50.27 \pm 15.28$  years (min: 25, Max: 85). Thirty-five healers (72.92%) were illiterate. Socio-demographic profile of participants is summarized in **Figure 2**. Experience in the use of medicinal plants varied from 4 to 52 years with an average of  $22.22 \pm 13.45$  years. Family initiation (81.25%) was the most common method of learning traditional medicine practice (**Figure 2(b)**). Many studies already reported that there are more male than female traditional healers in Burkina Faso [28] [29]. This trend could be explained by the cultural reasons why communities want to control and protect ancestral knowledge. In most communities, knowledge is transmitted from generation to generation through family initiations [30] [31]. The Mossi (39.58%) was the most represented ethnic group, followed by the Dioula and Bobo (16.67% each) (**Figure 2(c)**). The majority of people surveyed were Muslims (89.58%), followed by Christians and Animists (**Figure 2(d)**). The Bobo-Dioulasso area has various communities of different religious denominations [25].



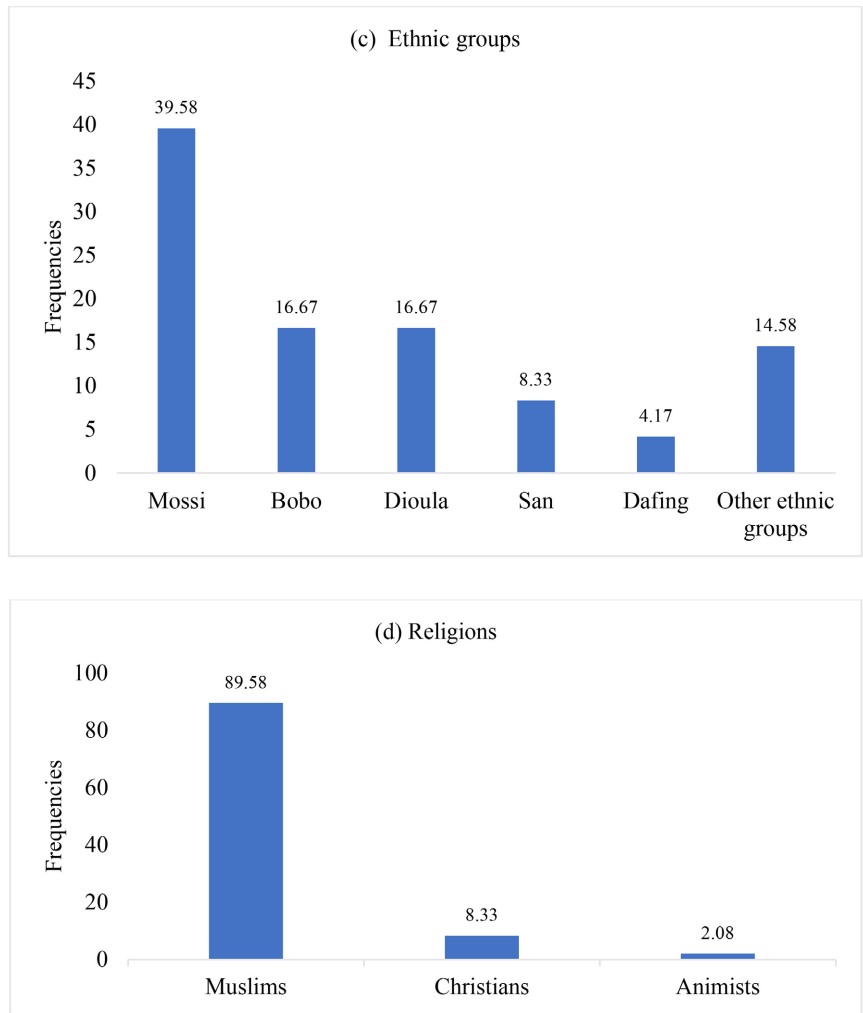


Figure 2. Traditional healers’ socio-demographic profile.

### 3.2. Healers’ Knowledge of Malaria Symptoms

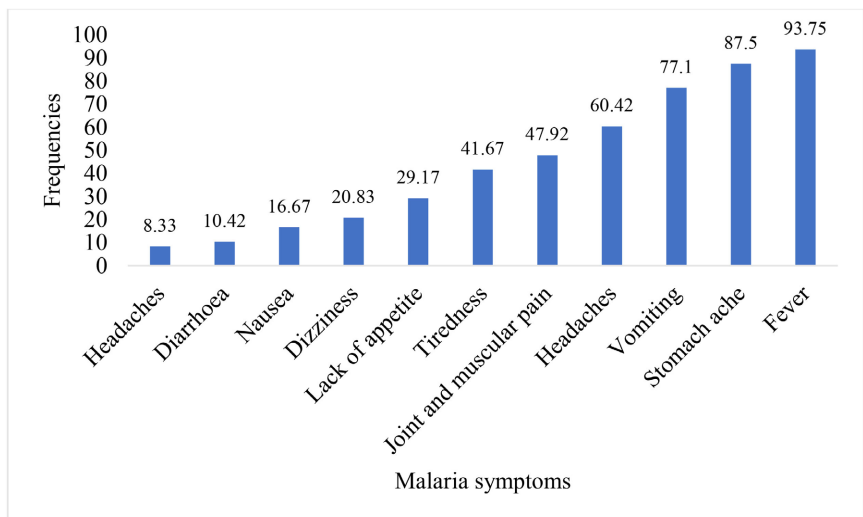


Figure 3. Malaria symptom citation frequencies.

The malaria symptoms most frequently cited by the healers were fever (93.75%), stomachache (87.5%), vomiting (77.1%), headache (60.42%) and articular and muscular pains (47.92%) (Figure 3). Each ethnic group had a local name to designate malaria. In Dioula, malaria is called “soumaya” meaning fever, in Mooré it is called “weoga-baanga” meaning “bush sickness” and in Bobo it is called “kon” meaning humidity. All healers interviewed had a good knowledge of malaria’s clinical manifestations. Since 2004, Burkina Faso government has adopted a national policy and a legal framework for traditional medicine to encourage phyto-medicine integration in the national health system. As a result, traditional healers often benefit from training modules designed to improve the quality of their interventions in the prevention, treatment and management of certain priority diseases such as malaria [32].

### 3.3. Plants’ Ethnomedicinal Characteristics

Traditional healers recognized and identified all the plants by name during the interviews. Some healers had dried or fresh stocks of the plants that they used to treat the patients who came for treatment. They used all 7 plants to treat various illnesses.

#### 3.3.1. Traditional Uses of Plants to Treat Malaria by Healers

Healers did not consider all seven plants to be antimalarial. Only *A. leiocarpus* and *C. planchonii* were designated by all healers (100%) as antimalarial, followed by *C. sieberiana* (77.1%), *T. emetica* (56.25%), and to a lesser extent *S. longipedunculata* (41.67%), *Z. zanthoxyloides* (20.83%) and *X. americana* (18.75%) (Figure 4). The comparison of these results with other surveys carried out in West Africa indicates that frequencies of plant use varied from one region to another. In the Sahel region, Burkina Faso, *C. sieberiana*, *C. planchonii* and *T. emetica* were the most cited among the seven plants, followed weakly by *A. leiocarpus*, *X. americana* and *S. longipedunculata* [33]. In the Selingué sub-district in Mali, *T. emetica* (80%) and *A. leiocarpus* (60%) were the most frequently cited, followed by *C. sieberiana* (50%), *S. longipedunculata* (40%), *X. americana* (20%) and *Z. zanthoxyloides* (15%) [34]. A survey in Abidjan District, Côte d’Ivoire, reported that *C. planchonii* (4.47%) was the most cited, followed by *C. sieberiana* (2.45%), *A. leiocarpus* (1.87%), *T. emetica* (1.73%), *X. americana* (0.72%) and *S. longipedunculata* (0.58%) [35]. Some plants included in this study were not cited in other West African regions. Either these plants don’t exist in the region, or they are not used by the local population to treat malaria. Healers’ selection of a medicinal plant for disease treatment is essentially based on its therapeutic capacity and safety [21]. However, the efficacy of medicinal plants is greatly influenced by the environment in which they grow and develop. Indeed, the production of active secondary metabolites responsible for the therapeutic efficacy of plants is influenced by environmental stress [36]-[39]. Other studies have also reported that the species of plants and the differential expression of genes in different species could also lead

to very specific reactions from one plant to another, environmental stress, and, therefore, the production of active molecules [40]. These are the reasons why the same plants are not used to treat the same diseases in different regions [41]. *A. leiocarpus*, *C. planchonii* and *C. sieberiana* have been used to treat malaria, as demonstrated by ethnobotanical surveys carried out in different regions of Burkina Faso [33] [42] [43]. *In vitro* studies of anti-plasmodial efficacy, also carried out in Burkina Faso, also reported that these plants had interesting antimalarial properties [44] [45]. Of the 7 plants, this study shows that *A. leiocarpus*, *C. planchonii* and *C. sieberiana* could be used preferentially in the Hauts-Bassins region for malaria treatment research.

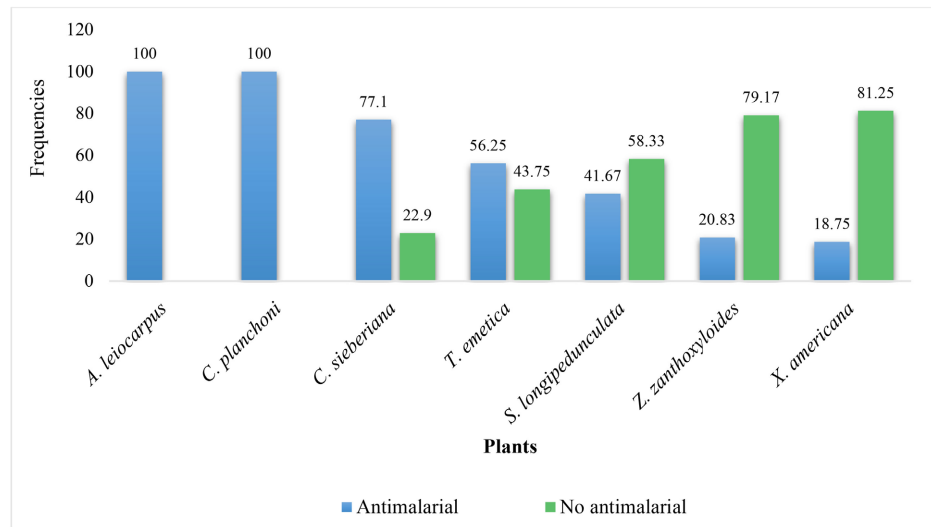


Figure 4. Plant use as antimalarials.

### 3.3.2. Plant Parts Used to Treat Malaria

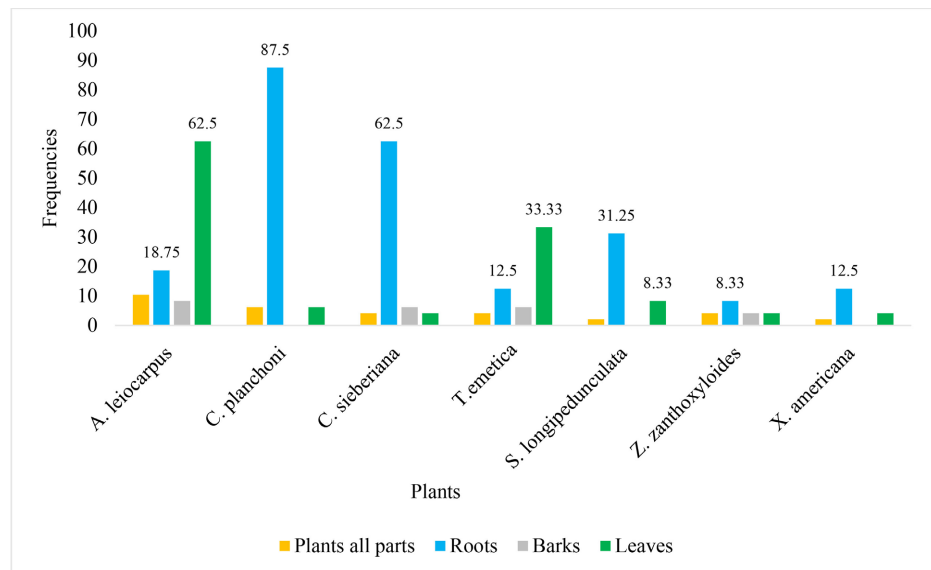


Figure 5. Plant part use frequencies.

Research has shown that healers use each plant part as phytomedicine. The most commonly used parts for malaria treatment varied from one plant to another but were mainly roots and leaves. *C. planchonii* (87.5%), *C. sieberiana* (62.5%), *S. longipedunculata* (31.25%), *X. americana* (12.5%) and *Z. xanthoxyloides* (8.33%) roots and *A. leiocarpus* (62.5%) and *T. emetica* (33.33%) leaves were the parts most used to treat malaria (Figure 5). Studies have shown that different parts of the same plant may have very different chemical compositions, which may influence their therapeutic action [46]-[48]. The choice of plant part in pharmacological research is therefore essential to obtain efficacy. In traditional medicine in Burkina Faso, a statistical study reported that the leaves and roots of medicinal plants were the parts most commonly used by the local population [49]. Leaves and roots may have been chosen because they contain large quantities of secondary metabolites [50].

### 3.3.3. Plant Forms Used to Treat Malaria

Healers used fresh or dried plants to treat malaria. The majority of the healers used fresh parts of *A. leiocarpus* (66.67%), *T. emetica* (37.5%) and *S. Longipedunculata* (22.92%) to treat malaria, while the other plants were used more in dried form (Figure 6). Healers use fresh leaves because they are more accessible than roots, which are harder to obtain and need to be dried for storage. Healers also consider fresh plants to be more effective because their contents are not lost before use, contrary to dried forms. [51]. Both forms are used for pharmacological research, but the dried form is preferred because it is suited to the time required for experiments, compared to fresh samples, which are fragile and deteriorate more quickly [52].

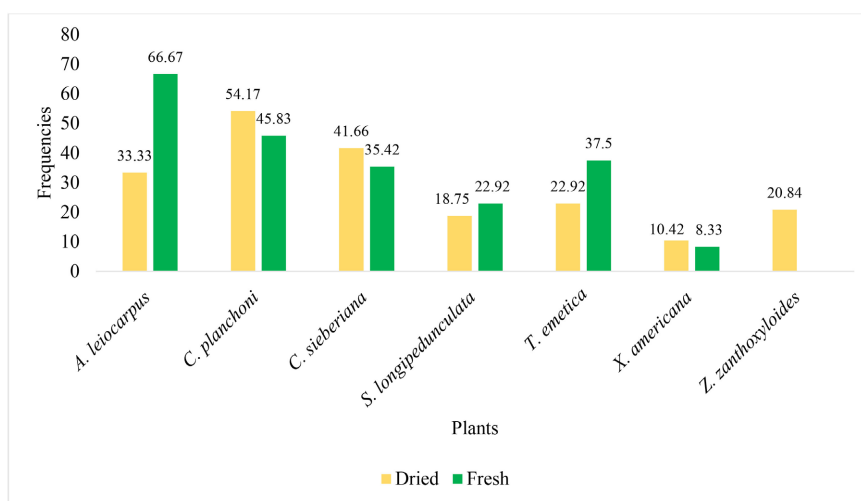


Figure 6. Plant part forms used.

### 3.3.4. Plant Collection Seasons

*A. leiocarpus* (70.83%) and *T. emetica* (41.67%) were collected preferentially during the rainy season and *C. planchonii* (62.5%), *C. sieberiana* (54.17%) etc. were

collected in the dry season (Figure 7). Various studies reported that plants react differently to seasonal variations and water availability, which would influence secondary metabolite production and concentration and therapeutic activity [53] [54]. Phytochemical studies have revealed a higher secondary metabolite concentration in leaves during the rainy season and in bark during the dry season [55].

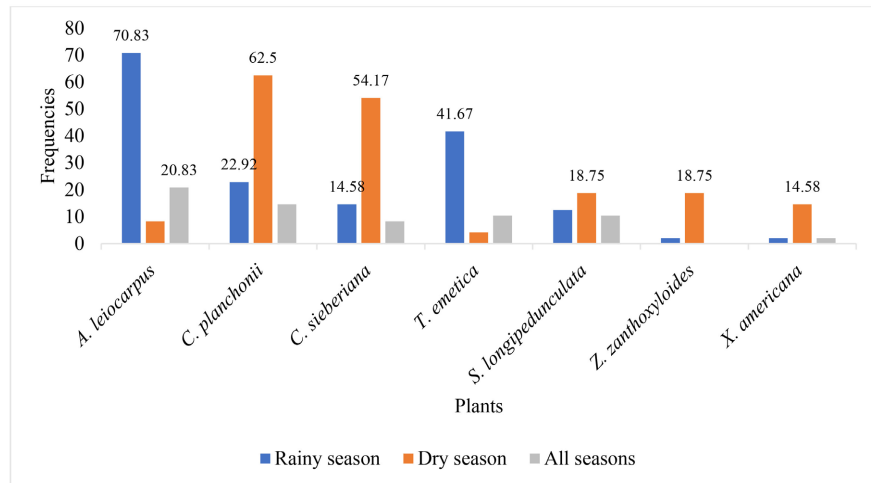


Figure 7. Plant part collection frequency by season.

### 3.3.5. Herbal Tea Preparation Methods Used by Healers

Healers used three different methods to prepare herbal teas with water alone for malaria treatment. Decoction was the preferred preparation technique for most plants, followed by maceration and infusion. (Figure 8). Decoction is generally recommended for extracting large quantities of thermostable and water-soluble compounds from the solid or woody parts of plants, and maceration is for extracting compounds that lose their active principles under heat [52].

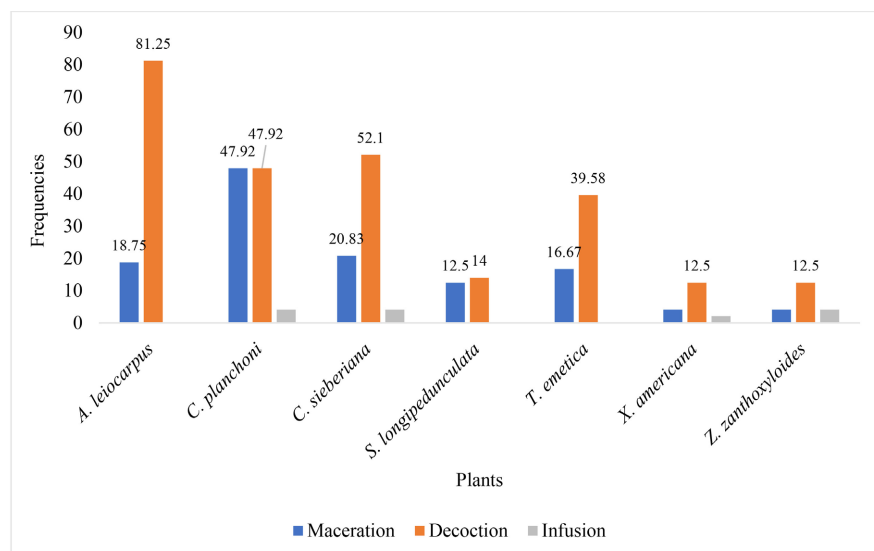
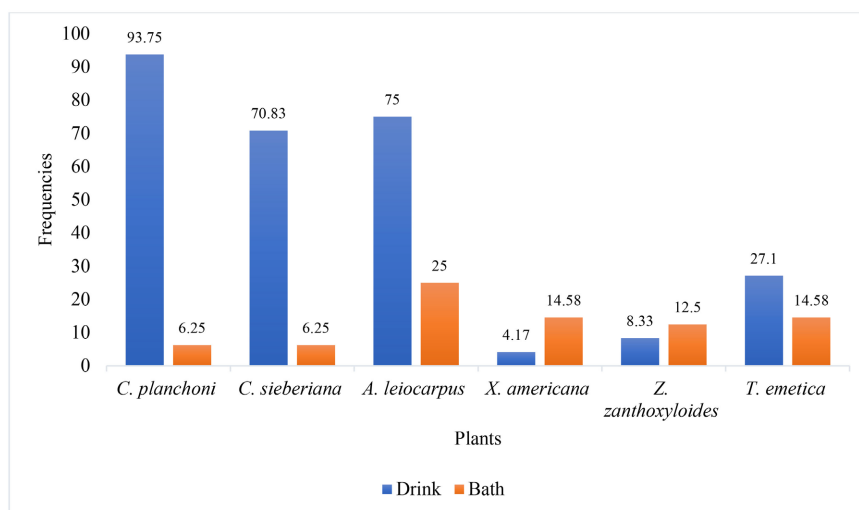


Figure 8. Preparation of traditional antimalarial herbal tea.

### 3.3.6. Administration Methods for Antimalarial Herbal Teas

Oral (drink) and dermal (bath) administration were the methods most used by healers to administer antimalarial herbal teas (**Figure 9**). The reason healers chose to drink, and bathe could be explained by the fact that these administration methods allow phytochemicals to exert a systemic action, thus targeting *Plasmodium* in the blood [56].



**Figure 9.** Methods of antimalarial herbal tea administration.

### 3.3.7. Five Other Illnesses Treated by Plants

The 7 plants were used by traditional healers to treat other illnesses in addition to malaria. **Table 2** lists the other illnesses or symptoms treated by each plant. Some of the symptoms cited by the healers, such as stomach pains, headaches, fever, diarrhoea and lack of appetite, are signs of malaria [57]-[59].

**Table 2.** Other diseases treated by plants.

Other symptoms/ diseases	Plants							
	<i>A. leiocarpus</i>	<i>C. planchonii</i>	<i>C. sieberiana</i>	<i>S. longipedunculata</i>	<i>T. emetica</i>	<i>X. americana</i>	<i>Z. zanthoxyloides</i>	
Haemorrhoids	11	1	4	15	38	7	4	
Fever	4	3	5	3	NA	NA	6	
Antivenom	NA	NA	3	5	NA	2	NA	
Abdominal pain	13	5	32	4	3	28	13	
Urinary infection	NA	5	NA	NA	2	NA	3	
Headache	NA	3	5	11	NA	NA	1	
Madness	NA	2	2	18	3	2	1	
Diarrhoea	4	NA	NA	NA	NA	3	3	
Hypertension	3	NA	NA	NA	NA	NA	NA	
Asthenia	NA	NA	NA	2	NA	NA	3	
Lack of appetite	NA	1	3	NA	NA	NA	NA	
Toothache	NA	NA	NA	NA	NA	NA	20	

NA = not applicable.

## 4. Conclusions

This survey aimed to collect data on the traditional uses of *A. leiocarpus*, *C. sieberiana*, *C. planchonii*, *S. longepedunculata*, *T. emetica*, *X. americana* and *Z. zanthoxyloïdes* from traditional healers practising in Bobo-Dioulasso to guide phyto-pharmacological research on these plants against malaria. Forty-eight traditional healers with a good knowledge of medicinal plants and malaria were surveyed. Among the seven plants, *A. leiocarpus*, *C. planchonii*, *C. sieberiana* and *T. emetica* were designated as antimalarial by the majority of healers.

In view of the lack of pharmacological data on these plants in Bobo-Dioulasso, results of this study could provide effective guidance for future phyto-pharmacological research.

Preclinical studies could be performed with each of these plants using extracts such as the decoction or maceration of the dried roots of *C. planchonii* harvested during the dry season, or the decoction of the dried roots of *C. sieberiana*, harvested during the dry season, or the decoction of the fresh leaves of *A. leiocarpus* harvested during the rainy season or the fresh leaves of *T. emetica*, also harvested during the rainy season.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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## Appendix

Ethnobotanical survey questionnaire

Interviewer name.....

File No.....

Data collection date.....

I: Healer socio-demographic profile

Full name ..... Phone number .....

1) ID.....

2) Gender: o man o woman

3) Age.....

4) Ethnic group.....

5) Religion: o muslim o christian o animist o other.....

6) Literate: o yes o no

7) Location .....

8) Practice duration as healer .....

9) Healer apprenticeship: o family initiation o initiation by a healer o revelation  
o experience acquired following treatment o other.....

II: Healers malaria knowledge

10) What signs would convince you that a patient has malaria?

<input type="checkbox"/> fever	<input type="checkbox"/> nausea	<input type="checkbox"/> vomiting
<input type="checkbox"/> headaches	<input type="checkbox"/> stomach aches	<input type="checkbox"/> constipation
<input type="checkbox"/> joint/muscular pain	<input type="checkbox"/> diarrhoea	<input type="checkbox"/> dizziness
<input type="checkbox"/> tiredness	<input type="checkbox"/> other.....	

11) What do you call malaria in your language?.....

III: Plant ethnomedical characteristics

12) Plant name.....

13) Do you know this plant? O yes o no

14) If yes, can it cure malaria? O yes o no

15) If so, do you use it to cure malaria? O yes o no

16) If so, which part(s) do you use?: o whole plant o root o bark o leaves o seeds  
o flowers o other ...

17) What form do you use? O fresh o dried

18) During which season do you harvest the plant? O rainy o dry

19) How do you prepare the herbal tea? O maceration o decoction o infusion o  
other

20) Which solvent do you use? O water o alcohol o other.....

21) How do you administrate the treatment to patients? o drink o chew o apply  
o bath o fumigate o inhale o lotion o other.....

22) List 5 other diseases treated by the plant .....